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UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
PHOENIX, ARIZONA
FEBRUARY 1991

FINAL DESIGN REPORT

JOB: East Maricopa Floodway, Reaches 1 & 2 Repair

PROJECT: East Maricopa Floodway

LOCATION: Pinal County, Arizona

AUTHORITY: Public Law 566

PHASE: Preliminary Design

SUMMARY

An engineering report dated November 8, 1985 was prepared by an investigation committee for Reach 1 of the East Maricopa Floodway (formerly RWCD Floodway). The following problems were identified:

1. Excessive toe erosion of the channel banks in the soil lined portions of the floodway,

2. Local scour downstream from most of the rock lined sections,

3. Rilling and gully development on most of the channel banks, and

4. Jug hole development on the crest and banks of the dikes along Reach 1.

The committee concluded that the problem was related to dispersive, plastic soils in the earth lining of the channel; and to the use of the tractive power design procedure in TR-25. It recommended that, when maximum velocity and maximum tractive stress greatly exceed the allowable velocity and allowable tractive stress, there should be concern with use of the tractive power procedure.

Project review started in March 1990, followed by comparative designs and estimates to develop an array of alternative solutions to the erosion problems. A meeting was held on July 6, 1990 among SCS and MCFCD representatives to discuss those alternatives which appeared most feasible. Agreement was reached on a solution which called for 1) riprap of the channel slopes; and 2) construction of soil-cement sills across the channel to provide grade control.

DESCRIPTION OF THE JOB

The project includes repair/protection of all earthen channel segments between the downstream end of the SAF Basin in Reach 2 (Station 1160+32.10) and the discharge of Reach 1 (Station 1450+50) into the Gila River. Design parameters of the existing channel are as follows for a 100 year storm event:

Q = 8700 cfs
d = 6 feet
v = 6.7 fps
b = 200 feet
z = 3
n = 0.027

The major feature of the work is riprap protection of the earthen slopes. The riprap will be placed on geotextile filter fabric which will overlay a 2-inch minimum bed of aggregate base course (ABC).

Soil-cement sills will be constructed at the downstream end of each existing channel riprap section, and at selected intermediate points for grade stabilization. The sills will be 10 feet wide and 6 feet deep. The finished grade of each sill will be from as-built channel grade at new toe of slope to 1 foot below grade at centerline of channel, forming a shallow "V" shaped channel bottom.

Another feature of the work will be placement of ABC on maintenance roads and on the freeboard portion of channel slopes.

A side inlet will be constructed over the left bank at Station 1282+00 where the bank was washed out by runoff from adjacent desert area during a 1990 storm.

DESIGN OBJECTIVE

The objective of the proposed work is to protect the channel from excessive erosion. It is accepted that erosion will occur in the unprotected portion of the channel bottom until it tends to stabilize through an aging process controlled by the soil cement sills and channel riprap. Scour holes will develop immediately after the sills. Deposition will tend to maintain normal grade upstream of riprap sections and intermediate sills. The "V" shaped soil cement sills are intended to keep the more frequent flows at the center of the channel, away from the banks.

ABC on the maintenance roads and freeboard area of channel slopes is intended to prevent rills and jugging in those areas, and to allow maintenance access during periods of wet conditions.

The plans call for a minimum of 3 inches of loose soil obtained from required excavations to be placed over the riprap. The intended purpose is to help lock the riprap in place as the soil is worked into the riprap by rainfall or channel flow. This will also act as the spoil area for the excavation. Minor amounts of borrow, if required to complete the loose

soil cover, will be taken from the center of the channel to enhance formation of a low-flow channel.

BASIS FOR DESIGN

1. Far West States (FWS), "Criteria for Riprap Rock Size", pg. 6-13a to 6-13d.

2. Advisory PO-18 (HRP 108 Adoption) "Rock Riprap Design Procedure", May 1, 1974.

3. Corps of Engineers EM 1110-2-1601, July 1970, pg. 43.

4. Engineering Field Manual, Chapter 16, Streambank Protection

5. National Crushed Stone Association

6. TR-59, Hydraulic Design of Riprap Gradient Control Structures

7. "Soil-Cement Slope Protection for Embankments: Planning and Design", PCA, 1975, Reprint 1984.

8. "Short Cut Soil-Cement Testing Procedures for Sandy Soils", PCA, 1958.

9. Chapter 6, Stability Design, TR-25, SCS, October 1977.

10. "Urban Hydrology for Small Watersheds", TR-55, SCS, June 1988.

GENERAL BASIC DATA

In 1985, nine soil samples were taken in the earth lining of Reach 1. The fines content (passing #200 sieve) averaged 77 percent. Two design problems were encountered because of the fine grain soils:

1. A single aggregate filter could not be readily designed to satisfy the requirements for preventing migration of the fines and also preventing migration of the filter through the overlaying riprap. A secondary filter was desirable between the primary filter and the riprap.

   A geotextile filter fabric placed over 2 inch minimum ABC bedding was selected in favor of an aggregate filter. The ABC bedding is to fill the irregularities of the existing slopes and provide intimate contact between the subgrade and filter fabric. This was estimated to be the more economical solution and allowed for more flexibility in design of a stable riprap surface.

2. The high fines content makes the soil unsuitable for soil-cement, the design of which usually calls for 5-35 percent fines. The project specifications require soil-cement materials meet a specific gradation.

   A satisfactory mix could be produced using some local material combined with imported sand/gravel material. Ths might be practical if the soil cement is to be produced on-site. However if it is

produced off-site the extra hauling cost would likely make the use of local material uneconomical.

The channel has a maintenance road on each side. Each is to be surfaced with 4 inches of ABC to prevent jugging and rilling that is degrading the O&M roads.

The condition of the maintenance roads at present is that they have some rills, jug holes and other rough features. Heavily loaded trucks carrying construction materials could damage the roads at these bumps. It is therefore being specified that the ABC material be placed on the road before it is used as a haul road for other materials, and that the Contractor maintain all in good condition during the construction period.

LOCATION AND LAYOUT

A topographic survey of the channel bottom was conducted in April 1990 to more precisely describe the scope of work. The most severe erosion was observed at the downstream end of each hard spot (riprap section). Scour holes were created sporadically across the channel as a result of turbulence from flow over and around large riprap rocks. Some of the rock was washed downstream as a result of the scour holes below the riprapped areas.

Soil-cement sills are to be placed at the downstream end of each riprap section to hold the rock in place and reduce the severity of the downstream erosion. The improved erosion conditions are expected because of sheet flow over the flat-topped soil cement-sills.

Intermediate soil-cement sills were located by establishing a maximum distance between grade control structures. That distance was set at 1,500 feet to 2,000 feet, and was based on an assumption of conditions when the channel is moderately aged. Those conditions are for a level channel bottom between grade control structures, resulting in erosion of 2.25 feet to 3 feet on the downstream sides of soil-cement sills.

One other feature was added to minimize the effects of erosion on the downstream side of the sills. The portion of riprap bank protection located in the channel bottom was increased in thickness by 33 percent (6 inches) for 100 feet downstream of each sill to provide extra protection of toe of slope where it is most vulnerable.

HYDROLOGY

Few hydrologic parameters were involved in this repair project as they were already considered in the original design of the floodway. However, a runoff estimate was made for an area south of the channel at approximately Station 1282+00. An existing pipe inlet located at Station 1283+05 lacks sufficient capacity and a large washout in the channel bank occurred in the summer of 1990. A spillway type inlet was designed to prevent future damage.

HYDRAULIC DESIGN

Hydraulic Slope The hydraulic slope of the floodway was determined by its original design and no changes were made in the channel based solely on hydraulic considerations. Rather, the elements of this project are intended to provide a satisfactory degree of protection to the earth lining in the channel under the conditions of flow in the original design (Q = 8,700 cfs).

The hydraulic design is affected in one way: the existing channel banks will be covered with approximately 14 inches of riprap and bedding material. This bank cover encroaches on the original design cross section, which was 200 feet wide at the bottom, and 6 feet deep.

The encroachment was considered not to be significant for the following reasons:

1. The n-value assumed in the original design was 0.027. The real n-value may be lower in the straight channel segments because of the fineness of the soil materials, and could be as low as 0.022. The true overall n-value of the channel should be little affected by the increased roughness of the riprapped banks.

2. Aging of the channel will come with erosion of the earth lining in the channel bottom, resulting in increased channel cross sectional area between hard spots. Velocities will be reduced and the affect of the riprap encroachment will tend to be abated.

3. Excavation along the banks for installation of the riprap would have required considerable additional improvements. It would have included redesign of the top of bank, narrowing of the maintenance road, or acquisition of additional right of way together with extensive grading and drainage work. These alternatives would have required excessive difficulties and expenditures.

Channel Stability Stability of the channel was checked in accordance with the tractive stress procedure in TR-25. It was clearly demonstrated that the channel lining is not stable if the fine grained materials in the lining are not sufficiently cohesive.

The original design, based on the Tractive Power Procedure in TR-25, incorporated a 3 foot thick compacted earth liner of plastic clay soils to resist erosion. The design was recognized as marginal but accepted on the basis of anticipated higher O&M costs. Channel flows since the time of construction has resulted in areas of concentrated scour and perhaps some general scour. The maximum flows experienced have been only about 30% of the design discharge. The bed scour, although acceptable from the O&M standpoint, has raised concerns as to what might happen during a major design storm event. A loose rock lining across the channel bottom would be stable but the O&M cost to date does not justify the expense associated with this type of treatment. Soil cement sills, although not as positive a treatment as loose rock, are relatively inexpensive and more commensurate with the level of protection believed necessary.

where?

An estimate of the potential limits of scour in the channel was prepared to determine the effects on the soil cement sills, assuming the sills are spaced at 2000 feet. The results showed that up to 10 feet of scour might be possible on the downstream side at sills. However, field conditions, particularly in the downstream channel, indicate considerable deposits have occurred in some cases. The extent and locations of extreme scour are difficult to forecast. It was therefore recommended that where excessive erosion is observed in the future, loose rock basins or additional sills would be constructed. New sills would butt against and stabilize the older sills. Considerable savings can be realized by not oversizing the sills initially, and by adding the additional sills or protective rock only where needed.

Sediment Transport Analysis of sediment transport was not a major part of the original design because the lining material was considered to be stable with cohesive soils and no consideration was given to import of soils from upstream reaches. Under the design for channel protection no attempt was made to quantify sediment transport, but rather to limit the erosive effects on the noncohesive soils. It is expected that sediment transport will be minimal after aging of the channel.

Side Inlet Design A side inlet was designed to augment the capacity of an existing pipe inlet at Station 1282+00. The pipe inlet will continue to receive small flows from the service area. The new inlet, designed as a spillway type of weir inlet, will take care of larger flows including that from a 100-year storm.

FOUNDATION AND/OR EMBANKMENT DESIGNS

Native Soil Material No special consideration for use of native soil material was made except that in areas of severe erosion of the embankment it shall be compacted to at least 90 percent of maximum density. Generally, this material is used as embankment material only to fill eroded channel areas to support new riprap being installed. The effort necessary to achieve a higher compaction level is not considered justified because the dispersive nature of the compacted material will cause it to soften after long term exposure to saturation, regardless of degree of compaction.

Aggregate Base Course (ABC) An ABC material was selected to serve as bedding for filter fabric and as gravel cover for maintenance roads and freeboard on channel slopes. The design selected was based on economics and ease of placement/grading to a thin layer down to 2 inches on the slopes (4" on the O&M roads). Nominal compaction by approved equipment is required of ABC materials.

Loose Rock Riprap Riprap design was based on review of several analyses made in conformance with design methods listed under "BASIS FOR DESIGN". The minimum factor of safety was 1.5 in accordance with a request by the Flood Control District.

Using Lanes' Method of the tractive stress approach, a D75 of 2.11 inches would provide a minimum riprap design with 1.5 factor of safety.

Calculations based on SCS Advisory PO-18 resulted in D50 = 2.5 inches, without additional consideration for factor of safety. Other methods suggested larger rock was necessary. A more conservative design gradation was selected with D50 > 4 inches.

The use of filter fabric limits the drop of riprap during placement to 3 feet. The advantage the filter fabric offers in this project is that the riprap need not serve as a secondary filter for a primary aggregate filter. The riprap can therefore be designed with economy and stability as the main considerations.

STRUCTURAL DESIGN

No structural designs were necessary for this project.

ENVIRONMENTAL CONSIDERATIONS

The construction of ABC and riprap surface over the existing soil surface will have a positive impact on the visual aspects of the channel. The severe erosion and rilling that is occurring on the channel banks will be eliminated. The gravelled O&M roads will reduce dust produced by maintenance vehicles travelling on them.

No impact on the conservation of biological or water resources is predicted. Water will be used to abate potential dust generated by construction activities.

CONSTRUCTION DRAWINGS

Original construction drawings for Reach 1 and Reach 2 were used to provide basic drafting information for the required drawings. The CADD system was used to produce and store the drawings using Versacad Software, Version 5.4.

SPECIFICATIONS

The technical specifications were prepared using the appropriate sections from NEH-20, and no special written specifications were required.
A supplementary requirement under 61. Loose Rock Riprap, is that ABC bedding be placed on maintenance roads prior to their being used for haul roads. Furthermore, these surfaces are to be maintained in a smooth condition to prevent roadway damage.

BID SCHEDULE

Water is considered a subsidiary item in this project because its main use is for dust abatement. The need for dust abatement is mostly a function of how the contractor conducts his work, and is less directly related to the materials being installed. Water will be necessary for earthfill and soil cement, but the quantity will be relatively small.

COST ESTIMATE

The Engineer's Estimate is $2,876,320. Most of the work involves the use of aggregate materials. ABC and materials for soil cement could be available within about 4 miles near the Gila River. Riprap for previous riprap work in the floodway came from the Salt River, approximately 25 miles away; however, the somewhat smaller grained riprap being specified for this project might be available locally.

The materials for construction are relatively simple, so little special preparation should be required to construct them. The project is of reasonable size so that little economy of scale is likely to result from an increase in the scope of work. No seasonal variation is expected.

CONSTRUCTION SCHEDULE

The construction period was based on an assumed production rate of 432 cubic yards (32 truck loads, or 16 truck loads per bank with a truck unloading every 30 minutes) per day of riprap placement, requiring 8 months for completion. Another month was added for mobilization and initial construction, making a total contract period of 9 months.

OPERATION AND MAINTENANCE

In general, the new improvements are expected to minimize maintenance requirements in the channel. However, some work might be necessary to repair maintenance ramps after high flows. The ramps are to be covered with 12 inches of ABC only, which might be subject to erosion with high flow. Riprap was not used on the ramps because it would be more difficult to maintain an ABC layer on top of it.

CONSTRUCTION REVIEW

Each proposed location of soil cement sill should be reviewed before proceeding with construction in order to verify there is no reason to adjust the stationing of the sill.

Damage to existing structures or other channel features should be noted along the channel in advance of the contractor's activities in the area of the damage. The objective is to prepare for extra items of work at a time when they can be least costly to the Contractor and SCS. A typical repair project would be replacement of riprap not already covered in the bid items.

AUTHORITY

Submitted by: William A. McPerrin (Design Engineer) — Feb. 19, 1991 (Date)

Approved by: John M Harrington (State Design Engineer) — Feb. 19, 1991 (Date)

Approved by: Ralph M Arrington (State Conservation Engineer) — Feb 19, 1991 (Date)

GOVERNMENT CONSTRUCTION AND QUALITY MANAGEMENT PLAN FOR EAST MARICOPA FLOODWAY REACHES 1 & 2 REPAIR

General

The repair work is within the East Maricopa Floodway in Pinal County, Arizona, approximately seven (7) miles south of Chandler Municipal Airport. The work will be constructed under a government contract that is scheduled to be awarded in January 1991.

Major items of work requiring inspection during construction are:

1.	Common Excavation	49,000 cy
2.	Earthfill	2,500 cy
3.	Loose Rock Riprap	62,700 cy
4.	ABC Bedding	52,000 tons
5.	Geotextiles	161,700 sy
6.	Soil Cement	7,281 cy
7.	Surveys	L.S.
8.	Contractor Inspection	L.S.
9.	Side Inlet	L.S.

Items of work to be inspected:

Periodic Inspection	Continuous Inspection
Survey	Earthfill
Mobilization	Side Inlet
Pollution Control	Loose Rock Riprap
Removal of Water	ABC Bedding
Water	Geotextile
Grading	Soil Cement
Common Excavation	
Contractor Inspection	

A. Excavation, Common

No specific material Testing is required. An inspector will be required to assure the correct geometrical foundation shape has been achieved in the channel bottom at toe of slope before placing ABC bedding.

B. Earthfill

1. All compacted earthfill will be tested for compaction and moisture. An inspector and materials testing technician will be required to document quality assurance.

2. The test frequency for compaction and moisture will be 1,000± cubic yards. This will require at least two (2) compaction and moisture tests for quality assurance.

3. Earthfill to be wheel rolled only will not require testing.

C. Loose Rock Riprap

The Contractor will perform initial testing on the material to demonstrate that it conforms with requirements of the specifications before being delivered to the site. The Engineer will perform visual tests as needed to assure proper placement of material and continued quality and gradation of rock.

D. ABC Bedding

1. Crushed aggregate will be tested for gradation and soundness. Processed material will be tested for gradation, percentage of wear, plasticity index and liquid limit. An inspector and materials testing technician will be required to document quality assurance.

2. Initial testing will be performed on the material to demonstrate that it conforms with requirements of the specifications before being delivered to the site. The initial test frequency for all applicable tests will be one test for each 3,000 tons of material or approximately two per week. As confidence in the Contractor's quality control is developed, the Engineer may approve reduced test frequency to one gradation test for each 5,000 tons or every week. The other tests will not be repeated unless the Contractor changes the material source or there is an apparent change in quality of the material.

E. Geotextiles

1. Geotextiles may be tested for tensile strength, bursting strength, elongation, puncture, ultraviolet light resistance and apparent opening size (AOS).

2. Approval for use of geotextile (filter fabric) will be based on manufacturer's literature having test results demonstrating the material equals or exceeds the applicable specifications. Material delivered to the site shall be inspected for tears, holes and other imperfections. Testing of material delivered will be performed if the Engineer believes the material may not meet the specifications.

F. Soil Cement

1. Moisture and density testing will be used to confirm that soil cement has been properly placed. An inspector and material testing technician will be required to document quality assurance.

2. Testing shall be performed on all soil cement to the extent necessary to demonstrate satisfactory mixture, placement and curing.

G. Survey

The SCS survey party chief will observe the Contractor's survey crew performance during the initial survey work and then at random intervals as the surveys progress to verify their ability, and for assurance that the staking is compatible with SCS standards. Random survey spot checks by SCS survey personnel will be made to determine the slope and reference stakes, and as-built sections are within tolerance.

Timing of Inspections

It is anticipated that the notice to proceed will be issued in September 1991 and the performance time has been calculated to be 255 calendar days. Once construction starts, work accomplished per day should be uniform with little variation. The construction sequence and performance time is based on the work being performed by an average small business contractor.

SKILLS NEEDED FOR CONTRACT ADMINISTRATION AND INSPECTION

PROJECT ENGINEER

Skills Needed:

a. Must be able to manage and schedule project staff effectively.

b. Must be familiar with and understand the philosophy and critical elements of the design.

c. Must be knowledgeable of quality assurance testing and inspection required for the works of improvement.

d. Must be knowledgeable of OSHA safety requirements, and the SCS supplement.

Training/Experience Required:

a. Have two years or more of construction inspection and contract administration. Have completed the Contract Administration for Construction Contracts training course.

b. Have completed the Unified Soil Classification (SM-1) course offered through SCS.

c. Have completed the Management Level II Course.

CHIEF INSPECTOR

Skills Needed:

a. Must be able to communicate effectively with the Contractor s field supervisory personnel.

b. Must understand basic staking and construction layout.

c. Must know the principles of earthwork inspection.

d. The ability to perform quantity computations.

e. The ability to maintain construction records.

f. The ability to supervise technicians assigned to the project.

g. Knowledge of OSHA safety requirements and the SCS supplement

Training/Experience Required:

a. A minimum of two construction contracts as lead inspector of a critical element of the work being constructed.

b. Have a minimum of four years construction inspection and testing experience.

c. Worked on one or more contracts as an earth inspector. Completed the SCS Construction Inspection training course.

d. Know earthfill, aggregate and riprap testing procedures.

SURVEY PARTY CHIEF, GS-6/7

Skills Needed:

a. Have ability to determine survey controls required for the construction of various elements of a project.

b. Must be capable of communicating with Contractor's survey crew and evaluate their abilities and effectiveness.

c. Coordinate SCS surveys with the Contractor's survey to verify compliance.

d. Must be capable of checking field notes for accuracy and completeness.

Training/Experience Required:

a. Have worked as an instrument man for two years.

b. Completed the SCS Construction Inspection training course or received comparable OJT.

c. Must have the ability to interpret plans and specifications.

d. Have received formal math training through trigonometry or equivalent experience.

SURVEY RODMAN, GS-5/6

Skills Needed:

a. Must be capable of performing the duties required of a rodman or chainman and other routine survey duties as directed by the survey party chief.

b. Must be able to determine distances, grades, etc., and interpret construction drawings.

Training/Experience Required:

a. Worked a minimum of one year as the primary lab technician on one or more construction projects.

b. Have the ability to perform the computations necessary to complete test results and reports.

c. Knowledgeable of the allowable tolerances for testing equipment.

d. Knowledgeable of the procedures for testing earthwork and drainfills.

e. Have completed the SCS Construction Inspection training course or received comparable OJT.

ESTIMATED STAFF HOURS REQUIRED TO COMPLETE THE CONTRACT

	Regular Time
Project Engineer	1,512 hours
Chief Inspector	1,780 hours
Material Testing Technician	1,060 hours
Survey Party Chief	710 hours

Not included in the above hours is the estimated overtime. If more hours of inspection are required, project personnel will be rotated to cover inspection duties.

PROJECT TESTING EQUIPMENT, FACILITIES AND PERSONNEL

The Mesa Construction Office will provide the necessary office space and a testing lab trailer, which is fully equipped to perform the required soil testing. All testing equipment is according to ASTM standards and will be serviced and calibrated prior to the start of the construction.

NAMES AND QUALIFICATIONS OF ASSIGNED PERSONNEL

Albert Rutledge, Chief Inspector GS-9

Experience:

Has been assigned to construction inspection duties in Arizona for 19 years. Has served as chief inspector during the construction of RWCD Reaches 1, 2, and 3, Vanar Diversion Repair, Signal Butte FRS/Pass Mountain Diversion, Apache FRS/Bulldog Floodway, and EMF Reach 6 Floodway, and Vineyard Road FRS Repair.

Soil Mechanics	Portland, OR 1969
Soil Mechanics II	Salt Lake UT 1978
Construction Inspection	Ft. worth, TX 1968
Construction Inspection	Ft. Worth, TX 1988
Concrete	Ft. Worth, TX 1980
Claim Avoidance, FAR's	Phoenix, AZ 1985
Troxler Nuclear Density Gauge	Phoenix, AZ 1981
ACI Grade I Certification	Phoenix, AZ 1987
Soil Compaction Techniques	Phoenix, AZ 1988
Contract Administration	Columbus, OH 1989

David Clough, Survey Party Chief, GS-7

Experience:

Has worked for the SCS since 1979 in the following positions:

Materials Testing Lab Technician, one year.
Instrument Man, four years.
Survey Party Chief, six years.

He has worked on the survey crew monitoring contractor surveys for EMF Floodway, Reaches 2, 3, 5, and 6. Signal Butte Floodway, Vanar Diversion Repair, Signal Butte FRS and Pass Mountain Diversion, Apache Junction FRS and Bulldog Floodway, and Vineyard Road FRS Repair.

Training:

Survey Records Investigation (BLM)	Phoenix, AZ 1984
Troxler Nuclear Gage	Phoenix, AZ 1980
Management Level II	Phoenix, AZ 1980

Gary Mason, Materials Testing Technician, GS-7

Experience:

Employed by SCS in Arizona for nine years in construction inspection. Served as an assistant laboratory testing technician for two years during construction of EMF Reach 1 and 2.

Assigned as the materials testing technician for the construction of Vanar Diversion Repair, EMF Reaches 3, 5, and 6, Signal Butte/Pass Mountain, and Apache/Bulldog and Vineyard Road FRS from 1984 to present.

Training:

Soils Testing	Lincoln, NE 1985
Concrete	Ft. Worth, TX 1985
Construction Inspection	Ft. Worth, TX 1983
Troxler Nuclear Gage	Las Vegas, NV 1984
ACI Grade I Certification	Phoenix, AZ 1987
Hydraulics for Technicians	Phoenix, AZ 1987
Management Level II	Phoenix, AZ 1989

Survey Rodman, GS-5

No one assigned, as surveying needs arise the position will be filled by available inspectors on the job sites.

STATEMENT OF AVAILABILITY

The above mentioned staff and equipment will be available for this project and will be assigned according to the inspection and testing needs.

By: _____ _____
(State Conservation Engineer) (Date)

By: _____ _____
(Project Engineer) (Date)

APPROVAL OF CO-DETERMINERS

_____ _____
(State Conservation Engineer) (Date)

_____ _____
(Contracting Officer) (Date)

ADDENDUM #1 - REACH 1
ADDENDUM #2 - REACH 2

OPERATION AND MAINTENANCE PLAN

EAST MARICOPA FLOODWAY, REACHES 1 & 2
(Formerly RWCD Floodway)

The operation and maintenance plans for Reaches 1 and 2 of the East Maricopa Floodway are hereby amended by adding the following maintenance items resulting from the repair contract to construct riprapped banks, soil-cement sills and related works. The limits of the work are from Station 1160+32.10 in Reach 2 to Station 1450+50 in Reach 1.

MAINTENANCE

Riprap

Check periodically and after major flows to appraise riprap damage. Replace rock in those areas where damage has occurred.

Riprap placed in the bottom of the channel at the toe of slope is extra thick to allow for moderate erosion in the channel. The rock will fall and continue to armor the toe of slope when the soil beneath is scoured away. However, if excessive scouring causes the rock to separate and expose the underlying geotextile filter fabric, the rock should be replaced.

Geotextile Filter Fabric

A geotextile filter fabric is between the riprap and a bedding layer of aggregate base course (ABC). The geotextile is not to be exposed to sunlight.

Check periodically and after major flows to verify that no geotextile is exposed. If it is exposed, cover the exposed area with riprap at least 12 inches thick. If the exposed fabric is damaged, cover the damaged area with other geotextile having at least three feet overlap all around the damaged area, and restore the appropriate riprap cover.

Aggregate Base Course (ABC)

ABC covers the maintenance roads and the freeboard portion of the top of slope. The ABC should be checked periodically and after heavy rain to determine if there has been rain damage. Holes, ruts and other rough areas should be filled with ABC and graded.

Soil Cement Sills

Soil cement sills are placed as grade control structures at the downstream end of each reach of channel riprap lining, and at intermediate locations. The scour depth at the downstream side of each sill should be inspected periodically and after each major storm event. If the general scour level equals or exceeds 4 feet from the top of any sill, a rock basin or additional sill should be placed at the downstream side to prevent damage to the sill. The top of basin or sill should be 4 feet from the top of existing sill.

SPECIFICATIONS
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531	Portland Cement	531-1
532	Aggregate for Portland Cement Concrete	532-1
534	Curing Compound (for Concrete)	534-1
539	Steel Reinforcement (for Concrete)	539-1 to 539-2

CONSTRUCTION SPECIFICATION

5. POLLUTION CONTROL

1. SCOPE

The work shall consist of installing measures or performing work to control erosion and minimize the production of sediment and other pollutants to water and air during construction operations in accordance with these specifications.

2. MATERIALS

All materials furnished shall meet the requirements of the Material Specifications listed in Section 8 of this specification.

3. EROSION AND SEDIMENT CONTROL MEASURES AND WORKS

The work and measures shall include but not be limited to the following, as shown on the drawings or as specified in Section 8 of this specification.

Staging of Earthwork Activities - The excavation and moving of soil materials shall be scheduled so that the smallest possible areas will be unprotected from erosion for the shortest time feasible.

Seeding - Seedings to protect disturbed areas shall be done as specified on the drawings or in Section 8 of this specification.

Mulching - Mulching shall be used to provide temporary protection to soil surfaces from erosion.

Diversions - Diversions shall be used to divert water away from work areas and/or to collect runoff from work areas for treatment and safe disposition.

Stream Crossings - Culverts or bridges shall be used where equipment must cross streams.

Sediment Basins - Sediment basins shall be used to settle and filter out sediment from eroding areas to protect properties and streams below the construction site.

Straw Bale Filters - Straw bale filters shall be used to trap sediment from areas of limited runoff. Bales are temporary and shall be removed when permanent measures are installed.

Waterways - Waterways shall be used for the safe disposal of runoff from fields, diversions and other structures or measures.

4. CHEMICAL POLLUTION

The Contractor shall provide watertight tanks or barrels or construct a sump sealed with plastic sheets to be used to dispose of chemical pollutants (such as drained lubricating or transmission oils, greases, soaps, asphalt, etc.) produced as a by-product of the project's work. At the completion of the construction work, sumps shall be voided without causing pollution as specified in Section 8 of this specification.

Sanitary facilities such as pit toilets, chemical toilets, or septic tanks shall not be placed adjacent to live streams, wells, or springs. They shall be located at a distance sufficient to prevent contamination of any water sources. At the completion of construction work, facilities shall be disposed of without causing pollution as specified in Section 8 of this specification.

5. AIR POLLUTION

Local and state regulations concerning the burning of brush or slash or disposal of other materials shall be adhered to.

Fire prevention measures shall be taken to prevent the start or the spreading of fires which result from project work. Fire breaks or guards shall be constructed at locations shown on the drawings.

All public access or haul roads used by the contractor during construction of the project shall be sprinkled or otherwise treated to fully suppress dust.

6. MAINTENANCE, REMOVAL, AND RESTORATION

All pollution control measures and works shall be adequately maintained in a functional condition as long as needed during the construction operation. All temporary measures shall be removed and the site restored to as nearly original conditions as practicable.

7. MEASUREMENT AND PAYMENT

Compensation for any item of work described in the contract but not listed in the bid schedule will be included in the payment for the item of work to which it is made subsidiary. Such items, and the items to which they are made subsidiary, are identified in Section 8 of this specification.

8. ITEMS OF WORK AND CONSTRUCTION DETAILS

Items of work to be performed in conformance with this specification and the construction details are:

a. Subsidiary Item, Pollution Control

(1) This item shall consist of all work and materials required to control or reduce pollution.

(2) This specification shall apply to all construction activities within the Floodway Right-of-Way.

(3) The Contractor is required to adhere to all applicable local, State and Federal laws and regulations pertaining to the control of pollution as may result from construction of this project. These laws and regulations include but are not limited to:

(a) The "Policy on Construction and Related Activities in Water" adopted April 13, 1977, by the Water Quality Control Council of Arizona.

(b) The Clean Air Act (42 U.S.C., Section 7401-7626), the Federal Water Pollution Control Act (33 U.S.C. 1251 et seq., as amended by the Clean Water Act of 1987), and Title 49 of the Arizona Revised Statutes, relating to inspection, monitoring, entry, reports, and information as well as the other requirements of these sections.

(4) The Contractor is responsible for maintaining air, water, and vegetative quality within the work area. Methods include:

(a) Establishing turn areas, haul roads, work site access roads, temporary building sites, equipment yards, etc., in approved locations, and staging earthwork activities to prevent contamination of air and water, to minimize destruction of existing vegetation, and to minimize erosion.

(b) Operating mechanized equipment at the job site in a manner that will avoid destruction or removal of trees and shrubs other than as necessary for construction of the measure.

(5) In Section 2, MATERIALS, there are no material specifications.

(6) Under Section 3, SEEDING, no seeding is required.

(7) No separate payment will be made for this item. Compensation for this work will be included in the payment for Bid Item 2, Excavation, Common, and Bid Item 4, Loose Rock Riprap.

CONSTRUCTION SPECIFICATION

7. CONSTRUCTION SURVEYS FOR LAYOUT, CONTROL AND MEASUREMENT

1. SCOPE

The work shall consist of performing: (1) all specified surveys for layout of work and construction controls, and (2) quantity surveys and computations for progress payment estimates. It includes furnishing all necessary equipment, personnel and material to perform the surveys required by the methods specified.

2. EQUIPMENT AND MATERIALS

Equipment for construction surveys shall be of a quality and condition to provide the required accuracy. The equipment shall be maintained in good working order and in proper adjustment at all times. Records of calibration tests, accuracy checks and adjustments shall be maintained and be available for inspection by the Contracting Officer.

Materials include all the necessary field notebooks, stakes, templates, platforms, equipment, spikes, steel pins, tools, and all other items necessary to perform the work specified.

3. QUALITY OF WORK

All work shall follow recognized professional practice and the standards of the industry unless otherwise specified in Section 9. The work shall be performed to the accuracy and detail appropriate for the type of job. Notes, sketches, and other data shall be complete, recorded neatly, legible, reproducible and organized in a manner that will allow reproduction of copies for job documentation.

All computations shall be mathematically correct. Computations shall include information to identify the bid item, date, and who performed, checked and approved the computations. Computations shall be legible, complete and clearly document the source of all information used including assumptions and measurements made.

If a computer program is used to perform the computations, a copy of the program, with user information, shall be submitted with the first set of computations. Computer generated computations shall show the input data used including the source of all information used and software assumptions.

The elevations of permanent and temporary bench marks shall be determined and recorded to the nearest 0.01 foot. Differential leveling and transit traverses shall be of such precision that the error of vertical closure in feet shall not exceed plus or minus 0.1

times the square root of the traverse distance in miles. Linear measurements shall be accurate to within 1.0 foot in 5000 feet, unless otherwise specified in Section 9. The angular error of closure for transit traverses shall not exceed 1.0 minute times the square root of the number of angles turned.

Slope stakes shall be placed, as a minimum; at 100 foot stations, breaks in the original ground surface and at any other intermediate stations necessary to insure accurate location for construction layout and measurement. Slope stakes and cross sections shall be perpendicular to the centerline. Significant breaks in grade shall be determined for cross sections. Distances shall be measured horizontally and recorded to the nearest 0.1 foot. Side shots for interim construction stakes may be taken with a hand level.

Unless otherwise specified in Section 9, measurement for stationing and establishing the location of structures shall be made to the nearest 0.1 of a foot.

Elevations for concrete work, pipes and mechanical equipment shall be determined and recorded to the nearest 0.01 foot. Elevations for earth work shall be determined and recorded to the nearest 0.1 foot.

4. PRIMARY CONTROL

The baselines and bench marks for primary control, necessary to establish lines and grades needed for construction, are shown on the drawings and have been located on the job site.

These baselines and bench marks shall be used as the origin of all surveys, layouts and measurements to establish construction lines and grades. The Contractor shall take all necessary precautions to prevent the loss or damage of primary control points.

5. CONSTRUCTION SURVEYS

Prior to commencement of work requiring contractor performed surveys, the Contractor shall submit in writing to the Contracting Officer for approval the name, qualifications and experience of the individuals to be assigned to the job.

Contractor performed surveys shall consist of the work necessary for: (1) establishing line and grade for all work, (2) setting slope stakes for all work, (3) checking and any supplemental or interim staking, (4) establishing final grade stakes, (5) performing quantity surveys, measurements and computations for progress payment and (6) other surveys as described in Section 9.

6. STAKING

Prior to the commencement of work on any item the construction staking required for that item shall be completed. Construction staking shall be completed as follows, or as otherwise specified in Section 9:

a. Clearing and grubbing - the boundary of the clearing and grubbing areas shall be staked or flagged at 200 foot intervals, or closer if needed, to clearly mark the limits of work.

b. Excavation and fill - slope stakes shall be placed at the intersection of the specified slopes and ground line. Slope stakes or the reference stakes for slopes shall be marked with the stationing, required cut, slope ratio and horizontal distance. Offset reference stakes and hubs shall be placed, as a minimum, at 100 foot stations, and shall be placed on at least one side of specified excavations and on both sides of specified fills.

c. Structures - centerline and offset reference line stakes for location, alignment and elevation shall be placed for all structures.

7. RECORDS

All survey data shall be recorded in fully identified, standard hard-bound engineering survey field notebooks with consecutively numbered pages. All field notes and printed data shall include the purpose or description of the work, the date the work was performed, weather data, sketches and the personnel who performed and checked the work. Electronically generated survey data and computations shall be bound, page numbered and cross referenced in a bound field notebook containing the index for all survey data.

The construction survey records shall be available at all times during the progress of the work for examination and use by the Contracting Officer and copies shall be made available to the Contracting Officer upon request. The original field notebooks and other records shall be turned over to and become the property of the Contracting Officer prior to final acceptance of the work.

Complete documentation of computations and supporting data for progress payments shall be submitted to the Contracting Officer with each invoice for payment as specified in Section 9.

8. MEASUREMENT AND PAYMENT

Work performed in accordance with this specification, for which a specified lump sum price has been established in the contract, will not be measured. Payment will be made as the work proceeds, after receipt of invoices from the Contractor. Reimbursement for the cost of materials and equipment having a residual value will not be

considered for inclusion in the progress payments. If the total of progress payments is less than the contract lump sum for this bid item, the balance will be included in the final contract payment. Total payment will be the contract lump sum price for this bid item, regardless of actual cost to the Contractor.

Payment of the contract lump sum price for surveys will constitute full compensation for all labor, materials, equipment, and all other items necessary and incidental to complete the work.

Compensation for any item of work described in the contract but not listed in the bid schedule will be included in the payment for the item of work to which it is made subsidiary. Such items and the item to which they are made subsidiary are identified in Section 9 of this specification.

9. ITEMS OF WORK AND CONSTRUCTION DETAILS

Items of work to be performed in conformance with this specification and the construction details are:

a. Bid Item 8, Surveys

(1) This item consists of furnishing personnel, equipment, materials and performing surveys required to construct the EMF Floodway Repair. (See Section 5.)

(2) In Section 5 "other surveys" shall include those required for computation of final quantities and preparation of as-built drawings.

(3) The Contractor shall provide the Government Representative at the beginning of each work week a schedule of surveys to be performed that week.

(4) The Contractor shall provide the Contracting Officer with copies of all relevant computations and supporting data with each invoice for progress payment and final payment.

(5) Base lines and bench marks for primary control are located on the sides of the right of way approximately at 500 foot stations, PC's and PT's.

(6) Any primary control monuments damaged or destroyed by the Contractor due to negligence will be replaced by the Government at the Contractor's expense. The actual cost to the Government for replacing the primary control monuments will be deducted from payments due the Contractor.

(7) All entries shall be consistent with Soil Conservation Service TR-62, "Engineering Layout, Notes, Staking and Calculations".

CONSTRUCTION SPECIFICATION

8. MOBILIZATION

1. SCOPE

The work shall consist of the mobilization of the Contractor's forces and equipment necessary for performing the work required under the contract. Mobilization will not be considered as work in fulfilling the contract requirement for commencement of work.

Mobilization shall include the cost for transportation of personnel, equipment, and operating supplies to the site; establishment of offices, buildings, and other necessary facilities at the site not covered in specific bid items, and other preparatory work at the site. The cost of the entire amount of premiums paid for performance and payment bonds, including coinsurance and reinsurance agreements as applicable shall be paid upon request when evidence of full payment to the surety has been provided to the Contracting Officer.

Work done under this specification shall not include mobilization for any specific item of work for which payment for mobilization is provided elsewhere in the contract.

The specification covers mobilization for work required by the contract at the time of award. If additional mobilization costs are incurred during performance of the contract as a result of changed or added items of work for which the Contractor is entitled to an adjustment in contract price, compensation for such costs will be included in the price adjustment for the item or items of work changed or added.

2. PAYMENT

Payment will be made as the work proceeds, after presentation of invoices by the Contractor showing his own mobilization costs and evidence of the charges of suppliers, subcontractors, and others for mobilization work performed by them. If the total of such payments is less than the contract lump sum for mobilization, the unpaid balance will be included in the final contract payment. Total payment will be the lump sum contract price for mobilization, regardless of actual cost to the Contractor.

Payment will not be made under this item for the purchase costs of materials having a residual value, the purchase costs of materials to be incorporated in the project, or the purchase costs of operating supplies.

Payment of the lump sum contract price for mobilization will constitute full compensation for all labor, materials, equipment, and all other items necessary and incidental to completion of the work.

3. ITEMS OF WORK AND CONSTRUCTION DETAILS

Items of work to be performed in conformance with this specification and the construction details are:

a. Bid Item 1, Mobilization

1. This item consists of mobilization of the Contractor's equipment and forces to perform the work required under this contract.

CONSTRUCTION SPECIFICATION

10. WATER FOR CONSTRUCTION

1. SCOPE

The work shall consist of furnishing, transporting, and using water for construction purposes in accord with the applicable specifications.

2. FACILITIES AND EQUIPMENT

The Contractor shall build and maintain such access and haul roads as are needed, and shall furnish, operate, and maintain all pumps, piping, tanks, and other facilities needed to load, transport, and use the water as specified.

These facilities shall be equipped with meters, tanks, or other devices by which the volume of water supplied can be measured.

3. DUST ABATEMENT AND HAUL ROAD MAINTENANCE

Water for dust abatement and haul road maintenance shall be applied to haul roads and other dust-producing areas as needed to prevent excessive dust and to maintain the roads in good condition for efficient operation while they are in use.

4. EARTHFILL, DRAINFILL, ROCKFILL

Water for earthfill, drainfill, or rockfill shall be used in the fill materials as specified in the applicable construction specifications.

5. CONCRETE, MORTAR, GROUT

Water used in mixing or curing concrete, pneumatically applied mortar, or other portland cement mortar or grout shall meet the requirements of the applicable construction specifications and shall be used in conformance with those specifications. Payment for water used in these items is covered by the applicable concrete, mortar or grout specification.

6. MEASUREMENT AND PAYMENT

Compensation for any item of work described in the contract but not listed in the bid schedule will be included in the payment for the item of work to which it is made subsidiary. Such items and the items to which they are made subsidiary are identified in Section 7 of this specification.

Except as otherwise specified, the measurement for payment will include all water needed at the construction site, except as noted in Section 5, to perform the work required under the contract in accordance with the specifications but will not include water wasted or used in excess of the amount needed. It will not include water used in concrete which is mixed elsewhere and transported to the site.

Payment for water will be made at the contract unit price. Such payment will constitute full compensation for all labor, materials, equipment, and all other items necessary and incidental to furnishing, transporting, and using the water.

7. ITEMS OF WORK AND CONSTRUCTION DETAILS

Items of work to be performed in conformance with this specification and the construction details are:

a. Subsidiary Item, Water

1. This item consists of furnishing and applying all water necessary for performance of the work described in this contract.

2. In Section 6, MEASUREMENT AND PAYMENT, no separate payment will be made for this item. Compensation for water will be included in the payment for Bid Item 3, Earthfill, Class A; Bid Item 5, ABC Bedding; and Bid Item 7, Soil-Cement.

CONSTRUCTION SPECIFICATION

11. REMOVAL OF WATER

1. SCOPE

The work shall consist of the removal of surface water and ground water as needed to perform the required construction in accordance with the specifications. It shall include (1) building and maintaining all necessary temporary impounding works, channels, and diversions, (2) furnishing, installing and operating all necessary pumps, piping and other facilities and equipment, and (3) removing all such temporary works and equipment after they have served their purposes.

2. DIVERTING SURFACE WATER

The Contractor shall build, maintain and operate all cofferdams, channels, flumes, sumps, and other temporary diversion and protective works needed to divert streamflow and other surface water through or around the construction site and away from the construction work while construction is in progress. Unless otherwise specified, a diversion must discharge into the same natural drainageway in which its headworks are located.

Unless otherwise specified, the Contractor shall furnish to the Contracting Officer, in writing, his plan for diverting surface water before beginning the construction work for which the diversion is required. Acceptance of this plan will not relieve the Contractor of responsibility for completing the work as specified.

3. DEWATERING THE CONSTRUCTION SITE

Foundations, cutoff trenches and other parts of the construction site shall be dewatered and kept free of standing water or excessively muddy conditions as needed for proper execution of the construction work. The Contractor shall furnish, install, operate and maintain all drains, sumps, pumps, casings, wellpoints, and other equipment needed to perform the dewatering as specified. Dewatering methods that cause a loss of fines from foundation areas will not be permitted.

Unless otherwise specified, the Contractor shall furnish to the Contracting Officer, in writing, his plan for dewatering before beginning the construction work for which the dewatering is required. Acceptance of this plan will not relieve the Contractor of responsibility for completing the work as specified.

4. DEWATERING BORROW AREAS

Unless otherwise specified in Section 8, the Contractor shall maintain the borrow areas in drainable condition or otherwise provide for

timely and effective removal of surface and ground waters that accumulate within the borrow areas from any source. Borrow material shall be processed as necessary to achieve proper and uniform moisture content for placement.

If pumping to dewater borrow areas is included as an item of work in the bid schedule, each pump used for this purpose shall be equipped with a water meter in the discharge line. Accuracy of the meters shall be such that the measured quantity of water is within 3 percent, plus or minus, of the true quantity. Means shall be provided by the Contractor to check the accuracy of the water meters when requested by the Contracting Officer.

5. EROSION AND POLLUTION CONTROL

Removal of water from the construction site, including the borrow areas shall be accomplished in such a manner that erosion and the transmission of sediment and other pollutants are minimized.

6. REMOVAL OF TEMPORARY WORKS

After the temporary works have served their purposes, the Contractor shall remove them or level and grade them to the extent required to present a sightly appearance and to prevent any obstruction of the flow of water or any other interference with the operation of or access to the permanent works.

Except as otherwise specified, pipes and casings shall be removed from temporary wells and the wells shall be filled to ground level with gravel or other material approved by the Contracting Officer.

7. MEASUREMENT AND PAYMENT

Compensation for any item of work described in the contract but not listed in the bid schedule will be included in the payment for the item of work to which it is made subsidiary. Such items and the items to which they are made subsidiary are identified in Section 8 of this specification.

8. ITEMS OF WORK AND CONSTRUCTION DETAILS

Items of work to be performed in conformance with this specification and the construction details are:

a. Subsidiary Item, Removal of Water

(1) This item consists of the removal or diversion of surface and ground water from the construction area shown on the drawings.

(2) The diversion or dewatering plans submitted to the Contracting Officer for approval shall be site specific for each structure and/or section of work. Any diversions or dikes proposed in the existing floodway shall incorporate "fuse" or breakaway sections or otherwise be capable of rapid removal of water in the event of surface water flows during construction.

(3) In Section 2, DIVERTING SURFACE WATER, this project is located in an active watershed consisting of a series of floodways and flood retarding structures which collect and discharge flows into the East Maricopa Floodway through uncontrolled outlets. In the event of significant rain storms there may be water flowing in Reaches 1 and 2 for extended periods of time. Work in the channel bottom may be impractical during periods of flow and subsequent dry-outs.

(4) No separate payment will be made for the Removal of Water. Compensation for Removal of Water will be included in the payment for Bid Item 2, Excavation, Common.

CONSTRUCTION SPECIFICATION

21. EXCAVATION

1. SCOPE

The work shall consist of the excavation required by the drawings and specifications and disposal of the excavated materials.

2. CLASSIFICATION

Excavation will be classified as common excavation or rock excavation in accordance with the following definitions or will be designated as unclassified.

Common excavation shall be defined as the excavation of all materials that can be excavated, transported, and unloaded by the use of heavy ripping equipment and wheel tractor-scrapers with pusher tractors or that can be excavated and dumped into place or loaded onto hauling equipment by means of excavators having a rated capacity of one cubic yard and equipped with attachments (such as shovel, bucket, backhoe, dragline or clam shell) appropriate to the character of the materials and the site conditions.

Rock excavation shall be defined as the excavation of all hard, compacted or cemented materials the accomplishment of which requires blasting or the use of excavators larger than defined for common excavation. The excavation and removal of isolated boulders or rock fragments larger than one cubic yard in volume encountered in materials otherwise conforming to the definition of common excavation shall be classified as rock excavation.

Excavation will be classified according to the above definitions by the Engineer, based on his judgment of the character of the materials and the site conditions.

The presence of isolated boulders or rock fragments larger than one cubic yard in size will not in itself be sufficient cause to change the classification of the surrounding material.

For the purpose of this classification, the following definitions shall apply:

Heavy ripping equipment shall be defined as a rear-mounted, heavy duty, single-tooth, ripping attachment mounted on a tractor having a power rating of 200-300 net horsepower (at the flywheel).

Wheel tractor-scraper shall be defined as a self-loading (not elevating) and unloading scraper having a struck bowl capacity of 12-20 yards.

Pusher tractor shall be defined as a track type tractor having a power rating of 200-300 net horsepower (at the flywheel) equipped with appropriate attachments.

3. UNCLASSIFIED EXCAVATION

Items designated as "Unclassified Excavation" shall include all materials encountered regardless of their nature or the manner in which they are removed. When excavation is unclassified, none of the definitions or classifications stated in Section 2 of this specification shall apply.

4. BLASTING

The transportation, handling, storage, and use of dynamite and other explosives shall be directed and supervised by a person of proven experience and ability in blasting operations.

Blasting shall be done in such a way as to prevent damage to the work or unnecessary fracturing of the foundation and shall conform to any special requirements in Section 12 of this specification.

5. USE OF EXCAVATED MATERIAL

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To the extent they are needed, all suitable materials from the specified excavations shall be used in the construction of required permanent earthfill or rockfill. The suitability of materials for specific purposes will be determined by the Engineer. The Contractor shall not waste or otherwise dispose of suitable excavated materials.

6. DISPOSAL OF WASTE MATERIALS

All surplus or unsuitable excavated materials will be designated as waste and shall be disposed of at the locations shown on the drawings.

7. BRACING AND SHORING

Excavated surfaces too steep to be safe and stable if unsupported shall be supported as necessary to safeguard the work and workmen, to prevent sliding or settling of the adjacent ground, and to avoid damaging existing improvements. The width of the excavation shall be increased if necessary to provide space for sheeting, bracing, shoring, and other supporting installations. The Contractor shall furnish, place and subsequently remove such supporting installations.

8. STRUCTURE AND TRENCH EXCAVATION

Structure or trench excavation shall be completed to the specified elevations and to sufficient length and width to include allowance for forms, bracing and supports, as necessary, before any concrete or earthfill is placed or any piles are driven within the limits of the excavation.

9. BORROW EXCAVATION

When the quantities of suitable materials obtained from specified excavations are insufficient to construct the specified fills, additional materials shall be obtained from the designated borrow areas. The extent and depth of borrow pits within the limits of the designated borrow areas shall be as directed by the Engineer.

Borrow pits shall be excavated and finally dressed in a manner to eliminate steep or unstable side slopes or other hazardous or unsightly conditions.

10. OVEREXCAVATION

Excavation in rock beyond the specified lines and grades shall be corrected by filling the resulting voids with portland cement concrete made of materials and mix proportions approved by the Engineer. Concrete that will be exposed to the atmosphere when construction is completed shall contain not less than 6 sacks of cement per cubic yard of concrete. Concrete that will be permanently covered shall contain not less than 4-1/2 sacks of cement per cubic yard. The concrete shall be placed and cured as specified by the Engineer.

Excavation in earth beyond the specified lines and grades shall be corrected by filling the resulting voids with approved compacted earthfill, except that, if the earth is to become the subgrade for riprap, rockfill, sand or gravel bedding, or drainfill, the voids may be filled with material conforming to the specifications for the riprap, rockfill, bedding or drainfill.

11. MEASUREMENT AND PAYMENT

For items of work for which specific unit prices are established in the contract, the volume of each type and class of excavation within the specified pay limits will be measured and computed to the nearest cubic yard by the method of average cross-sectional end areas. Regardless of quantities excavated, the measurement for payment will be made to the specified pay limits, except that excavation outside the specified lines and grades directed by the Engineer to remove unsuitable material will be included. Excavation required because unsuitable conditions result from the Contractor's improper construction operations, as determined by the Contracting Officer, will not be included for measurement and payment.

a. The upper limit shall be the original ground surface as it existed prior to the start of construction operations except that where excavation is performed within areas designated for previous excavation or fill the upper limit shall be the modified ground surface resulting from the specified previous excavation or fill.

b. The lower and lateral limits shall be the neat lines and grades shown on the drawings.

Payment for each type and class of excavation will be made at the contract unit price for that type and class of excavation. Such payment will constitute full compensation for all labor, materials, equipment, and all other items necessary and incidental to the performance of the work, except that extra payment for backfilling overexcavation will be made in accordance with the following provisions:

Payment for backfilling overexcavation, as specified in Section 10 of this specification, will be made only if the excavation outside specified lines and grades is directed by the Engineer to remove unsuitable material and if the unsuitable condition is not a result of the Contractor's improper construction operations as determined by the Contracting Officer.

Compensation for any item of work described in the contract but not listed in the bid schedule will be included in the payment for the item of work to which it is made subsidiary. Such items and the items to which they are made subsidiary are identified in Section 12 of this specification.

a. Bid Item 2, Excavation Common

21-5
21-6

(1) This item consists of all common excavation required for installation of all riprap, ABC bedding, geotextile, side inlet and soil-cement sills as shown on the drawings.

(2) Excess excavated materials from the toes of slope shall be placed over the completed riprap, as provided in Bid Item 4, Loose Rock Riprap.

(3) Soil material excavated for soil cement sills shall be used for loose soil cover for riprap, earthfill along the sides, or loose fill along the sides to direct low flow toward the channel center. The top surface of fill placed along the channel sides to direct low flow toward the channel center shall not be higher than the corresponding as-built grade, except as otherwise approved by the Engineer.

(4) In Section 11, MEASUREMENT AND PAYMENT, payment will include compensation for subsidiary items: Pollution Control, Water for Construction and Removal of Water.

b. Subsidiary Item, Grading for Soil Cement Sill Excavation

(1) This item shall consist of grading the site of each soil cement sill to a level of five feet (5') above bottom grade of sill as indicated on the plans.

(2) Payment for this item of work will be included in Bid Item 7, Soil Cement Sills.

CONSTRUCTION SPECIFICATION

23. EARTHFILL

1. SCOPE

The work shall consist of the construction of earth embankments and other earthfills required by the drawings and specifications.

2. MATERIALS

All fill materials shall be obtained from required excavations and designated borrow areas. The selection, blending, routing and disposition of materials in the various fills shall be subject to approval by the Engineer.

Fill materials shall contain no sod, brush, roots or other perishable materials. Rock particles larger than the maximum size specified for each type of fill shall be removed prior to compaction of the fill.

The types of materials used in the various fills shall be as listed and described in the specifications and drawings.

3. FOUNDATION PREPARATION

Foundations for earthfill shall be stripped to remove vegetation and other unsuitable materials or shall be excavated as specified.

Except as otherwise specified, earth foundation surfaces shall be graded to remove surface irregularities and shall be scarified parallel to the axis of the fill or otherwise acceptably scored and loosened to a minimum depth of 2 inches. The moisture content of the loosened material shall be controlled as specified for the earthfill, and the surface materials of the foundation shall be compacted and bonded with the first layer of earthfill as specified for subsequent layers of earthfill.

Earth abutment surfaces shall be free of loose, uncompacted earth in excess of two inches in depth normal to the slope and shall be at such a moisture content that the earthfill can be compacted against them to effect a good bond between the fill and the abutments.

Rock foundation and abutment surfaces shall be cleared of all loose materials by hand or other effective means and shall be free of standing water when fill is placed upon them. Occasional rock outcrops in earth foundations for earthfill, except in dams and other structures designed to restrain the movement of water, shall not require special treatment if they do not interfere with compaction of the foundation and initial layers of the fill or the bond between the foundation and the fill.

Foundation and abutment surfaces shall be not steeper than 1 horizontal to 1 vertical unless otherwise specified. Test pits or other cavities shall be filled with compacted earthfill conforming to the specifications for the earthfill to be placed upon the foundation.

4. PLACEMENT

Fill shall not be placed until the required excavation and foundation preparation have been completed and the foundation has been inspected and approved by the Engineer. Fill shall not be placed upon a frozen surface, nor shall snow, ice, or frozen material be incorporated in the fill.

Fill shall be placed in approximately horizontal layers. The thickness of each layer before compaction shall not exceed the maximum thickness specified. Materials placed by dumping in piles or windrows shall be spread uniformly to not more than the specified thickness before being compacted. Hand compacted fill, including fill compacted by manually directed power tampers, shall be placed in layers whose thickness before compaction does not exceed the maximum thickness specified for layers of fill compacted by manually directed power tampers.

Adjacent to structures, fill shall be placed in a manner which will prevent damage to the structures and will allow the structures to assume the loads from the fill gradually and uniformly. The height of the fill adjacent to a structure shall be increased at approximately the same rate on all sides of the structure.

Earthfill in dams, levees and other structures designed to restrain the movement of water shall be placed so as to meet the following additional requirements:

a. The distribution of materials throughout each zone shall be essentially uniform, and the fill shall be free from lenses, pockets, streaks or layers of material differing substantially in texture, moisture content, or gradation from the surrounding material.

b. If the surface of any layer becomes too hard and smooth for proper bond with the succeeding layer, it shall be scarified parallel to the axis of the fill to a depth of not less than 2 inches before the next layer is placed.

c. The top surfaces of embankments shall be maintained approximately level during construction, except that a crown or cross-slope of approximately 2 percent shall be maintained to insure effective drainage, and except as otherwise specified for drainfill or sectional zones.

d. Dam embankments shall be constructed in continuous layers from abutment to abutment except where openings to facilitate construction or to allow the passage of stream flow during construction are specifically authorized in the contract.

e. Embankments built at different levels as described under (c) or (d) above shall be constructed so that the slope of the bonding surfaces between embankment in place and embankment to be placed is not steeper than 3 feet horizontal to 1 foot vertical. The bonding surface of the embankment in place shall be stripped of all material not meeting the requirements of this specification, and shall be scarified, moistened and recompacted when the new fill is placed against it as needed to insure a good bond with the new fill and to obtain the specified moisture content and density at the contact of the in place and new fills.

5. CONTROL OF MOISTURE CONTENT

During placement and compaction of fill, the moisture content of the materials being placed shall be maintained within the specified range.

The application of water to the fill materials shall be accomplished at the borrow areas insofar as practicable. Water may be applied by sprinkling the materials after placement on the fill, if necessary. Uniform moisture distribution shall be obtained by disking.

Material that is too wet when deposited on the fill shall either be removed or be dried to the specified moisture content prior to compaction.

If the top surface of the preceding layer of compacted fill or a foundation or abutment surface in the zone of contact with the fill becomes too dry to permit suitable bond it shall either be removed or scarified and moistened by sprinkling to an acceptable moisture content prior to placement of the next layer of fill.

6. COMPACTION

Earthfill shall be compacted according to the following requirements for the class of compaction specified:

Class A compaction. Each layer of fill shall be compacted as necessary to make the density of the fill matrix not less than the minimum density specified. The fill matrix is defined as the portion of the fill material finer than the maximum particle size used in the compaction test method specified.

Class B compaction. Each layer of fill shall be compacted to a mass density not less than the minimum density specified.

Class C compaction. Each layer of fill shall be compacted by the specified number of passes of the type and weight of roller or other equipment specified, or by an approved equivalent method. Each pass shall consist of at least one passage of the roller wheel or drum over the entire surface of the layer.

Fill adjacent to structures shall be compacted to a density equivalent to that of the surrounding fill by means of hand tamping or manually directed power tampers or plate vibrators. Unless otherwise specified, heavy equipment including backhoe mounted powertampers, or vibrating compactors and manually directed vibrating rollers, shall not be operated within 2 feet of any structure. Towed or self-propelled vibrating rollers shall not be operated within 5 feet of any structure. Compaction by means of drop weights operating from a crane or hoist will not be permitted.

The passage of heavy equipment will not be allowed: (1) over cast-in-place conduits prior to 14 days after placement of the concrete; (2) over cradled or bedded precast conduits prior to 7 days after placement of the concrete cradle or bedding; or (3) over any type of conduit until the backfill has been placed above the top surface of the structure to a height equal to one-half the clear span width of the structure or pipe or 2 feet, whichever is greater.

Compacting of fill adjacent to structures shall not be started until the concrete has attained the strength specified in Section 10 for this purpose. The strength will be determined by compression testing of test cylinders cast by the Engineer for this purpose and cured at the work site in the manner specified in ASTM Method C 31 for determining when a structure may be put into service.

When the required strength of the concrete is not specified as described above, compaction of fill adjacent to structures shall not be started until the following time intervals have elapsed after placement of the concrete.

Structure	Time Interval
Retaining walls and counterforts (impact basins)	14 days
Walls backfilled on both sides simultaneously	7 days
Conduits and spillway risers, cast-in-place (with inside forms in place)	7 days
Conduits and spillway risers, cast-in-place (inside forms removed)	14 days

7. REWORKING OR REMOVAL AND REPLACEMENT OF DEFECTIVE FILL

Fill placed at densities lower than the specified minimum density or at moisture contents outside the specified acceptable range of moisture content or otherwise not conforming to the requirements of the specifications shall be reworked to meet the requirements or removed and replaced by acceptable fill. The replacement fill and the foundation, abutment and fill surfaces upon which it is placed shall conform to all requirements of this specification for foundation preparation, approval, placement, moisture control and compaction.

8. TESTING

During the course of the work, the Engineer will perform such tests as are required to identify materials, to determine compaction characteristics, to determine moisture content, and to determine density of fill in place. These tests performed by the Engineer will be used to verify that the fills conform to the requirements of the specifications. Such tests are not intended to provide the Contractor with the information required by him for the proper execution of the work and their performance shall not relieve the Contractor of the necessity to perform tests for that purpose.

Densities of fill requiring Class A compaction will be determined by the Engineer in accordance with ASTM Method D 1556, D 2167, D 2922 or D 2937 except that the volume and moist weight of included rock particles larger than those used in the compaction test method specified for the type of fill will be determined and deducted from the volume and moist weight of the total sample prior to computation of density or if using the nuclear gauge, added to the specified density to bring it to the measure of equivalent composition for comparison. The density so computed will be used to determine the percent compaction of the fill matrix. Unless otherwise specified, moisture content will be determined by one of the following methods: ASTM Method D 2216 or D 3017.

9. MEASUREMENT AND PAYMENT

For items of work for which specific unit prices are established in the contract, the volume of each type and compaction class of earthfill within the specified zone boundaries and pay limits will be measured and computed to the nearest cubic yard by the method of average cross-sectional end areas. Unless otherwise specified, no deduction in volume will be made for embedded conduits and appurtenances.

The pay limits shall be as defined below, with the further provision that earthfill required to fill voids resulting from overexcavation of the foundation, outside the specified lines and grades, will be included in the measurement for payment only where such overexcavation is directed by the Engineer to remove unsuitable material and where

the unsuitable condition is not a result of the Contractor's improper construction operations as determined by the Contracting Officer.

The pay limits shall be the measured surface of the foundation when approved for placement of the fill and the specified neat lines of the fill surface.

Payment for compaction of earthfill will be made at the contract unit price for earthfill. Such payment will constitute full compensation for all labor, materials, equipment and all other items necessary and incidental to the performance of the work, including furnishing, transporting, and applying water to the foundation and fill materials.

Compensation for any item of work described in the contract but not listed in the bid schedule will be included in the payment for the item of work to which it is made subsidiary. Such items and the items to which they are made subsidiary are identified in Section 10 of this specification.

10. ITEMS OF WORK AND CONSTRUCTION DETAILS

Items of work to be performed in conformance with this specification and the construction details are:

a. Bid Item 3, Earthfill, Class A

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(1) This item consists of placing and compacting all earthfill required to construct the floodway repairs as shown on the drawings and described herein.

(2) Earthfill shall be placed at the lower slope and channel bottom limits of ABC bedding as indicated when necessary to bring the grade up to the subgrade level of the ABC bedding.

(3) Earthfill shall be placed at the locations of soil cement sills, as necessary to accommodate excavation for placement of soil cement.

(4) In Section 6, COMPACTION, Class A shall apply. The fill matrix shall be compacted to at least 90 percent of the maximum density obtained in compaction tests of the fill materials performed by ASTM D 698, Method A (Standard Proctor Test or Rapid Compaction Test (Test No. S-6) SCS National Engineering Handbook, Section 19.

(5) The maximum size of rock fragments incorporated in the fill shall be six (6) inches.

(6) The maximum thickness of a layer before compaction shall be nine (9) inches.

(7) In Section 8, TESTING, densities of fill will be determined in accordance with ASTM 1556. The moisture content of the material incorporated in the fill shall be maintained within the range of one percent point above the optimum moisture content to three (3) percentage points below the optimum moisture content as determined by ASTM D 2216.

(8) Section 9, MEASUREMENT AND PAYMENT, payment will include compensation for Subsidiary Item, Water for Construction.

b. Subsidiary Item, Earthfill, Class C

(1) This item shall consist of placing and compacting earthfill in the channel, as indicated on the plans, to provide support at the limits of ABC and riprap where Earthfill, Class A is not required.

(2) In Section 6, COMPACTION, Class C shall apply. Each layer of fill shall be compacted with a minimum of three (3) complete passes over the entire surface area by equipment having a minimum empty weight of 25,000 pounds or two (2) complete passes over the entire surface area by approved equipment designed specifically for compaction of earthfill materials.

(3) The fill material shall contain sufficient moisture that when a small portion is taken in the hand and squeezed, it remains intact when released and does not leave free water on the palm of the hand.

(4) No separate payment will be made for Earthfill, Class C. Compensation for this work will be included in the payment for Bid Item 4, Loose Rock Riprap.

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CONSTRUCTION SPECIFICATION

32. CONCRETE FOR MINOR STRUCTURES

1. SCOPE

The work shall consist of furnishing, forming, placing, finishing and curing portland cement concrete as required to build the structures named in Section 24 of this specification.

2. MATERIALS

Portland cement shall conform to the requirements of Material Specification 531 for the specified type.

Aggregates shall conform to the requirements of Material Specification 522 unless otherwise specified. The grading of coarse aggregates shall be as specified in Section 24.

Water shall be clean and free from injurious amounts of oil, salt, acid, alkali, organic matter or other deleterious substances.

Preformed expansion joint filler shall conform to the requirements of Material Specification 535.

Waterstops shall conform to the requirements of Material Specifications 537 and 538 for the specified kinds.

3. CLASS OF CONCRETE

Concrete for minor structures shall be classified as follows:

Class of Concrete	Maximum Net Water Content (gallons/bag)	Minimum Cement Content (bags/cu. yd.)
3000M	7	6
4000M	6	6

4. AIR CONTENT AND CONSISTENCY

Unless otherwise specified, the slump shall be 2 to 4 inches. If air entrainment is specified, the air content by volume shall be 5 to 8 percent of the volume of the concrete. When specified, directed or approved by the Engineer, a water-reducing, set-retarding or other admixture shall be used.

5. DESIGN OF THE CONCRETE MIX

The proportions of the aggregates shall be such as to produce a concrete mixture that will work readily into the corners and angles

of the forms and around reinforcement when consolidated, but will not segregate or exude free water during consolidation.

Prior to placement of concrete, the Contractor shall furnish the Contractor Officer for approval, a statement of the materials and mix proportions (including admixtures, if any) he intends to use. The statement shall include evidence satisfactory to the Contracting Officer that the materials and proportions will produce concrete conforming to this specification. The materials and proportions so stated shall constitute the "job mix." After a job mix has been approved, neither the source, character or grading of the aggregates nor the type or brand of cement or admixture shall be changed without prior notice to the Contracting Officer. If such changes are necessary, no concrete containing such new or altered materials shall be placed until the Contracting Officer has approved a revised job mix.

6. INSPECTION AND TESTING

The Engineer shall have free entry to the plant and equipment furnishing concrete under the contract. Proper facilities shall be provided for the Engineer to inspect materials, equipment and processes and to obtain samples of the concrete. All tests and inspections will be conducted so as not to interfere unnecessarily with manufacture and delivery of the concrete.

7. HANDLING AND MEASUREMENT OF MATERIALS

Materials shall be stockpiled and batched by methods that will prevent segregation or contamination of aggregates and insure accurate proportioning of the ingredients of the mix.

Except as otherwise provided in Section 8, cement and aggregates shall be measured as follows:

Cement shall be measured by weight or in bags of 94 pounds each. When cement is measured in bags, no fraction of a bag shall be used unless weighed.

Aggregates shall be measured by weight. Mix proportions shall be based on saturated, surface-dry weights. The batch weight of each aggregate shall be the required saturated, surface-dry weight plus the weight of surface moisture it contains.

Water shall be measured, by volume or by weight, to an accuracy within one percent of the total quantity of water required for the batch.

Admixtures shall be measured within a limit of accuracy of three percent.

8. MIXERS AND MIXING

Concrete shall be uniform and thoroughly mixed when delivered to the work. Variations in slump of more than 1 inch within a batch will be considered evidence of inadequate mixing and shall be corrected by increasing mixing time or other means.

For stationary mixers, the mixing time after all cement and aggregates are in the mixer drum shall be not less than 1-1/2 minutes. When concrete is mixed in a truck mixer, the number of revolutions of the drum or blades at mixing speed shall be not less than 70 nor more than 100.

Unless otherwise specified, volumetric batching and continuous mixing at the construction site will be permitted. The batching and mixing equipment shall conform to the requirements of ASTM Specification C 685 and shall be demonstrated prior to placement of concrete, by tests with the job mix, to produce concrete meeting the specified proportioning and uniformity requirements. Concrete made by this method shall be produced, inspected, and certified in conformance with Sections 6, 7, 8, 13, and 14 of ASTM Specification C 685.

No mixing water in excess of the amount called for by the job mix shall be added to the concrete during mixing or hauling or after arrival at the delivery point.

9. FORMS

Forms shall be of wood, plywood, steel or other approved material and shall be mortar tight. The forms and associated falsework shall be substantial and unyielding and shall be constructed so that the finished concrete will conform to the specified dimensions and contours. Form surfaces shall be smooth and free from holes, dents, sags or other irregularities. Forms shall be coated with a nonstaining form release agent before being set into place.

Metal ties or anchorages within the forms shall be equipped with cones, she-bolts or other devices that permit their removal to a depth of at least one inch without injury to the concrete. Ties designed to break off below the surface of the concrete shall not be used without cones.

All edges that will be exposed to view when the structure is completed shall be chamfered, unless finished with molding tools as specified in Section 18.

10. PREPARATION OF FORMS AND SUBGRADE

Prior to placement of concrete the forms and subgrade shall be free of chips, sawdust, debris, water, ice, snow, extraneous oil, mortar,

or other harmful substances or coatings and the temperature of all surfaces to be in contact with the new concrete shall be no colder than 40°F. Any oil on the reinforcing steel or other surfaces required to be bonded to the concrete shall be removed. Rock surfaces shall be cleaned by air-water cutting, wet sandblasting or wire brush scrubbing, as necessary, and shall be wetted immediately prior to placement of concrete. Earth surfaces shall be firm and damp. Placement of concrete on mud, dried earth or uncompacted fill or frozen subgrade will not be permitted.

Items to be embedded in the concrete shall be positioned accurately and anchored firmly.

Weepholes in walls or slabs shall be formed with nonferrous materials.

11. CONVEYING

Concrete shall be delivered to the site and discharged into the forms within 1-1/2 hours after the introduction of the cement to the aggregates. In hot weather or under conditions contributing to quick stiffening of the concrete, the time between the introduction of the cement to the aggregates and discharge shall not exceed 45 minutes.

The Engineer may allow a longer time, provided the setting time of the concrete is increased a corresponding amount by the addition of an approved set-retarding admixture. In any case, concrete shall be conveyed from the mixer to the forms as rapidly as practicable by methods that will prevent segregation of the aggregates or loss of mortar.

12. PLACING

Concrete shall not be placed until the subgrade, forms and steel reinforcement have been inspected and approved. No concrete shall be placed except in the presence of the Engineer. The Contractor shall give reasonable notice to the Engineer each time he intends to place concrete. Such notice shall be far enough in advance to give the Engineer adequate time to inspect the subgrade, forms, steel reinforcement and other preparations for compliance with the specifications. "Other preparations" includes but is not limited to the concrete mixing plant, delivery equipment system, placing and finishing equipment and system, schedule of work, workforce, heating or cooling facilities if applicable. Deficiencies are to be corrected before concrete is delivered for placing.

The concrete shall be deposited as closely as possible to its final position in the forms and shall be worked into the corners and angles of the forms and around all reinforcement and embedded items

in a manner to prevent segregation of aggregates or excessive laitance. Formed concrete shall be placed in horizontal layers not more than 20 inches thick. Concrete shall not be dropped more than five feet vertically unless suitable equipment is used to prevent segregation. Hoppers and chutes, pipes or "elephant trunks" shall be used as necessary to prevent segregation and the splashing of mortar on the forms and reinforcing steel above the layer of being placed.

Immediately after the concrete is placed in the forms, it shall be consolidated by spading, hand tamping or vibration as necessary to insure smooth surfaces and dense concrete. Each layer shall be consolidated to insure monolithic bond with the preceding layer. If the surface of a layer of concrete in place sets to the degree that it will not flow and merge with the succeeding layer when spaded or vibrated, the Contractor shall discontinue placing concrete and shall make a construction joint according to the procedure specified in Section 13.

If placing is discontinued when an incomplete horizontal layer is in place, the unfinished end of the layer shall be formed by a vertical bulkhead.

13. CONSTRUCTION JOINTS

Construction joints shall be made at the locations shown on the drawings. If construction joints are needed which are not shown on the drawings, they shall be placed in locations approved by the Engineer.

Where a feather edge would be produced at a construction joint, as in the top surface of a sloping wall, an insert form shall be used so that the resulting edge thickness on either side of the joint is not less than 6 inches.

In walls and columns, as each lift is completed, the top surfaces shall be immediately and carefully protected from any condition that might adversely affect the hardening of the concrete.

Steel tying and form construction adjacent to concrete in place shall not be started until the concrete has cured at least 12 hours. Before new concrete is deposited on or against concrete that has hardened, the forms shall be retightened. New concrete shall not be placed until the hardened concrete has cured at least 12 hours.

Surfaces of construction joints shall be cleaned of all unsatisfactory concrete, laitance, coatings or debris by washing and scrubbing with a wire brush or wire broom or by other means approved by the Engineer. The surfaces shall be kept moist for at least one hour prior to placement of the new concrete.

14. EXPANSION AND CONTRACTION JOINTS

Expansion and contraction joints shall be made only at locations shown on the drawings.

Exposed concrete edges at expansion and contraction joints shall be carefully tooled or chamfered, and the joints shall be free of mortar and concrete. Joint filler shall be left exposed for its full length with clean and true edges.

Preformed expansion joint filler shall be held firmly in the correct position as the concrete is placed.

When open joints are specified, they shall be constructed by the insertion and subsequent removal of a wooden strip, metal plate or other suitable template in such a manner that the corners of the concrete will not be chipped or broken. The edges of open joints shall be finished with an edging tool prior to removal of the joint strips.

15. WATERSTOPS

Waterstops shall be held firmly in the correct position as the concrete is placed. Joints in metal waterstops shall be soldered, brazed or welded. Joints in rubber or plastic waterstops shall be cemented, welded or vulcanized as recommended by the manufacturer.

16. REMOVAL OF FORMS

Forms shall not be removed without the approval of the Engineer. Forms shall be removed in such a way as to prevent damage to the concrete. Supports shall be removed in a manner that will permit the concrete to take the stresses due to its own weight uniformly and gradually.

17. FINISHING FORMED SURFACES

Immediately after the removal of the forms:

a. All fins and irregular projections shall be removed from exposed surfaces.

b. The holes produced on all surfaces by the removal of form ties, cone-bolts, and she-bolts shall be cleaned, wetted and filled with a dry-pack mortar consisting of one part portland cement, three parts sand that will pass a No. 16 sieve, and just sufficient water to produce a consistency such that the filling is at the point of becoming rubbery when the material is solidly packed.

18. FINISHING UNFORMED SURFACES

All exposed surfaces of the concrete shall be accurately screeded to grade and then float finished, unless specified otherwise.

Excessive floating or troweling of surfaces while the concrete is soft will not be permitted.

The addition of dry cement or water to the surface of the screeded concrete to expedite finishing will not be allowed.

Joints and edges on unformed surfaces that will be exposed to view shall be chamfered or finished with molding tools.

19. CURING

Concrete shall be prevented from drying for a curing period of at least 7 days after it is placed. Exposed surfaces shall be kept continuously moist for the entire period, or until curing compound is applied as specified below. Moisture shall be maintained by sprinkling, flooding or fog spraying or by covering with continuously moistened canvas, cloth mats, straw, sand or other approved material. Wood forms left in place during the curing period shall be kept continuously wet. Formed surfaces shall be thoroughly wetted immediately after forms are removed and shall be kept wet until patching and repairs are completed. Water or covering shall be applied in such a way that the concrete surface is not eroded or otherwise damaged.

Concrete, except at construction joints, may be coated with the approved curing compound in lieu of continued application of moisture, except as otherwise specified in Section 24. The compound shall be sprayed on the moist concrete surfaces as soon as free water has disappeared, but shall not be applied to any surface until patching, repairs and finishing of that surface are completed. The compound shall be applied at a uniform rate of not less than one gallon per 150 square feet of surface and shall form a continuous adherent membrane over the entire surface. Curing compound shall be thoroughly mixed before applying and continuously agitated during application. Curing compound shall not be applied to surfaces requiring bond to subsequently placed concrete, such as construction joints, shear plates, reinforcing steel and other embedded items. If the membrane is damaged during the curing period, the damaged area shall be resprayed at the rate of application specified above. Surfaces covered by the membrane shall not be trafficked unless protected from wear.

20. REMOVAL AND REPLACEMENT OR REPAIR

When concrete is honeycombed, damaged or otherwise defective, the Contractor shall remove and replace the structure or structural

member containing the defective concrete or, where feasible, correct or repair the defective parts. The Contracting Officer will determine the required extent of removal, replacement or repair. Prior to starting repair work the Contractor shall obtain the Contracting Officer's approval of his plan for effecting the repair. The Contractor shall perform all repair work in the presence of the Engineer.

21. CONCRETING IN COLD WEATHER

Concrete shall not be mixed nor placed when the daily minimum atmospheric temperature is less than 40°F unless facilities are provided to prevent the concrete from freezing. The use of accelerators or antifreeze compounds will not be allowed.

22. CONCRETING IN HOT WEATHER

The Contractor shall apply effective means to maintain the temperature of the concrete below 90°F during mixing, conveying and placing.

23. MEASUREMENT AND PAYMENT

For items of work for which specific unit prices are established in the contract, concrete will be measured to the neat lines shown on the drawings and the volume of concrete will be computed to the nearest 0.1 cubic yard. Measurement of concrete placed against the sides of an excavation without the use of intervening forms will be made only to the neat lines or pay limits shown on the drawings. No deduction in volume will be made for chamfers, rounded or beveled edges or for any void or embedded item that is less than 3 cubic feet in volume.

Payment for each item of concrete for minor structures will be made at the contract unit price or the contract lump sum, whichever is applicable, for that item. Such payment will constitute full compensation for all labor, materials, equipment, transportation, tools, forms, falsework, bracing and all other items necessary and incidental to the completion of the work, except items listed for payment elsewhere in the contract.

Compensation for any item of work described in the contract but not listed in the bid schedule will be included in the payment for the item of work to which it is made subsidiary. Such items and the items to which they are made subsidiary are identified in Section 24 of this specification.

24. ITEMS OF WORK AND CONSTRUCTION DETAILS

Items of work to be performed in conformance with this specification and the construction details are:

a. Bid Item 10, Side Inlet

(1) Bid Item 10 consists of furnishing, placing and curing the reinforced concrete side inlet, located at Station 1282+00, in accordance with the details on the plans.

(2) In Section 3, CLASSES OF CONCRETE, the class of concrete shall be 4000.

(3) In Section 18, FINISHING UNFORMED SURFACES, the surfaces of the 8 inch thick concrete slabs shall be finished with a broom finish.

(5) In Section 23, MEASUREMENT AND PAYMENT, payment for the side inlet will be by lump sum and will include compensation for Subsidiary Item, Welded Wire Fabric and Subsidiary Item, Standard Reinforcing Bars.

CONSTRUCTION SPECIFICATION

34. STEEL REINFORCEMENT

1. SCOPE

The work shall consist of furnishing and placing steel reinforcement for reinforced concrete or pneumatically applied mortar.

2. MATERIALS

Steel reinforcement shall conform to the requirements of Material Specification 539. Before reinforcement is placed, the surfaces of the bars and fabric and any metal supports shall be cleaned to remove any loose, flaky rust, mill scale, oil, grease or other coatings or foreign substances. After placement, the reinforcement shall be maintained in a clean condition until it is completey embedded in the concrete.

3. BAR SCHEDULE, LISTS AND DIAGRAMS

Any supplemental bar schedules, bar lists or bar-bending diagrams required to accomplish the fabrication and placement of reinforcement shall be provided by the Contractor. Prior to placement of reinforcement, the Contractor shall furnish four prints or copies of any such lists or diagrams to the Contracting Officer. Acceptance of the reinforcement will not be based on approval of these lists or diagrams but will be based on inspection of the reinforcement after it has been placed.

4. BENDING

Reinforcement shall be cut and bent in compliance with the requirements of the American Concrete Institute Standard 315. Bars shall not be bent or straightened in a manner that will injure the material. Bars with kinks, cracks or improper bends will be rejected.

5. SPLICING BAR REINFORCEMENT

Splices of reinforcement shall be limited to those locations shown on the drawings. Splice lengths shall be determined prior to fabrication and meet the requirements of ACI Standard 318 "Building Code Requirements for Reinforced Concrete" based upon design information contained in Section 10 of this specification. Bar placement drawings and schedules shall be provided for

approval prior to fabrication. The drawings shall show all splice locations, layouts, and lap distances.

6. SPLICING WELDED WIRE FABRIC

Unless otherwise specified, welded wire fabric shall be spliced in the following manner:

a. Adjacent sections shall be spliced end to end (longitudinal lap) by overlapping a minimum of one full mesh plus 2 inches plus the length of the two end overhangs. The splice length is measured from the end of the longitudinal wires in one piece of fabric to the end of the longitudinal wires in the lapped piece of fabric.

b. Adjacent sections shall be spliced side to side (transverse lap) a minimum of one full mesh plus 2 inches. The splice length shall be measured from the centerline of the first longitudinal wire in one piece of fabric to the centerline of the first longitudinal wire in the lapped piece of fabric.

7. PLACING

Reinforcement shall be accurately placed and secured in position in a manner that will prevent its displacement during the placement of concrete. Tack welding of bars will not be permitted. Metal chairs, metal hangers, metal spacers and concrete chairs may be used to support the reinforcement. Metal hangers, spacers and ties shall be placed in such a manner that they will not be exposed in the finished concrete surface. The legs of metal chairs or side form spacers that may be exposed on any face of slabs, walls, beams or other concrete surfaces shall have a protective coating or finish by means of hot dip galvanizing, epoxy coating, plastic coating, or be stainless steel. Metal chairs and spacers not fully covered by a protective coating or finish shall have a minimum cover of 3/4 inch of concrete over the unprotected metal portion except for those with plastic coatings may have a minimun cover of 1/2 inch of concrete over the unprotected metal portion. Precast concrete chairs shall be manufactured of the same class of concrete as that specified for the structure and shall have tie wires securely anchored in the chair or a V-shaped groove at least 3/4 inch in depth molded into the upper surface to receive the steel bar at the point of support. Precast concrete chairs shall be moist at the time concrete is placed.

High density or structural plastic rebar accessories, designed to insure maximum concrete bond, may be substituted for metal or concrete accessories in spacer applications as approved by the Contracting Officer. Exposure of plastic rebar accessories at the finished concrete surface shall be kept to a minimum. Plastic rebar accessories, if used, shall be staggered along adjacent parallel bars and shall be placed at intervals no closer than 12 inches. Plastic rebar accessories shall not be used in concrete sections 6 inches or less in thickness.

Reinforcement shall not be placed until the prepared site has been inspected and approved by the Engineer. After placement of the reinforcement, concrete shall not be placed until the reinforcement has been inspected and approved by the Engineer.

8. STORAGE

Steel reinforcement stored at the work site shall be placed above the ground surface on platforms, skids or other supports and protected from mechanical damage or corrosion.

9. MEASUREMENT AND PAYMENT

Compensation for any item of work described in the contract but not listed in the bid schedule will be included in the payment for the item of work to which it is made subsidiary. Such items to which they are made subsidiary are identified in Section 10 of this specification.

TABLE 34-1. STANDARD REINFORCING BARS

Bar Size No.	Wt. (lb./ft.)
3	0.376
4	0.668
5	1.043
6	1.502
7	2.044
8	2.670
9	3.400
10	4.303
11	5.313
14	7.65
18	13.60

TABLE 34-2. RECTANGULAR WELDED WIRE FABRIC1/

Style Designation By Steel Wire Gauge	Style Designation By W-Number	Weight, lb. Per 100 Sq. Ft.
6 x 6 - 10 x 10	6 x 6 - W1.4 x W1.4	21
6 x 6 - 8 x 8	6 x 6 - W2.1 x W2.1	30
6 x 6 - 6 x 6	6 x 6 - W2.9 x W2.9	42
6 x 6 - 4 x 4	6 x 6 - W4.0 x W4.0	58
4 x 4 - 10 x 10	4 x 4 - W1.4 x W1.4	31
4 x 4 - 8 x 8	4 x 4 - W2.1 x W2.1	44
4 x 4 - 6 x 6	4 x 4 - W2.9 x W2.9	62
4 x 4 - 4 x 4	4 x 4 - W4.0 x W4.0	85
4 x 12 - 8 x 12	4 x 12 - W2.1 x W0.9 2/	25
4 x 12 - 7 x 11	4 x 12 - W2.5 x W1.1 2/	31

1/ Style designation is defined in ACI Standard 315 of the American Concrete Institute.

2/ Welded smooth wire fabric with wires smaller than Size W1.4 is manufactured from galvanized wire.

10. ITEMS OF WORK AND CONSTRUCTION DETAILS

Items of work to be performed in conformance with this specification and the construction details are:

a. Subsidiary Item, Welded Wire Fabric

(1) This item shall consist of furnishing and installing all Welded Wire Fabric required to construct the Side Inlets.

(2) In Section 6, SPLICING WELDED WIRE FABRIC, the minimum overlapping shall be two (2) full meshes.

(3) No separate payment will be made for Wire Fabric. Compensation for this item will be included in Bid Item 10, Side Inlet.

b. Subsidiary Item, Standard Reinforcing Bars

(1) This item shall consist of furnishing and installing all standard reinforcing bars to construct the Side Inlet.

(2) No separate payment will be made for Standard Reinforcing Bars. Compensation for this item will be included in Bid Item 10, Side Inlet.

CONSTRUCTION SPECIFICATION

61. LOOSE ROCK RIPRAP

1. SCOPE

The work shall consist of the construction of loose rock riprap revetments and blankets, including filter layers or bedding where specified.

2. MATERIALS

Rock for loose rock riprap shall conform to the requirements of Material Specification 523 or, if so specified shall be obtained from designated sources. It shall be free from dirt, clay, sand, rock fines and other materials not meeting the required gradation limits.

At least 30 days prior to delivery of rock from other than designated sources, the Contractor shall designate in writing the source from which he intends to obtain the rock and information satisfactory to the Contracting Officer that the material meets the requirements of the contract. The Contractor shall provide the Engineer free access to the source for the purpose of obtaining samples for testing. The size and grading of the rock shall be as specified in Section 9 of this specification.

Rock from designated sources shall be excavated, selected and processed as necessary to meet the quality and grading requirements in Section 9 of this specification. The rock shall conform to the specified grading limits when installed in the riprap.

Filter or bedding materials when required, shall, unless otherwise specified, conform to the requirements of Material Specification 521.

3. SUBGRADE PREPARATION

The subgrade surfaces on which the riprap or bedding course is to be placed shall be cut or filled and graded to the neat lines and grades shown on the drawings. When fill to subgrade lines is required, it shall consist of approved materials and shall conform to the requirements of the specified class of fill.

Riprap shall not be placed until the foundation preparation is completed and the subgrade surfaces have been inspected and approved by the Engineer.

4. EQUIPMENT-PLACED ROCK RIPRAP

The rock shall be placed by equipment on the surfaces and to the depths specified. The riprap shall be constructed to the full course

thickness in one operation and in such a manner as to avoid serious displacement of the underlying materials. The rock shall be delivered and placed in a manner that will insure that the riprap in place shall be reasonably homogeneous with the larger rocks uniformly distributed and firmly in contact one to another with the smaller rocks and spalls filling the voids between the larger rocks.

Riprap shall be placed in a manner to prevent damage to filter fabric or bedding. Hand placing will be required to the extent necessary to prevent damage to the permanent works. The maximum allowable drop of rock onto filter fabric is three feet.

5. HAND-PLACED RIPRAP

The rock shall be placed by hand on the surfaces and to the depths specified. It shall be securely bedded with the larger rocks firmly in contact one to another. Spaces between the larger rocks shall be filled with smaller rocks and spalls. Smaller rocks shall not be grouped as a substitute for larger rock. Flat slab rock shall be laid on edge.

6. FILTER LAYERS OR BEDDING

When the drawings specify a filter layer and bedding beneath riprap, the filter and bedding material shall be spread uniformly on the subgrade surfaces to the depth specified. Compaction of bedding will not be required, but the surface shall be finished reasonably free of mounds, dips or windrows.

7. TESTING

The Engineer will perform such tests as are required to verify that the riprap, filter, and bedding materials and the completed work meet the requirements of the specifications. These tests are not intended to provide the Contractor with the information he needs to assure that the materials and workmanship meet the requirements of the specifications, and their performance will not relieve the Contractor of the responsibility of performing his own tests for that purpose.

8. MEASUREMENT AND PAYMENT

For items of work for which specific unit prices are established in the contract, the volume of riprap will be measured within the specified limits and computed to the nearest cubic yard by the method of average cross-sectional end areas. Payment for riprap will be made at the contract unit price for riprap. Payment for filter or bedding will be made at the contract unit prices for filter or bedding. Such payment will be considered full compensation for all labor, materials,

equipment and all other items necessary and incidental to the completion of the riprap, filter layer and bedding.

Compensation for any item of work described in the contract but not listed in the bid schedule will be included in the payment for the item of work to which it is made subsidiary. Such items and the items to which they are made subsidiary are identified in Section 9 of this specification.

9. ITEMS OF WORK AND CONSTRUCTION DETAILS

Items of work to be performed in conformance with this specification and the construction details are:

a. Bid Item 4, Loose Rock Riprap and Bid Item 5, ABC Bedding

(1) Bid Item 4 consists of furnishing and placing all riprap, with loose soil cover, between Stations 1160+32.10 and 1208+04.42; 1215+00 and 1234+89; 1249+80 and 1314+97; 1315+46 and 1367+40; 1368+40 and 1381+02; 1395+40 and 1401+40.85; 1414+95 and 1430+63; 1431+12 and 1450+50; as shown on the drawings.

Bid Item 5 consists of furnishing and placing ABC bedding for riprap and as gravel cover on the floodway slopes, channel bottom, O&M roads, and maintenance ramps, and to the limits and thicknesses shown on the plans.

(2) The rock shall be graded as follows:

Particle Size (Inch)	Percent Passing (by Dry Weight)
8	100
6	60 - 100
3	0 - 30
1	0 - 5

(3) The ABC bedding shall be graded as follows:

Sieve Size	Percent Passing (by Dry Weight
1 1/8"	100
#4	38 - 65
#8	25 - 60
#30	10 - 40
#200	3 - 12

(4) In Section 3, SUBGRADE PREPARATION, no subgrade preparation is required. ABC bedding shall be placed directly on the existing rilled slope or on the compacted earthfill and compacted to the lines and grades as indicated on the drawings.

(5) In Section 6, FILTER LAYERS OR BEDDING, compaction of ABC bedding is required. Compaction shall be accomplished with a minimum of two (2) complete passes over the entire surface area by equipment having a minimum empty weight of 25,000 pounds or two (2) complete passes over the entire surface area by approved equipment designed specifically for the compaction of earthfill materials.

(6) In Section 7, TESTING, ABC bedding shall meet the following requirements:

(a) Percentage of Wear: When tested in accordance with ASTM C-131, the percentage of wear shall not exceed 40 percent after 500 revolutions.

(b) Plasticity Index: When tested in accordance with AASHTO T-90, the plasticity index shall not be more than five (5).

(c) Liquid Limit: When tested in accordance with AASHTO T-89, the liquid limit shall not be more than 25 percent.

(7) The Contractor shall install a four (4) inch ABC bedding cover on any O&M road before using that road as a haul road for project purposes. The cover shall be compacted and maintained in good, level condition during project use and shall be left to the thickness and neat line and grade indicated on the plans.

(8) The ABC bedding material, when being placed, shall contain sufficient moisture that when a small portion is taken in the hand and squeezed, it remains intact when released and does not leave free water on the palm of the hand.

(9) Rock shall be either hand or equipment placed and shall not be pushed or rolled around on the filter fabric.

(10) The Contractor shall place a three-inch minimum layer of loose soil over all riprap surfaces. The soil layer shall not be placed on any section of riprap until the Engineer has approved that section. The loose soil to be installed shall be from material excavated for construction along the toe of slope, or from the center 50 feet of channel bottom. Excavation within the center 50 feet of the channel bottom shall not extend down more than one foot below design (as-built) channel grade, except as otherwise approved by the Engineer.

(11) Measurement and Payment will be in accordance with the requirements of Section 8 and will include compensation for subsidiary items: Pollution Control and Earthfill, Class C. Payment for Item 5 will include compensation for Subsidiary Item, Water.

CONSTRUCTION SPECIFICATION 94

CONTRACTOR INSPECTION

1. SCOPE

The work shall consist of developing, implementing, and maintaining a quality control system to ensure that the specified quality is achieved for all materials and work performed. The work shall include all equipment, materials, labor and services necessary to implement and maintain the quality control system throughout the duration of the work.

2. EQUIPMENT AND MATERIALS

Equipment and materials for quality control shall be of the quality and condition required to meet the test specifications cited in the contract references. Testing equipment shall be properly adjusted and calibrated at the start of operations and the calibration maintained at the frequency specified. Records of equipment calibration tests shall be available to the Contracting Officer at all times. Where specific requirements exist, equipment shall be operated and maintained by qualified operators. All equipment and materials used in performing quality control testing shall be as prescribed by the test standards referenced in the contract.

Equipment and materials shall be handled and operated in a safe and proper manner complying with all applicable state and federal regulations pertaining to their use, operation, handling and transportation.

3. QUALITY CONTROL SYSTEM

The Contractor shall develop, implement and maintain a system adequate to achieve the specified quality of all work performed, material incorporated and equipment furnished. The system established shall be documented in a written plan developed by the Contractor and approved by the Contracting Officer. The system activities shall include the material testing and inspection work needed to verify the adequacy of completed work and procedures to be followed when corrective action is required. Daily Records to substantiate the conduct of the system shall be maintained by the Contractor. The quality control plan shall cover all aspects of quality control and shall address, as a minimum, any specified testing and inspection requirements. The system provided shall be consistent with the planned performance in the Contractor's approved construction schedule. The system shall identify the Contractor's on-site quality control manager and provide an organizational listing of all quality control personnel and their specific duties. The system shall be submitted to the Contracting Officer within 15 calendar days after notice of award.

4. QUALITY CONTROL PERSONNEL

Quality control activities shall be accomplished by qualified personnel. The Contractor shall identify and furnish to the Contracting Officer, for approval, the names, qualifications, experience and availability of all personnel who will perform the quality control activities.

5. POST-AWARD CONFERENCE

The Contractor shall meet with the Contracting Officer prior to beginning any work and discuss the Contractor's written quality control plan. The Contracting Officer and the Contractor shall develop a mutual understanding regarding the quality control plan. The finalized plan will be approved by the Contracting Officer.

6. Records

The Contractor's quality control Records shall be kept daily and shall document both acceptable and deficient features of the work. All Records shall be on forms approved by the Contracting Officer and shall be legible.

Records shall include but are not limited to the following:

a. The material or item tested, or inspection performed.

b. Date and time of tests or inspections.

c. Type and number of quality control activities and tests involved.

d. The location and extent of work inspected or tested.

e. Test results and description of conditions observed during the quality control activities.

f. Method of testing used (e.g., citation of reference specification).

g. Nature of defects, specifications not met, etc.

h. Proposed corrective action, and reason for corrective action.

i. Corrective actions taken and supporting quality control recertification testing.

j. Signature of authorized testing or inspecting official with appropriate checkers verification.

k. Manufacturers' recommendations and certifications if any.

l. Documentation of material delivered including quantity, location stored, and results of examinations citing applicable construction, material and reference specification.

m. Documentation of shop drawings including date submitted to and date approved by the Contracting Officer, and results of examinations citing applicable construction, material and reference specifications and construction drawings.

n. Date of the Records creation.

7. REPORTING RESULTS

The results of contractor quality control inspections and tests shall be communicated to the Contracting Officer's representative immediately upon completion of the inspection or test.

8. SUBMITTAL OF Records

An original plus one copy of all Records shall be submitted to the Contracting Officer's representative within one working day of the completion of the inspection or test.

9. ACCESS

The Contracting Officer and the Contracting Officer's representatives shall be given free access to all testing equipment, facilities, sites, and related Records.

10. MEASUREMENT AND PAYMENT

For items of work for which lump sum prices are established in the contract, payment will be made as the work proceeds, after presentation of invoices by the Contractor showing their costs. If the total of such payments are less than contract lump sum for this item, the unpaid balance will be included in final contract payment. Total payment will be the lump sum contract price for this item, regardless of actual cost to the Contractor.

Payment will not be made under this item for the purchase cost of materials and equipment having a residual value.

Payment of the lump sum contract price for contractor quality control will constitute full compensation for all labor, materials, equipment, transportation, and all other items necessary and incidental to completion of the work.

Compensation for any item of work described in the contract but not listed in the bid schedule will be included in the payment for the item of work to which it is made subsidiary. Such items and the items to which they are made subsidiary are identified in Section 11.

11. ITEMS OF WORK AND CONSTRUCTION DETAILS

Items of work to be performed in conformance with this specification and the construction details are:

a. Bid Item 9, Contractor Inspection

(1) This item shall consist of furnishing the personnel, equipment and material required by the Contractor to perform the testing and inspection that is necessary to implement an inspection system that will insure the specified quality is being maintained for:

a. Construction Surveys
b. Excavation
c. Earthfill
d. Loose Rock Riprap
e. ABC Bedding
f. Geotextiles
g. Soil Cement

(2) In Section 2, EQUIPMENT AND MATERIALS, equipment and materials needed for materials testing shall be calibrated at the specified frequency given in the appropriate materials testing standards. Records of all calibrations shall be submitted to the Engineer within three (3) days of the calibration.

(3) In Section 3, QUALITY CONTROL SYSTEM, the Contractor's Quality Control System shall provide the degree of inspection and testing necessary to ensure that the specified quality is maintained on all work performed.

The Contractor shall describe his Quality Control System in writing and submit three (3) copies of the written plan to the Engineer five (5) days prior to the Pre-Construction Conference.

The written plan will also describe how the Contractor intends to monitor the work, establish the frequency or timing of testing and inspection and the procedure used for selecting the work to be tested.

The Quality Control System will also include inspections and materials testing as follows:

(a) Inspection of construction staking to ensure their accuracy.

(b) Inspection of all excavation to ensure that it is constructed to the lines and grades shown on the drawings.

(c) Moisture density determinations required for the quality control of earthfill shall be performed in accordance with Method A, ASTM D 698 (Standard Proctor Test) or Test No. S-6 (Rapid Compaction Control Method) as described in Section 19 of the SCS National Engineering Handbook. Testing for densities of fill shall be determined in accordance with ASTM Method D-1556 and the moisture content by ASTM D-2216.

For earthfill production operations the initial moisture density test frequency shall be one (1) test per 500 cubic yards of compacted earthfill. When approved by the Contracting Officer, the testing frequency may be modified as the job progresses, provided the quality of the fill is consistent or when the testing frequency is not compatible with the daily production.

(d) Rock proposed for use as riprap shall be initially tested for bulk specific gravity, absorption and soundness, all in accordance with MS 532. Rock for Riprap, and shall meet the requirements of that specification. Additional tests will not be required if the initial tests are satisfactory, unless the source of rock changes or there is a visually obvious change in quality of the rock.

The rock gradation shall first be tested at the source for approval by the Contracting Officer. Subsequent gradations of in-place riprap shall be performed at a frequency of one per 5,000 cubic yards until the Contracting Officer determines that the frequency can be modified.

(e) Crushed aggregate for ABC bedding shall be initially tested for gradation and soundness. Processed aggregate shall be initially tested for gradation, percentage of wear, plasticity index and liquid limit. After the material has been approved for use, gradation tests and inspections shall be continued to verify that the finished and/or imported materials are within the specified limits. During placement operations one sieve analysis of the in-place ABC will be performed for each 1,500 tons placed. Sieve analyses will be performed at more frequent intervals whenever the tested in-place

material does not meet the gradation requirements, or visual inspection indicates the need to increase the frequency. The other tests need not be performed again unless the source of material is changed.

(f) Initial testing of geotextiles, when required by the Contracting Officer, includes tests for tensile strength, bursting strength, elongation, puncture, ultra violet light resistance and apparent opening size (AOS). Subsequent testing may be required if there is a change in the geotextile being furnished, or other tests or observations indicate the required quality is not being maintained.

(g) All materials proposed for use in mixing soil cement shall be tested, and a "job mix" designed in accordance with the specifications.

Moisture-density determinations required for quality control of soil cement shall be performed in accordance with Method B, ASTM D558 or Test No. S-6 (Rapid Compaction Control Method) as described in Section 19 of the SCS National Engineering Handbook. Testing for densities of soil cement shall be determined in accordance with ASTM D1556 (sand cone) or ASTM D2922 and D3017 (nuclear) methods. The moisture content shall be determined by ASTM D2216 with an oven dry temperature of 60±5 degrees C.

For production operations the initial moisture density tests shall be used to determine adequate compaction procedures. Test frequency thereafter shall be one test per 100 cubic yards of compacted soil cement.

(4) The Contractor shall designate an experienced quality control manager and inspection staff whose primary responsibility will be implementing the inspection system. The manager shall be on site during major construction activities and will not be involved in directing production oriented activities unless it pertains to achieving the specified quality for the work being performed. The quality control manager shall be employed by and answerable to the Contractor. The manager's duties cannot be delegated to a subcontractor or others.

(5) Copies of all test results and inspection reports (including visual inspections of earthwork, and placement of ABC bedding, geotextile, riprap and soil cement), required by the approved inspection plan shall be submitted to the Contracting Officer within 24 hours of when the test or inspection report is completed and certified.

CONSTRUCTION SPECIFICATION

203 GEOTEXTILES

1. SCOPE

This work shall consist of furnishing all materials, equipment, and labor necessary for the installation of geotextiles.

2. MATERIALS

Geotextile materials shall conform to the requirements of Material Specification 303 and Section 7 of this specification.

3. STORAGE

Prior to use, the geotextile shall be stored in a clean dry place, out of direct sunlight, not subject to extremes of either hot or cold, and with the manufacturer's protective cover in place.

4. SURFACE PREPARATION

The surface on which the geotextile is to be placed shall be graded to the neat lines and grades as shown on the drawings. The surface shall be reasonably smooth, free of holes, depressions, and projections. Excessively wet, muddy conditions shall be dewatered where geotextiles are to be placed against an excavation or prepared slope. The surface preparation will be inspected and approved by the Engineer prior to placing the geotextile.

5. PLACEMENT

A. General

The geotextile shall be placed in intimate contact with the approved prepared surface at the locations and in accordance with the details shown on the drawings and specified in Section 7. The geotextile shall be unrolled along the placement area and loosely laid (not stretched) in such a manner that it will conform to the surface irregularities when the stone or other material is placed on or against it. No cuts or punctures will be permitted in the geotextile unless otherwise specified. The geotextile may be folded and overlapped to permit proper placement in the designated area.

When specified in Section 7, the geotextile shall be provided in panels. Seams of the geotextile shall be machine sewn with thread of a material meeting the chemical requirements specified by the manufacturer. The panels shall be manufactured at the factory for the size specified.

The orientation of the width and length of the geotextile panels shall be as shown on the drawings. (NOTE: Alternate panel sizes may be submitted for approval.) The length shall be placed parallel to the direction of water flow unless otherwise indicated on the drawings. The end roll details shall be as shown on the drawings or as specified in Section 7. The minimum overlap shall be 18 inches unless otherwise specified. Field sewing can be used in lieu of overlap seams. If field sewing is used, two rows of stitching, located at least three inches from the edge shall be provided. Thread shall meet the chemical requirements specified by the manufacturer.

Securing pins, provided by the geotextile manufacturer, shall be placed along the edge of the geotextile to adequately secure it during placement. Pins shall be steel or fiberglass formed as a "U", "L", or "T" shape or contain "ears" to prevent total penetration. Washers shall be provided on all but the "U" shaped pins. At vertical laps, securing pins shall be inserted through both layers along a line through the approximate midpoint of the overlap. At horizontal laps and laps across slopes, securing pins shall be inserted through the bottom layer only. Securing pins shall be placed along a line approximately 2 inches in from the edge of the outer limits of the placed geotextile at intervals not greater than 12 feet unless otherwise specified. Additional pins shall be installed as necessary to prevent any slippage of the geotextile, regardless of locations. The use of securing pins shall be held to the minimum necessary. Pins shall be left in place unless otherwise specified. The geotextile may be secured with other methods when specified.

Unless otherwise specified in Section 7, material shall not be dropped on uncovered geotextile from a height greater than three feet.

B. Slope Protection

The geotextile shall not be placed until it can be anchored and protected with the intended covering within 48 hours. If this is not practical, temporary cover, for protection from ultraviolet light, may be used as approved by the Engineer.

C. Subsurface Drains

The geotextile shall not be placed until drainfill or other material can be used to cover it within the same working day. Drainfill material shall be placed in a manner that prevents damage to the geotextile.

D. Road Stabilization

The geotextile shall be unrolled parallel to the roadway centerline, and loosely laid (not stretched) in a manner that it will conform to the surface irregularities when the gravel or other fill material is placed on it. Unless otherwise specified, the minimum overlap of geotextile shall be 24 inches for unsewn laps. Securing pins, provided by the geotextile manufacturer, may be used when necessary, to insure temporary anchoring of the geotextile during the installation process. The pins shall be removed prior to permanent backfilling.

The gravel or select backfill shall be dumped and spread in a uniform thickness generally not to exceed 9 inches after compaction. The first 2 or 3 lifts may be used to cover the geotextile and receive only light compaction. Overstressing the soil and sever rutting shall be avoided by utilizing equipment in spreading and dumping that exerts only moderate pressures on the soil. Backfill depths may have to be increased and equipment loads reduced to control soil stress. Ruts developed during spreading and compacting shall be filled with additional backfill material so that backfill thickness can be maintained.

6. MEASUREMENT AND PAYMENT

For items of work for which specific unit prices are established in the contract, the quantity of geotextile placed within the specified limits will be determined to the nearest unit area by computing the area covered. Payment for the geotextile will be made at the contract unit price. Such payment will be considered full compensation for all labor, materials, equipment, (including specified overlaps and anchorages, as shown on the drawings), and other incidental items necessary for the completion of the work.

Compensation for any item of work described in the contract but not listed in the bid schedule will be included in the payment for the item of work to which it is made subsidiary. Such items and the items to which they are made subsidiary are identified in Section 7 of this specification.

7. ITEMS OF WORK AND CONSTRUCTION DETAILS

Items of work to be performed in conformance with this specification and construction details are:

a. Bid Item 6, Geotextiles

(1) This item consists of providing and installing Class I nonwoven geotextile filter fabric between the ABC bedding and the riprap, in accordance with this specification and the drawings.

(2) In Section 5, PLACEMENT, other manufacturer's recommended methods of securing the geotextile during construction will be permitted.

(3) Repair or replace all torn, punctured or otherwise damaged geotextiles. Repair by placing a patch of the specified geotextile over the affected area. The patch shall overlap the damaged area a minimum of three feet in all directions.

(4) Geotextile shall be placed parallel to the centerline of channel. Ends of rolls shall be staggered.

CONSTRUCTION SPECIFICATION

206 SOIL-CEMENT

1. SCOPE

The work shall consist of the furnishing, placing, compacting, and curing a mixture of soil material, Portland cement and water. The mixture shall be uniformly mixed, blended, compacted, finished and cured as specified. It shall conform to the lines, grades, thicknesses, and cross section(s) shown on the plans.

2. MATERIALS

Soil materials shall be obtained from the required excavations or designated borrow locations and shall meet the requirements stated below.

Deleterious materials such as sod, brush, or roots shall be separated from soil materials during the selection, blending, and routing operations. Maximum size of rock particles shall be 2 inches. Soil materials, cement content, and moisture content other than those specified in Section 15 may be used as approved by the Engineer. Proposed alternatives must meet one of the following requirements to be considered:

a. If the soil material to be used has similar gradation and Atterberg limits as the soils specified, the same cement content and water content shall be used. The Contractor shall provide gradation and Atterberg test data from a reputable commercial soil testing laboratory verifying gradation and Atterberg limits.

b. If the soil materials do not have the same gradation and Atterberg limits as the soils specified, the Contractor shall provide soil-cement durability tests, moisture density relations data, Atterberg limits and gradation tests from a reputable commercial soil testing laboratory. The soil-cement mix ratio and water content shall also be provided by the lab. As a minimum, the following durability tests shall be provided: ASTM D 559 and ASTM D 560. The moisture density relations are to be in accordance with ASTM D 558. The tests must indicate a soil-cement of a quality equal to or exceeding the quality specified.

Portland cement shall conform to the requirements of Material Specification 531 for the specified type. Mixing of different brands or types of cement will not be allowed.

Portland cement shall be furnished in sacks, barrels, or bulk. Sacked cement that is stored at the job site shall be used in the same order as the deliveries to the site. Each shipment of sacked cement shall

be stored so that it may be readily distinguished from other shipments. Emptied cement sacks shall be burned or buried in accordance with Construction Specification 5 unless otherwise specified.

Water used in mixing or curing soil-cement shall be clean and free from injurious amounts of oil, acid, alkali, organic matter or other deleterious substances and shall meet the requirements for water as specified in ASTM C 94.

Pozzolanic Materials, if used, shall comply with requirements of ASTM C 618 Class F, Specifications for Fly Ash, and Raw or Calcined Natural Pozzolan, except the loss of ignition shall not exceed 3.0 percent.

Curing compounds shall conform to the requirements of Material Specification 534 for the type of curing compound specified. A liquid petroleum asphalt curing material may be used as specified in Section 15. Application of the curing compound shall be in accordance with Section 12 of this specification and the manufacturer's recommendations.

3. OPERATIONS OF PITS OR STOCKPILES OF SOIL MATERIALS

All work involved in the opening and/or operation of borrow pits or stockpiles shall be performed by the Contractor. The pits or stockpiles shall be opened in such a manner as to expose a near vertical face of the soil material for a suitable working depth. The face should not exceed five feet in height without benching back if it poses a threat to workers.

Material shall be excavated in successive vertical cuts extending across the pit or stockpile. When approved by the Engineer, successive horizontal cuts on a horizontal oriented working face may be permitted in homogeneous soils. All pockets or strata of unsuitable materials not meeting the quality requirements specified in Section 2 shall be wasted. The method of operating the pit or stockpile and the blending of materials shall be changed when such action is necessary to obtain material conforming to the specifications. Upon completion of the work, the pits shall be graded and dressed to minimize erosion and drain freely.

4. FOUNDATION PREPARATION

Before soil-cement processing begins, the subgrade placement area shall be graded, shaped, and compacted in conformance with the lines and grades shown on the plans. The subgrade shall firmly support the construction equipment. Immediately prior to the placement of the soil-cement, the compacted subgrade surface shall be moistened to approximately the same moisture content as specified for the soil-cement, and shall be kept moist until the soil cement is placed.

5. DESIGN OF SOIL-CEMENT MIXTURE

General - The materials and proportion of the soil-cement mixture shall constitute the "job mix". After a job mix has been approved, neither the source, character or grading of the soil nor the type, brand, or quantity of cement or pozzolanic material shall be changed without prior approval of the Engineer. A change in materials or proportions requires the establishment of a new job mix supported by evidence, as required for the initial job mix, that the proposed new materials and mix proportions will produce soil-cement of the strength specified.

The use of calcium chloride or other accelerators or antifreeze compounds will not be allowed unless approved by the Engineer.

The Contractor shall determine the mix proportions and submit the job-mix design, along with the supporting test results to the Engineer for his approval prior to incorporating any of the material into the work. The brand of cement and the location of the soil material source shall be included with the job-mix design data. The mix design shall be such that the soil-cement meets or exceeds the minimum compressive strength specified. A new mix design shall be submitted for approval any time the Contractor requests a change in materials or a proportioning of materials from that given in the approved mix design. In no case will the Engineer's review and approval of a mix design relieve the Contractor of responsibility to provide soil-cement meeting the contract specifications.

The percent of cement to be used in the mix will be determined by dividing the weight of cement by the oven dry weight of the soil material.

6. MIXING

The mixing plant shall be capable of producing a uniform mixture of soil, cement, and water. The plant shall be equipped with measurement devices that will proportion the mix in the specified quantities. Prior to use, all measurement devices shall be calibrated and certified by a technician approved by the Engineer. The actual quantities of the mix shall not vary more than 2 percent from the specified quantities, unless otherwise specified. The water content shall be percentage of moisture in the mixture at the time of compaction.

The Engineer shall have free access to the mixing plant at all times for inspection of the plant's operation and for sampling the soil-cement mixture and its components.

Method 1 Mixing of the soil, cement, and water shall be accomplished in a stationary mixing plant. The plant may be either a batch type of a continuous flow type design. The plant may use either weight or

volume proportioning. The scale or metering devices shall be sensitive to one percent of the maximum load that may be required or imposed. The mixer shall be a pugmill, revolving blade or rotary drum system.

Facilities for efficiently storing, handling and proportioning unmixed materials shall be provided at the plant.

Method 2 Mixing of the soil, cement and water shall be accomplished in a truck mixer. The mixer shall meet the requirements for truck mixers contained in ASTM C94.

The following provisions apply to all methods of mixing. The mixing time shall be controlled so that all ingredients shall be mixed for at least 30 seconds or longer as may be necessary to insure a thorough, uniform and homogeneous mixture of soil, cement, pozzolanic materials (if used) and water. Mixing time may be adjusted based on tests and field determinations. The mixing time shall be considered as the interval between the time and cement contacts the soil and water and the time the mixture leaves the mixing unit or when the mixer speed is reduced to the agitating speed. The soil and cement shall be mixed sufficiently to prevent cement balls from forming before the water is added. The water may be applied throughout the mixing machine or separately by approved pressure distributing equipment.

Soils containing plastic silt or clay lumps larger than 1 inch shall be pulverized or screened out of the raw soil prior to mixing.

7. TRANSPORTING

The soil-cement mixture shall be transported from the mixing plant to the site of placement in vehicles having tight, clean and smooth beds or mixer trucks. Haul time shall not exceed 30 minutes. Haul time shall be the elapsed time form when the water and cement are mixed together and the mixture is spread onto the foundation or soil cement surface.

The Contractor shall protect the soil-cement mixture if transported during unfavorable weather. Any material excessively wet by precipitation will be subject to rejection.

Equipment shall not be operated on a finished and compacted layer of the soil-cement, except where specifically permitted. Any damage resulting from the finished surfaces of the soil-cement from such operation shall be repaired by the Contractor at no cost to the Government.

Earth ramps crossing over completed soil-cement must have a minimum compacted thickness of two (2) feet. Where ramps are constructed over soil-cement that is not to finished grade, all foreign materials and

the uppermost one (1) inch of the top layer of soil-cement must be removed prior to the continuation of the soil-cement construction.

8. PLACEMENT

Soil-cement shall not be placed until the required excavations and preparation of the foundation are completed and the foundation has been inspected and approved by the Engineer.

Equipment for spreading the soil-cement mixture shall be suitable for the purpose and shall be operated in such a manner as to produce a reasonably smooth, uniform surface. The equipment shall be controllable so as to produce uniform layers not more than the specified maximum thickness. The layer of soil- cement, or each successive lift when layering is required, shall be spread and compacted as soon as possible after the preceding layer is completed and approved. Soil-cement shall be placed in horizontal layers or layers conforming to the plane of the subgrade.

If the time elapsed between completion of compaction on a layer and start of placement of the next layer is greater than two (2) hours, the Contractor shall scarify the surface to a depth of one (1) inch. The Contractor shall clean off the scarified surface thoroughly by power brooming or other approved methods prior to proceeding. The broomed surface shall then be thoroughly moistened over its entire surface before the next layer of soil-cement is placed.

Soil-cement shall not be mixed or placed when the air temperature is below 45 degrees F. Soil-cement shall not be placed on a frozen foundation, or if the soil to be processed is frozen, or if weather conditions are such that the material being processed cannot be completely compacted and protected before the onset of damaging weather (such as overnight lows below 40 degrees F, cold fronts, rainstorms, etc.) . The use of accelerators or antifreeze compounds will not be allowed, unless otherwise specified. The temperature of fresh soil-cement shall not be allowed to drop below 32 degrees F for a period of seven (7) days. If temperatures are expected to be below 45 degrees F, the Contractor's method for protection shall be approved by the Engineer prior to placement of any soil-cement.

9. COMPACTION

a. Equipment- The Contractor may use any type of compaction equipment to obtain the specified density of the soil cement mixture, provided such equipment does not have any projections or tamping feet which penetrate to previously compacted layers. Wheel rolling with only the hauling equipment shall not be an acceptable method of compaction.

b. Compaction Requirements - Soil- cement shall be uniformly compacted to a density not less than the minimum density specified. Optimum moisture and maximum density shall be determined by ASTM D 558. Soil Conservation Service Test No. S-6 (USBR Test E-25), Rapid Compaction Control Method, as referenced in NEH-19, may be used as equivalent to ASTM D 588. The compaction shall begin on all areas within 30 minutes after the addition of water to the soil-cement mixture. The compaction shall proceed in such a manner that the length of time between spreading of the soil-cement mixture and completion of compaction shall not exceed 1 hour for each layer.

c. Other Requirements - If the surface of a layer of soil-cement has been rutted or compacted unduly by hauling or other equipment, the Contractor shall scarify and recompact such surfaces. When required to maintain uniformity of the layer surface, blading in connection with compaction operations shall be employed. If blading is required, raw unmixed soil shall not be bladed onto the mixed soil cement.

10. CONSTRUCTION JOINTS

At the end of each workday, or when the adjacent placing operation is shut down for a period longer than 2 hours, a vertical construction joint shall be made along all unfinished edges of the thoroughly compacted soil-cement. Just before placing operations are resumed, the construction joint shall be shaved to remove all dry soil-cement and all curing compound from the face of the joint.

11. REMOVAL AND REPLACEMENT

Rejected or defective soil-cement shall be removed and replaced in accordance with these specifications, when:

a. Compaction operations are interrupted for any reason prior to the completion of compaction and the soil-cement mixture is left undisturbed for more than 30 minutes.

b. The soil-cement mixture, prior to completion of compaction, becomes excessively wet so that the moisture content exceeds the specified limits.

c. The compacted soil-cement does not meet the density and moisture requirements; except that when the moisture is lower than required, the soil cement mixture may be reworked, thoroughly mixed and compacted within the one (1) hour time limit as stated in Section 9. (b)., Compaction Requirements.

d. The finished surface is rough or below grade such that a thin "scab" section would be required to smooth the surface or bring the surface to grade.

12. PROTECTING AND CURING

a. Moistening Bonding Surfaces - Compacted surfaces of soil-cement that are to receive an overlying layer of soil-cement or concrete shall be kept moist, until placement of the overlying or adjacent layer of soil-cement or concrete. The Contractor will not be required to keep such surfaces moistened for longer than seven (7) days.

b. Curing Finished Exposed Surfaces - Concrete curing compound conforming the ASTM C 309 of the type specified shall be applied at a rate of not less than 1 gallon per 150 square feet of surface using constantly agitating, pressure spray equipment. It shall form a uniform, continuous, adherent film that shall not check, crack, or peel.

Any curing membrane that is removed from the surface or damaged within seven (7) days after application shall be repaired immediately. The surfaces of each section of soil-cement to be treated with curing compound shall be moistened with a light spray or water immediately after the section has been compacted. As soon as the surface film of moisture disappears, but while the surface still has a damp appearance, the curing compound shall be applied. Special care shall be taken to insure ample coverage with the compound at edges, corners and around rough spots. After application of the curing compound has been completed and the coating is dry to the touch, any required repair of the soil cement surfaces shall performed. Each repair, after being finished, shall be moistened and coated with curing compound in accordance with foregoing requirements. The Contractor shall have all equipment and materials required for curing at the site ready for use before placement of soil-cement begins.

13. INSPECTION AND TESTING

The Engineer shall make such inspections and tests as necessary to verify that the soil-cement materials and soil-cement in place meet the specified requirements.

All testing of soil-cement or its individual components, unless otherwise specified, will be in accordance with the latest applicable ASTM Specifications. These tests are not intended to provide the Contractor with information he needs to assure that the material and workmanship meets the requirements of the specifications and their performance will not relieve the Contractor of the responsibility of performing tests for that purpose.

Tests for density and moisture will be performed at any location chosen by the Engineer. If the soil cement-does not pass the minimum

moisture and density requirements specified, it shall be reworked or removed at the Contractor's expense. The Contractor shall not place any additional soil-cement until the rejected material has been removed, or reworked, and meets the density requirements specified.

14. MEASUREMENT AND PAYMENT

For items of work for which specific unit prices are established in the contract, the quantity of soil-cement will be measured within the specified limits and computed to the nearest cubic yard by the method of average cross sectional end areas. The quantity of soil-cement required to fill voids resulting from overexcavation outside the neat lines or pay limits will be included in the measurement for payment where such overexcavation is directed by the Engineer to remove unsuitable foundation material, but only to the extent that the unsuitable condition is not a result of the Contractor's improper construction operations, as determined by the Engineer.

Payment for soil-cement will be made at the contract unit price per cubic yard. The payment will constitute full compensation for all labor, materials, equipment, transportation, tools and all other items necessary and incidental to completion of the work, but not including other items listed for payment elsewhere in the contract.

Compensation for any item of work described in the contract but not listed in the bid schedule will be included in the payment for items of work to which it is made subsidiary. Such payment and the items to which they are made subsidiary are identified in Section 15 of this specification.

15. ITEMS OF WORK AND CONSTRUCTION DETAILS

Items of work to be performed in conformance with this specification and the construction details are:

a. Bid Item 7, Soil-Cement

(1) This item consists of furnishing, placing and curing soil-cement required for installation of 14 soil-cement sills at the locations indicated on the plans.

In Section 2, MATERIALS, soil materials will have to be imported from off-site sources selected by the Contractor. Such material may be blended with on-site material provided the resulting blend meets the gradation requirements of Section 15.a.(3).

(2) The soil-cement mix shall be designed for a minimum compressive strength of 750 psi at the end of 7 days as determined from ASTM D-1632 and ASTM D-1633. The soil-cement mix ratio and optimum water content shall be determined as specified in Section 2, MATERIALS.

(3) In Section 2, MATERIALS, the first sentence does not apply. Materials shall be obtained from off-site sources as the Contractor chooses. Soils to be used for soil-cement shall meet the following gradation:

Sieve Size	Percent Passing (Dry Weight)
2"	100
#4	60 - 100
#10	40 - 70
#200	5 - 25

The Plasticity Index shall not exceed 5 for that fraction of the material passing the #40 sieve.

(4) Portland cement shall be Type II, IIA or IP(MS).

(5) If Type IP(MS) is used, pozzolan shall not exceed 20 percent based on absolute volume and the R factor ($R = CaO / Fe\ O$) shall be less than 1.5.

(6) At the time of compaction, the moisture content shall not be below optimum and shall not be more than 2 percentage points above optimum when the mean air temperature during construction hours does not exceed 90 degrees F. Testing shall be in accordance with ASTM D-2216 at an oven temperature of 60±5 C.

(7) The compacted layers of soil-cement shall not exceed 8 inches in thickness, nor be less than 4 inches in thickness.

(8) Section 9, COMPACTION, soil-cement shall be uniformly compacted to a minimum of 98 percent of maximum density. Testing for in-place density shall be determined in accordance with ASTM D-1556 or ASTM D-2922 and ASTM D-3017.

(9) In Section 12, PROTECTING AND CURING, the curing compound shall be Type I-D, Class B.

(10) In Section 11, MEASUREMENT AND PAYMENT, payment for soil-cement will include compensation for Subsidiary Item, Water.

MATERIAL SPECIFICATION

303 GEOTEXTILES, WOVEN AND NONWOVEN

1. SCOPE

This specification is applicable to the quality control of both woven and nonwoven geotextiles.

2. QUALITY

Geotextiles shall be manufactured from synthetic long chain or polymeric filaments or yarns such as polypropylene, polyethylene, polyester, polyamide, or polyvinylidene-chloride. The geotextile shall be formed into a stable network of filaments or yarn that retain their relative position to each other, are inert to commonly encountered chemicals, and are resistant to ultraviolet light, heat, hydrocarbons, mildew, rodents, and insects. The geotextile shall be free of any chemical treatment or coating that might significantly reduce its permeability and shall have no flaws or defects that significantly alter its physical properties. The geotextile shall not be exposed to ultraviolet radiation (sunlight) for more than 15 days total in the period of time following manufacture until the geotextile is covered with soil, rock, concrete, etc. Unless otherwise specified, the requirements for materials are a follows:

a. Woven Geotextile

Woven geotextile shall conform to the physical properties listed in Table 1. The woven geotextile shall be manufactured from monofilament yarn that is woven into a uniform pattern with distinct and measurable openings. The geotextile shall be manufactured so that the yarns will retain their relative position with regard to each other. Yarn composition shall be at least 85 percent by weight of propylene, ethylene, or vinylidene-chloride, and shall contain stabilizers and/or inhibitors to enhance its resistance to ultraviolet or heat exposure. The edges of the material shall be selvaged or otherwise finished to prevent the outer yarn form unraveling.

b. Nonwoven Geotextile

Nonwoven geotextile shall conform to the physical properties listed in Table 2. Nonwoven geotextile shall be manufactured from randomly oriented fibers bonded together by the needle-punched process. In addition, one side may be slightly heat bonded.

(NOTE: Non-needle punch, heat bonded nonwoven geotextile may be used for Class IV in Table 2.)

c. Shipping, Product Identification, Certification, and Test Data

The geotextile shall be shipped in rolls wrapped with a protective covering to keep out mud, dirt, dust, debris and direct sunlight. Each roll of geotextile shall be clearly marked to identify the brand, type and the individual production run. (See ASTM D 4873, Standard Guide for Identification, Storage, and Handling of Geotextiles.)

The geotextile shall meet the specified requirements (Table 1 or 2) for the product style or type shown on the label. Product properties as listed in the "Specifiers Guide" (latest issue), Geotechnical Fabrics Report, Industrial Fabrics Association International, 345 Cedar Bldg., Suite 450, St. Paul, MN, 55105, and test data that represent minimum average roll values, will be acceptable documentation that the product style or type meets these specified requirements.

For products that do not appear in the above guide, or do not have minimum average roll values listed, typical test data from the identified production run of the geotextile will be required for each of the specified tests, Table 1 or 2, as appropriate.

All geotextile materials will be subject to sampling and testing by qualified testing laboratories at any time.

TABLE 1. REQUIREMENTS FOR WOVEN GEOTEXTILES

Property	Test Method	Slope Protection Unprotected Class I	Slope Protection Protected and Subsurface Drainage Class II & III	Road Stabilization Class IV
Tensile Strength lbs 1/	ASTM D 4632 Grab Test Method	200 min. in any principal direction	120 min. in any principal direction	150 min. in any principal direction
Bursting Strength psi 1/	ASTM D 3786 Diaphragm Tester	450 min	300 min.	250 min.
Elongation - % 1/ Failure	ASTM D 4632	35 max.	35 max.	35 max.
Puncture - lbs. 1/	ASTM D 4833	100	55	60
Ultraviolet Light Resistance	ASTM D 4355 500 hrs. exposure	70% min. tensile strength retained	70% min. tensile strength retained	70% min. tensile strength retained
Apparent Opening Size (AOS)	ASTM D 4751	As specified	As specified	As specified
Percent Open Area	CW-02215	As specified	As specified	As specified
Permeability 2/	ASTM D 4491	As specified	As specified	As specified

1/ Average roll minimum value (weakest principal direction).

2/ Permeability = Permittivity x geotextile thickness.

TABLE 2. REQUIREMENTS FOR NONWOVEN GEOTEXTILES

Property	Test Method	Slope Protection Unprotected Class I	Slope Protection Protected Class II	Subsurface Drainage Class III	Road Stabilization Class IV 3/
Tensile Strength lbs 1/	ASTM D 4632 Grab Test Method	180 min.	120 min.	90 min.	120 min.
Bursting Strength psi 1/	ASTM D 3786 Diaphragm Tester	320 min.	210 min.	180 min.	210 min.
Elongation - % 1/ Failure	ASTM D 4632	100 max.	100 max.	100 max.	100 max.
Puncture - lbs. 1/	ASTM D 4833	80	40	35	50
Ultraviolet Light Resistance	ASTM D 4355 500 hrs.	70% tensile strength retained	70% tensile strength retained	70% tensile strength retained	70% tensile strength retained
Apparent Opening Size (AOS)	ASTM D 4751	Size ≤ #40 max. 2/	Size ≤ #40 max. 2/	Size ≤ #40 max. 2/	Size ≤ #40 max. 2/

1/ Average roll minimum value (weakest principal direction).

2/ U.S. standard sieve size.

3/ A heat-bonded (non-needle punched) nonwoven geotextile may be used for this class.

MATERIAL SPECIFICATION

522. AGGREGATE FOR PORTLAND CEMENT CONCRETE

1. SCOPE

This specification covers the quality of fine aggregate and coarse aggregate for use in the manufacture of portland cement concrete.

2. QUALITY

Aggregate shall conform to the requirements of ASTM Specification C-33 for the specified sizes. Aggregates that fail to meet any requirement may be accepted only when: (1) the specified alternate conditions of acceptance can be proved prior to the use of the aggregates on the job and within a period of time such that no work under the contract will be delayed by the requirements of such proof; or, (2) the specification for concrete expressly contains a provision of special mix requirements to compensate for the effects of the deficiencies.

3. REACTIVITY WITH ALKALIES

The potential reactivity of aggregates with the alkalies in cement shall be evaluated by petrographic examination and, where applicable, the chemical method of test, ASTM Designation C 289, or by the results of previous tests or service records of concrete made from similar aggregates from the same source. The standards for evaluating potential reactivity shall be as described in ASTM Specification C 33, Appendix A1.

Aggregates indicated by any of the above to be potentially reactive shall not be used, except under one of the following conditions:

a. Applicable test results of mortar bar tests, made according to ASTM Method C 227, are available which indicate an expansion of less than 0.10 percent at six months in mortar bars made with cement containing not less than 0.8 percent alkalies expressed as sodium oxide; or

b. Concrete made from similar aggregates from the same source has been demonstrated to be sound after 3 years or more of service under conditions of exposure to moisture and weather similar to those anticipated for the concrete under these specifications.

Aggregates indicated to be potentially reactive, but within acceptable limits as determined by mortar bar test results or service records, shall be used only with "low alkali" cement, containing less than 0.60 percent alkalies expressed as sodium oxide.

4. STORING AND HANDLING

Aggregate of each class and size shall be stored and handled by methods that prevent segregation of particles sizes or contamination by intermixing with other materials.

MATERIAL SPECIFICATION

523. ROCK FOR RIPRAP

1. SCOPE

This specification covers the quality of rock to be used in the construction of rock riprap.

2. QUALITY

Individual rock fragments shall be dense, sound and free from cracks, seams and other defects conducive to accelerated weathering. The rock fragments shall be angular to subrounded in shape. The least dimension of an individual rock fragment shall be not less than one-third the greatest dimension of the fragment.

Except as provided below, the rock shall have the following properties:

a. Bulk specific gravity (saturated surface-dry basis) not less than 2.5.

b. Absorption not more than 2 percent.

c. Soundness: Weight loss in 5 cycles not more than 10 percent when sodium sulfate is used or 15 percent when magnesium sulfate is used.

The bulk specific gravity and absorption shall be determined by ASTM Method C 127. The test for soundness shall be performed by ASTM Method C 88 for coarse aggregate modified as follows:

The test sample shall not be separated into fractions. It shall consist of 5000 ± 300 grams of rock fragments, reasonably uniform in size and shape and weighing approximately 100 grams each, obtained by breaking the rock and selecting fragments of the required size.

After the sample has been dried, following completion of the final test cycle and washing to remove the sodium sulfate or magnesium sulfate, the loss of weight shall be determined by subtracting from the original weight of the sample the final weight of all fragments which have not broken into three or more pieces.

The report shall show the percentage loss of weight and the results of the qualitative examination.

Rock that fails to meet the requirements stated in a, b, and c above, may be accepted only if similar rock from the same source has been demonstrated to be sound after 5 years or more of service under conditions of weather, wetting and drying, and erosive forces similar to those anticipated for the rock to be installed under this specification.

3. GRADING

The rock shall conform to the specified grading limits after it has been placed in the riprap.

MATERIAL SPECIFICATION

531. PORTLAND CEMENT

1. SCOPE

This specification covers the quality of portland cements.

2. QUALITY

Portland cement shall conform to the requirements of ASTM Specification C 150 for the specified types of cement, except that, when Type I portland cement is specified, Type IS portland blast-furnace slag cement or Type IP portland-pozzolan cement conforming to the requirements of ASTM Specification C 595 may be used unless prohibited in the specifications.

If air-entraining cement is to be used, the Contractor shall furnish the manufacturer's written statement giving the source, amount and brand name of the air-entraining addition.

3. STORAGE AT THE CONSTRUCTION SITE

Cement shall be stored in such a manner as to be protected from weather, dampness or other destructive agencies. Cement that is partially hydrated or otherwise damaged will be rejected.

MATERIAL SPECIFICATION

532. AIR-ENTRAINING ADMIXTURES (FOR CONCRETE)

1. SCOPE

This specification covers the quality of air-entraining admixtures for concrete.

2. QUALITY

Air-entraining admixtures shall conform to the requirements of ASTM Specification C 260, except that the relative durability factor in the freezing and thawing test shall be not less than 95.

MATERIAL SPECIFICATION

534. CURING COMPOUND (FOR CONCRETE)

1. SCOPE

This specification covers the quality of liquid membrane-forming compounds suitable for spraying on concrete surfaces to retard the loss of water during the curing process.

2. QUALITY

The curing compound shall meet the requirements of ASTM Specification C 309.

Unless otherwise specified the compound shall be Type 2.

3. DELIVERY AND STORAGE

All curing compound shall be delivered to the site of the work in the original container bearing the name of the manufacturer and the brand name. The compound shall be stored in a manner to prevent damage to the containers and to protect water-emulsion types from freezing.

MATERIAL SPECIFICATION

539. STEEL REINFORCEMENT (FOR CONCRETE)

1. SCOPE

This specification covers the quality of steel reinforcement for reinforced concrete.

2. QUALITY

All reinforcement shall be free from rust, oil grease, paint or other deleterious matter.

Steel bars for concrete reinforcement requiring bends shall be deformed billet-steel bars conforming to ASTM Specification A 615, Grade 40 or Grade 60.

Straight steel bars shall be deformed bars conforming to one of the following specifications:

Deformed Billet-Steel Bars for Concrete Reinforcement (Grade 40 or Grade 60) - ASTM Designation A 615.

Rail-Steel Deformed Bars for Concrete Reinforcement (Grade 50 or Grade 60) - ASTM Designation A 616.

Axle-Steel Deformed Bars for Concrete Reinforcement (Grade 40 or Grade 60) - ASTM Designation A 617.

Fabricated steel bar mats shall conform to the requirements of ASTM Specification A 184.

Welded steel wire fabric reinforcement shall conform to the requirements of ASTM Specification A 185.

Welded deformed steel wire fabric for concrete reinforcement shall conform to the requirements of ASTM Specification A 497.

Cold-drawn steel wire reinforcement shall conform to the requirements of ASTM Specification A 82.

Deformed steel wire for concrete reinforcement shall conform to the requirements of ASTM Specification A 496.

3. DIMENSIONS OF WELDED WIRE FABRIC

Gauges, spacing and arrangement of wires in welded steel wire fabric shall be as defined in ACI Standard 315 of the American Concrete Institute for the specified style designations.

4. STORAGE

Steel reinforcement stored at the site of the work shall be stored above the ground surface on platforms, skids or other supports and shall be protected from mechanical injury and corrosion.