

**CONSTRUCTION
SPECIAL PROVISIONS
FOR
CAMELBACK RANCH LEVEE - SOUTH
INDIAN SCHOOL ROAD TO CAMELBACK ROAD**

FCD CONTRACT NO. 97-18

May 1, 1997

Prepared for:
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
2801 West Durango
Phoenix, AZ 85009
(602) 506-1501

Prepared by:
DMJM ARIZONA, INC.
300 West Clarendon Avenue
Suite 400
Phoenix, AZ 85013
(602) 264-1397



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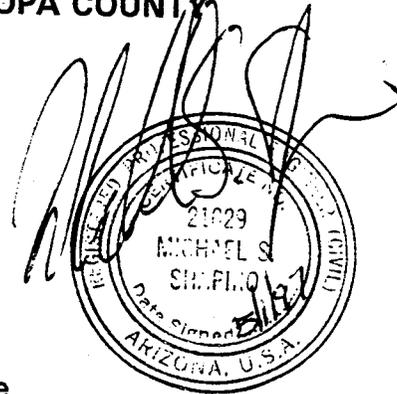
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The larger rocks shall be well distributed and the entire mass of rock shall conform to the gradation specified in Subsection 220.4. All material going into riprap bank protection shall be so placed and distributed that there will be no large accumulations of either the larger or smaller sizes of rock.

It is the intent of these specifications to produce a fairly compact riprap protection in which all sizes of material are placed in their proper proportions. Hand placing or rearranging of individual rocks by mechanical equipment may be required to the extent necessary to secure the results specified.

The Contractor shall maintain the riprap protection until accepted, and any material displaced by any cause shall be replaced to the lines and grades shown on the plan at no additional cost to the District.

220.6 - Measurement:

The quantities of riprap construction shall be measured by the cubic yards of riprap, in place, within the limits of dimensions shown on the plans. Quantities of salvaged riprap in excess of design requirements may be disposed of within the project limits, placed in the toe excavation backfill or placed adjacent to the existing riprap south of Camelback Road. No measurement shall be made for quantities in excess of design requirements.

220.7 - Payment:

Payment for loose riprap will be made for the number of cubic yards of riprap in place, as measured above, on the basis of unit prices stipulated in the Bid Schedule for Item 220 and shall include preparation of ground surfaces and trenching. No separate payment shall be made for Filter Fabric. Cost is incidental to the cost of loose riprap.

SECTION 221 - SOIL-CEMENT BANK PROTECTION is hereby added:

221.1 - Description:

The work shall consist of furnishing all labor, equipment and materials and constructing soil-cement bank protection as required by the Plans, including toe trench excavation, backfill, and dewatering for the construction of all soil-cement falling below the proposed channel bed profile.

The Contractor shall submit a plan showing his intended method of constructing the soil-cement. The plan shall be sufficient in detail to clearly describe the planned execution of the work. Such plan shall include, but not necessarily be limited to, mixing plant, transport equipment, spreading equipment, and compacting equipment, indicating number and capacities of each type of equipment.

The Contractor shall have full responsibility for administration of a Quality Control Plan for soil-cement which shall meet the same quality control requirements as Section 105 of the MAG Standard Specifications.

The plan shall also show the access planned for performing the work.

221.2 - Materials:

221.2.1 - Portland Cement

Portland Cement shall comply with the latest specifications as approved by the Engineer, for Portland Cement (ASTM C150, Type II [low alkali]), and shall conform to the requirements of Subsection 725.2 of the MAG Standard Specifications.

221.2.2 - Water

Water shall be clear and free from injurious amounts of oil, acid, alkali, organic matter, or other deleterious substances. Water shall contain not more than 1,000 parts per million of chlorides as CL or of sulfates as SO₄. Water shall be sampled and tested in accordance with the requirements of AASHTO T26.

221.2.3 - Aggregate

Soil aggregate for use in soil-cement may be produced by the Contractor by processing, screening, crushing and/or blending soils obtained from the required excavations, and/or may be furnished by the Contractor from Contractor - furnished borrow. Soil aggregate for soil-cement shall contain no deleterious material. Before mixing as soil-cement the soils shall be stockpiled and sampled, and shall be approved by the Engineer, in accordance with the requirements of Section 221.9 of these Special Provisions. The distribution and gradation of materials in the soil-cement lining shall not result in lenses, pockets, streaks, or layers of material differing substantially in texture or gradation from surrounding material.

The maximum allowable plasticity index for soil-cement aggregate shall be five (5). Soil aggregate for soil-cement shall conform to the following gradation requirements when tested in accordance with ASTM C-136 and C-117:

Sieve #	Percent Passing, By Dry Weight
2"	100%
No. 4	50% to 80%

No. 200

0% to 20%

Plasticity index shall be between 0 and 5 when tested in accordance with the requirements of AASHTO T-90.

Soil aggregate for soil-cement shall not contain clay/silt lumps larger than one-half (1/2) inch.

Blending of soil aggregate by combining soils from separate soil stockpiles shall be performed by utilization of separate storage feed bins at the plant, to the satisfaction of the Engineer.

221.2.4 - Fly Ash

Fly ash shall not be allowed as cementitious material.

221.3 - Equipment:

The soil-cement bank protection may be constructed with any combination of machines and/or equipment, except as noted herein, that will produce a completed soil-cement meeting the requirements for soil pulverization, cement and water application, mixing, transporting, placing, compacting, finishing, and curing as provided in these Specifications.

221.4 - Construction Requirements:

221.4.1 - Required Contractor Submittals

Approval by the Engineer shall not relieve the Contractor of the responsibility for achieving the desired result of constructing sound soil-cement, free from defects, according to the specifications and plans, or as directed by the Engineer.

Prior to the start of construction, the Contractor shall submit, in writing, for approval, the following items:

1. The approximate length of soil-cement bank protection to be placed prior to starting compaction operations.
2. The type of compaction equipment to be used.
3. The number and type of watering equipment to be used.
4. The method to be used to keep surfaces continually moist until subsequent layers of soil-cement are placed.

5. The method to be used to cure permanently exposed soil-cement surfaces.
6. The proposed source(s) of soil to be used in soil-cement.
7. The proposed size and number of soil aggregate stockpiles.
8. The mix design to be used in conformance with the requirements specified herein.

221.4.2 - Preparation

Before soil-cement processing begins, the area on which soil-cement will be placed shall be graded and shaped to lines and grades as shown on the Plans or as directed by the Engineer.

The subgrade shall be compacted to a minimum of 95% of the maximum density. Optimum moisture and maximum density shall be determined in accordance with ASTM D-698 or AASHTO T-99. Field density tests shall be performed in accordance with ASTM D-1556 "Sand Cone Method" or AASHTO T-238 "Nuclear Method". Moisture contents shall be measured and reported to the nearest 0.1%.

Immediately prior to placement of the soil-cement mixture, the subgrade shall be moistened. Soft or yielding subgrade shall be corrected and made stable before construction proceeds.

Excavation and backfill of toes, and any dewatering necessary to construct soil-cement bank protection below the channel bed profile elevations shown on the plans shall be considered incidental to the construction of the soil-cement and included in the cost of Item 221, Soil-Cement Bank Protection.

221.4.3 - Mixing

Soil-cement shall be mixed in an approved central-type plant having a stationary twin shaft pugmill mixer of the continuous-mixing type or an approved batch-type pugmill. The mixing plant shall be designed, coordinated, and operated to produce a soil-cement mixture of the proportions specified within the required tolerances. The plant shall be equipped with positive means for controlling and maintaining a constant time of mixing. Twin shaft pugmills shall also be equipped with a positive means for maintaining a constant speed of rotation of the shafts. The plant shall be equipped with screening, feeding, and weighing and metering measuring devices that will add the soil, cementitious material(s) and water into the

mixer in the specified quantities. The blades of twin shaft continuous pugmill mixers shall be adjustable for angular position on the shaft and reversible to retard the flow of the mix.

When the quantity of water is controlled by metering, provisions shall be made by the Contractor whereby the quantity of water delivered through the meter can be readily converted to weight. A water storage tank may be required to prevent the adverse effects created by surge drawdown.

The soil aggregate feed rate shall be controlled by a variable speed belt or a remotely operated gate, calibrated to accurately deliver any specified quantity of material. The feed rate shall be readily adjustable from the control panel to compensate for changes in the moisture content of the soil or to change soil aggregate proportions when blending is required and separate bins are utilized. The combined aggregate belt feeding the mixer shall be equipped with an approved belt scale. The belt scale shall operate automatic controls which will govern the proportions of cementitious material and water as ratios of the total soil aggregate, with provisions for ready changing of the proportions.

When a continuous mixing plant with a fixed soil aggregate feed rate system is used, the belt shall travel at a constant speed. The feed system shall continuously deliver aggregate to the mixer at a constant feed rate, calculated on a dry weight basis, at any locked gate setting. The feed system shall be mechanically interlocked with all other feed devices. The soil aggregate feed monitoring system shall provide and record the rate of and total quantity of soil aggregate fed into the mixture.

The plant shall be equipped with a hydraulically or mechanically operated discharge holding bin having a minimum capacity of twenty (20) tons.

Mixing shall be sufficient to secure a homogeneous, intimate, uniform mixture of the soil, and water within the specified tolerances. Soil and cementitious material shall be mixed sufficiently to prevent cementitious balls from forming when water is added.

Mixing shall not proceed when the soil aggregate or the area on which the soil-cement is to be placed is frozen. Soil-cement shall not be mixed or placed when the air temperature is below 45° F (7° C), unless the air temperature is at least 40° F (5° C) and rising.

At the completion of moist mixing, any lumps consisting of silt, clay and/or cementitious material shall be so pulverized that, exclusive of gravel-sized

and larger stones, 100% shall pass a one (1) inch sieve, and at least 80% by dry weight shall pass a No. 4 sieve.

In the production of soil-cement, the percent of cementitious material shall not vary by more than +0.3 percent of the contents specified by the Engineer.

Silos and feeders shall be equipped and operated so as to provide uniform rates of feed and prevent caking. Provisions shall be made to allow for ready, safe sampling of the cementitious material(s).

The weighing and metering systems shall include digital readouts which continuously display, and shall provide an hourly printed record of, the following information:

1. The total discharged quantity per hour of each weighed or metered material.
2. The cumulative total discharged quantity of each weighed or metered material.
3. The moisture content of the combined soil aggregate currently entering the mixer.
4. The cumulative total discharged weight of soil aggregate moisture.

Copies of the hourly printed records of discharged quantities and soil aggregate moisture information shall be given to the Engineer by the Contractor at the end of each day of soil-cement mixing.

Measuring devices shall be calibrated, at the Contractor's expense, and the calibration shall be approved by the Engineer.

Each measuring device shall be calibrated throughout its range to within an accuracy between plus/minus two (2.0) percent and shall be inspected and calibrated as often as the Engineer deems necessary to assure their accuracy. Calibration shall be performed by a certified lab.

The Contractor shall notify the Engineer at least 48 hours in advance of the initial plant calibration. Prior to, or at the time of, this notification the Contractor shall provide a Plant Operating Manual to the Engineer.

221.4.4 - Required Moisture

At the time of compaction, the moisture content of the soil-cement shall not be more than 2.0 percent below optimum and shall not be above optimum when the mean air temperature during construction hours does not exceed 90° F. The relationship between the soil-cement's moisture content and its optimum moisture content will be determined in accordance with ASTM D-558 or AASHTO T-134. When the mean air temperature does exceed 90° F, or there is a breeze or wind which promotes the rapid drying out of the soil-cement mixture, the moisture content of said mix shall be increased as needed at the direction of the Engineer, but shall be less than that quantity that will cause the soil-cement to become unstable during compaction and finishing operations.

221.4.5 - Sampling Facilities

Free and safe access to the plant must be provided to the Engineer at all times for inspection of the plants operation.

The Contractor shall provide suitable facilities and shall take representative samples of materials as they enter the mixer, are discharged from the mixer, and are discharged from the gob hopper. The frequency of the Engineers sampling of the combined said aggregate feed shall be at the discretion of the Engineer, but will not be less than once a day or once for each 500 cubic yards of soil-cement produced. These samples shall be used for Contractor quality control and quality assurance testing. All necessary platforms, tools, equipment and trained personnel for obtaining samples shall be furnished by the Contractor.

221.4.6 - Handling

The soil-cement mixture shall be transported from the mixing area to the embankment in clean equipment provided with suitable protective devices in unfavorable weather. The total elapsed time between the addition of water to the mixture and the start of compaction shall be the minimum possible. In no case shall the total elapsed time exceed thirty (30) minutes. (This time may be reduced by the Engineer when the air temperature exceeds 90° F or when there is a breeze or wind which promotes rapid drying of the soil-cement mixture.) Compaction shall start as soon as possible after spreading.

The Contractor shall take all necessary precautions to prevent damage to completed soil-cement by the equipment and to prevent the deposition of raw earth or foreign materials between layers of soil-cement. Earth ramps crossing completed soil-cement must have at least two (2) foot compacted

thickness. Where ramps are constructed over soil-cement that is not to grade, all foreign materials and the uppermost one (1) inch of the previously placed soil-cement mixture must be removed prior to continuation of the soil-cement construction.

221.4.7 - Placing

The mixture shall be placed on the moistened subgrade, embankment, or previously completed soil-cement with spreading equipment that will produce layers of nine (9) feet in width with a thickness as is necessary for compaction to the required dimensions of the completed soil-cement layers. The nine (9) feet dimension is to allow for full compaction of the design width of eight (8) feet with one (1) foot of excess that will not be trimmed. The compacted layers of soil-cement shall not exceed eight (8) inches in thickness nor be less than four (4) inches in thickness. The maximum depth of compacted soil cement that shall be placed per day shall be four (4) feet.

Each successive layer shall be placed as soon as practicable after the compaction of the preceding layer has been verified by the Engineer.

The Contractor shall schedule placement of all soil-cement above channel bottom such that the placement of soil-cement protection at each location will be completed from channel bottom to plan top of soil-cement within five (5) calendar days, unless otherwise approved by the Engineer, or unless prevented by inclement weather.

All soil-cement surfaces that will be in contact with succeeding layers of soil-cement shall be kept continuously moist by fog spraying until placement of the subsequent layer, except that the Contractor will not be required to keep such surfaces continuously moist for a period longer than seven (7) days.

Mixing shall not proceed when the soil aggregate or the area on which the soil-cement is to be placed is frozen. Soil-cement shall not be mixed or placed when the air temperature is below 45° F (7° C), unless the air temperature is at least 40° F (5° C) and rising.

221.4.8 - Compaction

Soil-cement shall be uniformly compacted to an average of 98% and no less than 95% of maximum density as determined by field density tests. Optimum moisture and maximum density shall be determined in accordance with ASTM D-558 or AASHTO T-134. Field density tests shall be performed in accordance with ASTM D-1556 "Sand Cone Method" or AASHTO T-238

"Nuclear Method". Moisture contents shall be measured and reported to the nearest 0.1%.

Wheel rolling with hauling, grading, spreading, or watering equipment, exclusively, shall not be an acceptable method of compaction. Vibratory compaction methods or equipment shall not be used when their use contributes to sloughing or caving of the soils which the soil-cement is to be placed against.

At the start of compaction, the mixture shall be in a uniform, loose condition throughout its full depth. Its moisture content shall be as specified in Subsection 221.4.4 herein. No section shall be left undisturbed for longer than thirty (30) minutes during compaction operations. Compaction of each layer shall be done in such a manner as to produce a dense surface, free of compaction planes, in not longer than one (1) hour from the time water is added to the mixture. Whenever the Contractor's operation is interrupted for more than two (2) hours, the top surface of the completed layer, if smooth, shall be scored to a depth of at least one (1) inch with a spike-tooth instrument, or by other means approved by the Engineer, prior to placement of the next lift. The spacing of scores shall not exceed eighteen (18) inches, measures across the direction of soil-cement placement. The surface, after said scoring, shall be swept using a power broom or other method approved by the Engineer to completely free the surface of all loose material prior to actual placement of the soil-cement mixture for the next lift.

221.4.9 - Finishing

After compaction, the top surface of the soil-cement shall be shaped to the required lines and grades, and cross-sections and rolled to a reasonably smooth surface.

Surface compaction and finishing of each layer shall be done in such a manner as to produce a dense surface free of compaction planes or loose material in no more than two (2) hours from the time compaction is started or three (3) hours from the time water is added to the mixture.

221.4.10 - Curing

Temporarily exposed surfaces shall be kept moist as set forth in Subsection 221.4.7.

Permanently exposed surfaces of the soil-cement shall be kept moist during the seven (7) day cure period. Whenever atmospheric temperatures are expected to drop below 30° F, soil-cement shall be protected from freezing

for seven (7) days after its construction by a covering of loose earth, straw, or other suitable material approved by the Engineer.

221.4.11 - Construction Joints

At the end of each day's work, or whenever construction operations are interrupted for more than two (2) hours, a transverse construction joint shall be formed in the last-placed lift by cutting back into the complete lift to form a full-depth vertical face.

221.4.12 - Maintenance

The Contractor shall be required, within the limits of the Contract, to maintain the soil-cement in good condition until all work is completed and accepted. Maintenance shall include immediate repairs of any defects that may occur. This work shall be done by the Contractor at his own expense and repeated as often as necessary. Faulty work shall be replaced for the full depth of the layer.

221.5 - Inspection and Testing:

The Engineer, with the assistance and cooperation of the Contractor, will make such inspections and tests as he deems necessary to verify the conformance of the work to the Contract Documents. These inspections and tests will include, but will not be limited to: (1) the taking of test samples of the soil-cement and its individual components at all stages of processing and after completion, and (2) the close observation of the operation of all equipment used on the work. Only those materials, machines, and methods meeting the requirements of the Contract Documents will be approved by the Engineer.

All testing of soil-cement or its individual components, unless otherwise provided specifically in the Contract Documents, shall be in accordance with the latest applicable test methods in effect as of the date of advertisement for bids on the project.

Testing for proper compaction shall be done on at least every other lift of compacted soil-cement and at least once for every 500 cubic yards of soil-cement. Test locations shall be chosen by the Engineer. If the lift being tested does not meet the specified density requirements, it must be reworked as directed by the Engineer until it passes or be removed by the Contractor at the Contractor's expense. The Contractor shall not be permitted to continue placing lifts of soil-cement on any lift which has failed the compaction tests until such time as that lift has been reworked, retested, and passed as to meeting density and moisture content requirements.

The initial acceptance of material shall in no way preclude further examination and testing at any time, during the course of construction or subsequent warranty period, if the Engineer suspects the material is no longer properly represented by the acceptance sample. The acceptance at any time of any material incorporated into the work shall not bar its future rejection if it is subsequently found to be defective in quality or uniformity.

221.6 - Mix Design Methodology:

The design requirements for the soil-cement bank protection shall be such that it has a minimum compressive strength of 750 psi at 7 days plus two (2) percent additional cementitious material to compensate for variations in mixing method, material and placement. The Contractor shall determine the mix proportions of the aggregate, cement and water, and shall furnish soil-cement conforming to the requirements specified herein. The job-mix design with the supporting test results shall be submitted to the Engineer for approval, prior to incorporating any of the material into the work.

Included in the job-mix design data shall be the brand of cement and source of aggregate. A new mix design shall be submitted for approval any time the Contractor requests a change in material, or proportioning of the materials, from that given in the approved mix designs.

221.7 - Mix Design for This Project:

For bidding purposes only, the estimated mix design for this project shall include eleven percent (11%) base cementitious material for the soil-cement banks.

The percent of cementitious material to be used in the mix shall be calculated to be the weight of cementitious material divided by the total weight of the dry soil-cement materials. The actual mix designs used on this project shall be determined by laboratory tests on each soil aggregate stockpile after construction of stockpiles has been completed.

The cement content may be increased at any time by the Engineer if, in the Engineer's opinion, increased cement content is needed to assure design strength. An increase in cement content may be justified by inconsistencies in production methods, various test results, and test results which drop below acceptable standard deviation.

221.8 - Stockpiling of Aggregate:

Soil aggregate stockpiles shall be constructed on level, firm ground free of brush, trees, stumps, roots, rubbish, debris, and other objectionable or deleterious material and shall be located so as to provide a distance of not less than fifty (50) feet from

the outside bottom edge of conical stockpiles built up under processing plant conveyors or any other existing stockpiles. Stockpiles shall not be placed in the Agua Fria River channel. The stockpiles shall be constructed in layers, each layer not exceeding two (2) feet in thickness. Ramps formed for stockpile construction shall be of the same material as that being stockpiled, and will be considered a part of the stockpile. Before steepening a ramp, any contaminated surface material shall be removed. The stockpile height shall be limited to a maximum of eight (8) feet.

Stockpiled material shall be thoroughly mixed throughout its depth, width, and length before utilization. The material shall be homogeneous and uniform in color, gradation, and moisture throughout.

Sampling of stockpiles will be done by the Engineer. After the stockpiles have been sampled and approved, material shall not be added to them. Each stockpile shall be completed and approved at least fourteen (14) days prior to start of soil-cement production from the stockpile.

221.9 - Sampling and Use of Stockpiles:

During construction of stockpiles to be utilized in the production of soil-cement, the Contractor will be solely responsible for monitoring the uniformity of the material being placed therein to assure conformance with the gradation requirements specified for said soil material. The Contractor's attention is directed to the soils reports prepared for this project and which are on file at the office of the Flood Control District of Maricopa County, 2801 West Durango Street, Phoenix, AZ 85009.

Stockpiles for use in soil-cement production shall be constructed to the following maximum size:

1. 20,000 cubic yards, or
2. The total quantity of material required to complete all soil-cement when the quantity of material required for blending into the soil aggregate is less than 20,000 cubic yards.

The height of the stockpiles shall be limited to a maximum of eight (8) feet.

Upon completion of each stockpile, the Contractor shall notify the Engineer in order to allow for verification of the soil-cement mix design determined during design from random site sampling. The Contractor shall provide the manpower and equipment necessary to sample each stockpile in accordance with the following procedure:

Under the direction of the Engineer, the Contractor shall use a front-end loader to excavate a face for the full height of the stockpile, extending into the stockpile a distance required by the Engineer, at a minimum of four (4) different sampling locations around the perimeter of the stockpile. The Contractor shall excavate one (1) additional sampling location for each 5,000 cubic yards in the stockpile in excess of 20,000 cubic yards. The front-end loader shall then be used to channel the total excavated face at each location from the bottom to the top in one operation, and the material obtained shall be dumped on the ground in piles.

The Engineer or his representative will then sample each of the sample piles by channeling it with a hand shovel at four (4) locations equally spaced around the perimeter.

Approval of a stockpile shall not relieve, in any degree, the full responsibility of the Contractor to furnish, in its final position, a material conforming to all the specification requirements.

221.10 - Field Quality Control:

The Contractor shall establish and maintain an effective quality control program for soil-cement which will be his means of ensuring compliance with Contract requirements and of maintaining records of his control. The program shall include, but not limited to the following: aggregate manufacture and gradations, moisture, batching requirements and mix proportions at the mixing plant, insuring adequate materials are on hand, and all other tests inspections required by the Specification.

All quality control tests shall be performed in strict accordance with the applicable standards as specified hereinafter. The quality control program for soil-cement shall be established by the Contractor and be proposed to the Engineer for review and approval. The Contractor shall supply all equipment and provide qualified personnel for testing and fulfillment of his quality control program. No soil-cement placement or aggregate production will be allowed until the Contractor has received approval of an acceptable quality control program. The Contractor's program shall be similar in nature to the quality control program established in the following paragraphs. If at any time, in the opinion of the Engineer, the Contractor's proposed system is inadequate or fails to ensure compliance with the Specification, the Contractor will be required to adopt a new system which, at a minimum, conforms strictly to the requirements stated in the following paragraphs.

(A) Aggregate Gradations:

1. Testing:

At least once during each shift that soil-cement is placed and that aggregates are produced, aggregates shall be checked for the characteristics specified in Section 221.2.3. A recheck sample is required for any test out of specifications. The location from which samples are taken may be selected by the Contractor providing that they give an accurate indication of gradations of materials as they enter the mixer. However, provisions must be made for accurate sampling of aggregates on the feed belts.

2. Action Required:

Whenever a test result is outside of the specification limits, the Engineer shall be immediately notified and a recheck sample taken. If the recheck sample is outside of the specification limits, the Engineer shall be immediately notified again, the process shall be considered out of control, and positive steps shall be taken by the Contractor to rectify the situation. The Engineer will advise the Contractor if production and placement of soil-cement shall be stopped at that time. The Contractor will be responsible for all costs incurred as a result of stopping any soil-cementing operations due to out of specification materials.

(B) Aggregate Moisture Determination:

1. Testing:

At least once during each day of placement for each aggregate size used, moisture content determinations shall be made in accordance with ASTM C566 (ASTM C70 where appropriate for fine aggregate if it is stockpiled separately). The location from which the sample is selected may be determined by the Contractor, providing that it is typical of materials entering the soil-cement.

2. Action Required:

The Engineer may test for verification any field determinations of moisture contents made by the Contractor. This verification will use the oven drying procedure. If there is a discrepancy

between the Contractor's test results and the verification tests, immediate steps shall be taken to identify the source of the problem and correct it so that accurate field determinations are obtained. When moisture content determinations indicate a change in water entering the soil-cement with the aggregates, the placement foreman shall be contacted to see if a corresponding adjustment in water added at the soil-cement mixer is necessary to obtain maximum compaction at the placement site.

(C) Soil-Cement Plant Control:

When the mixing plant is operating, the measurement of all constituent materials including cement, each size of aggregate, water and admixtures, shall be continuously controlled. The aggregate weights and amount of added water to compensate for free moisture in the aggregates shall be adjusted as necessary. A daily report shall be prepared indicating the type and source of cement used during that day; the amount, type and source of admixtures used; aggregate size groups used; required mix proportions per cubic yard for each mix design used; the amount of water as free moisture in each size of aggregate; and the aggregate and water weights per cubic yard for each mix design of soil-cement made during plant operation.

(D) Scales for Weigh Batching:

1. Tests and Checking:

The accuracy of scales shall be checked by test weights prior to the start-up of soil-cementing operations. Such tests shall also be made whenever there are variations in properties of the soil-cement that could result from batching errors. The accuracy of each batching device when weight batching procedures are used shall be routinely checked during a weighing operation by noting and recording the required weight and the weight actually batched. Rechecks shall be made at least every four shifts of operation thereafter and whenever there are variations in the properties or control of soil-cement that could result from batching errors.

2. Action Required:

Whenever either the weighing accuracy or batching accuracy is found not to comply with specification requirements, the plant

shall not be operated until necessary adjustments or repairs have been made.

(E) Volumetric Feed Calibrations:

1. Tests and Checking:

The accuracy of volumetric feeds shall be checked by collecting all material delivered during a unit of time to the mixer and also by washout tests of material exiting from the mixer. Suitable methods and equipment shall be provided for obtaining and handling samples at the mixing plant. The weight of material corresponding to a standard time interval, and the resulting proportions of materials per cubic yard, shall be determined. The accuracy of volumetric feeds shall be determined at least three times during check out of the mixing plant prior to production operations and soil-cement placement. Rechecks shall be made at least every four shifts of operation thereafter and whenever there are variations in the properties of control of soil-cement that could result from volumetric feed errors. The sample shall be of sufficient size to give accurate determinations and calibration may require weights in excess of 500 pounds per item checked.

2. Action Required:

Whenever the volumetric feed is found not to comply with Specification requirements, the plant shall not be operated until necessary adjustments or repairs have been made.

(F) Testing Soil-Cement Mixes:

1. General:

Fresh soil-cement shall be sampled and tested for compliance with the Specification and for additional information required by the Engineer. Samples and tests will primarily be made at the placing location at the time of placement, but may also be required at the mixing plant. The Contractor shall provide a method of readily obtaining representative soil-cement samples from the plant and any gob hopper locations.

2. Mixer Performance:

A complete mixer performance test of three different batches of soil-cement or runs through a volumetric plant shall be made on each stationary mixer in accordance with the Army Corps of Engineers CRD-D 55 prior to the start of soil-cement placing. Additional tests may be made at any time to support a Contractor's request for reduction of mixing time. Whenever mixer adjustments are necessary because of failure of a mixer to comply, the mixer shall be retested after adjustment. The abbreviated test may be used for this purpose. Abbreviated tests shall be run routinely on each mixer at least once every five days.

3. Temperature:

a. Testing:

At least one test of temperature shall be made at the mixing plant and at the placement on a randomly selected batch of each mix design of soil-cement used per shift of placement. Additional tests shall be made when rapid set time or workability loss is reported by the placing foreman or Engineer's inspector, or when cold weather problems occur. The temperature of air and soil-cement shall be reported during the period of cure and cold weather protection when those restrictions are applicable.

b. Action Required:

Whenever the mix temperature falls below 50° F or is above 90° F, the Contractor shall notify the Engineer immediately. All other temperatures shall be included as standard data in the quality control reports.

4. Moisture Content:

a. Tests and Checking:

At least once during each four hours of production placement at the mixing plant, and once every two hours at the placement site (immediately after compaction), the moisture content shall be determined on the soil-cement mix using a nuclear gauge in accordance with AASHTO T-239. The gauge shall be calibrated against oven-dry samples of each mix design used. If, after three days of production placement, consistent moisture control

is achieved, the rate of testing may be decreased to one test per eight hours at the plant and one test per four hours at the placement. In any case, at least three tests shall be made in different areas of each layer of soil-cement placed. The placing foreman shall continuously monitor the apparent effectiveness of compaction equipment from a visual standpoint, and shall notify the mixing plant whenever the mix becomes too dry or too wet.

b. Action Required:

Whenever moisture content tests indicate a change from what has been established as the optimum batching and placing moisture for maximum density and efficiency of compaction equipment, a corresponding adjustment shall be made in the mix water added at the mixing plant and the adjustment shall be noted. Whenever the placing foreman observes a condition of moisture which begins to consistently allow the vibratory rollers to sink excessively in the mix, cause excessive paste to develop at the surface, or leave an open appearing unconsolidated surface, an adjustment shall be made in the mix water added at the plant and the adjustment shall be noted.

5. Cement Content:

The Contractor shall obtain samples of the soil-cement mix at the mixing plant and/or placement area for determination of cement content using a chemical chloride titration or similar procedure. The test equipment shall also allow moisture content determinations to be made. The equipment shall be provided by the Contractor and all testing shall be by the Contractor.

6. Soil-Cement Compressive Strength Tests:

The Contractor shall cast, transport and cure specimens for compressive strength tests and test the specimen for compressive strength at time intervals as directed by the Engineer, but not less than one set of three cylinders per 500 cubic yards of soil-cement placed. The soil-cement samples shall be prepared and tested in accordance with the requirements of Arizona Test Method 241a.

7. Density:

a. Testing and Checking:

At least once every two hours during placement, but not less than once every 500 cubic yards of soil-cement, the density and moisture content of soil-cement after compaction shall be determined with a nuclear density gauge in accordance with AASHTO Designation T-238, previously calibrated against sand cone densities. The Contractor shall maintain a nuclear gauge in good working condition on the placement area at all times. The Engineer shall have access to the gauge at all times and shall be allowed to use it for quality assurance check tests. Each lift of soil-cement shall be tested by the nuclear gauge in at least six separate locations for density. The direct transmission mode shall be used and readings shall be taken in each quadrant of a circle obtained by rotating the gauge 90° each after each reading around the transmission probe. The probe shall be inserted into pre-driven holes of diameter recommended by the manufacturer to a depth of at least 10 inches for each reading. Density shall be as specified in Subsection 221.4.8 of this Special Provision. The vibratory roller operators shall continually monitor their "on board" compaction meters as an indicator or any areas which have not been fully compacted.

b. Action Required:

Whenever a roller operator finds that his compaction meter indicates insufficient compaction, he shall continue rolling until the required compaction meter readout is achieved. If this requires more than an estimated six passes, the Engineer shall be notified by the placing foreman, and the Contractor shall determine the actual density with a nuclear gauge. Whenever the nuclear gauge indicates compaction of less than specified in Subsection 221.4.8 of this Special Provision, a retest shall be made. If the retest indicates incomplete compaction, the Engineer shall be notified, additional rolling shall be immediately provided and a determination shall be made as to whether the lower density resulted from insufficient passes of the roller or a change in the

mix properties. If the mix properties have changed, adjustments such as increasing or decreasing the moisture content shall be made at the mixing plant. If the problem persists, the Engineer may require the Contractor to adjust the proportions of aggregates, and/or cement. If the lower density is the result of incomplete rolling, the operator shall be notified and the Engineer may require removal of the incompletely compacted material at no cost. If the same operator repeatedly rolls less than the required number of passes, and/or if his compaction meter repeatedly indicates underrolling due to deliberate action or inattentiveness, he shall be replaced with a different operator.

(G) Compaction Equipment:

1. Tests and Checking:

Before any compactor is used in soil-cement construction, it shall be checked for current dimensions, weight and vibratory capacity. At least once per four shifts of use, a spot recheck of frequency shall be made. At least once per each shift of placement for the first five days of operation by any new operator, his performance shall be spot checked for the correct number of passes, correct spread, coverage of the area being rolled, and good rolling practice. Thereafter, spot checks shall be made on each operator at least every four shifts.

2. Action Required:

Compaction equipment not meeting the physical dimensions and weights required shall be removed from the site. Any roller having improper frequency shall be corrected before being used for soil-cement compaction. Roller operators running at speeds in excess of Specification requirements shall be immediately notified and shall correct any noted improper practices or be replaced by another operator.

(H) Dumping and Spreading:

1. Tests and Checking:

The placing foreman or other designated representative shall continually observe and monitor dumping and spreading operations to insure that they are done in a manner that

minimizes segregation and spreading after dumping. Each lift of soil-cement shall be routinely checked in its spread uncompacted condition for evenness and correct thickness that will result in a smooth, even, compacted layer having thickness as required.

2. Action Required:

Whenever thickness checks on uncompacted soil-cement indicate an excess or shortage of material, the lift shall be immediately bladed off or supplemented to establish the correct thickness before compaction. Whenever a compacted layer thickness or elevation exceeds the specified thickness by two inches, the Engineer shall be immediately notified and he will determine whatever corrective action is necessary.

(I) Preparation for Soil-Cement Placement:

Foundations and construction joints shall be inspected in sufficient time prior to each soil-cement placement by the Contractor in order to certify that the area is ready to receive soil-cement. The results of inspections shall be reported in writing as a part of the quality control reports. The placing foreman shall supervise all placing operations and shall be responsible for measuring and recording concrete temperatures, ambient temperature, weather conditions, time of placement, yardage placed and method of placement. The placing foreman shall not permit placing to begin until he has verified that an adequate number of vibratory rollers and spreading equipment of the right size, in working order, and with competent operators are available.

(J) Construction Joints:

Vertical construction joints are to be provided at the end of each day's work or when work is halted for two hours or more. The joints shall be trimmed to a straight line and vertical to the full depth of the lift. Before resuming placement of new soil-cement, loose material shall be removed from the joint.

(K) Curing, Protection and Joint Surfaces:

1. Moist Curing:

At least once each shift around the clock, seven days per week, an inspection shall be made of all areas subject to moist curing

and joint protection. The surface moisture condition shall be noted and recorded. If an isolated area has been allowed to dry, that area shall be considered as improperly cured. The Contractor shall immediately wet the surface and take positive steps to insure that the problem does not reoccur.

2. Protection:

At least once each shift, around the clock, seven days per week, an inspection shall be made of all areas subject to cold weather protection or protection against damage. Deficiencies shall be noted. During removal of cold weather protection, measurement of soil-cement and ambient temperature shall be made at least every three hours.

(L) Finishing:

After compaction, the soil-cement shall be further shaped, if necessary, to the required lines, grades, and cross sections, and rolled to a reasonably smooth surface.

(M) Backfill:

Backfill shall not be placed against the soil-cement until it has achieved its full design strength. Special care shall be taken when placing backfill against soil-cement.

(N) Reports:

Mixing plant control reports and all results (both passing and failing) of tests conducted at the site shall be reported daily and shall be delivered to the Engineer within two days after the end of each weekly reporting period. These requirements do not relieve the Contractor of the obligation to report certain failures immediately as required in the preceding paragraphs. Such reports of failures and the action taken shall be confirmed in writing in the routine reports. The Engineer has the right to examine all Contractor quality control records.

221.11 - Acceptance Sampling and Testing

Rejection of soil-cement will occur due to improper temperatures, and/or density for the soil-cement mixture delivered to the site, placed and compacted. The Engineer at his discretion may allow failed soil-cement mixture already in place to remain in place subject to acceptance by compressive strength or may require its removal.

Rejection of soil-cement will also occur due to insufficient compressive strength. Soil-cement compressive strength requirements consist of the specified strength which the soil-cement shall attain at 7 days.

A. Sampling and Testing of Soil-Cement:

1. General:

Fresh soil-cement shall be sampled and tested for compliance with the Specification. Samples and tests will be made at the placing location at the time of placement. The Contractor shall provide a method of readily obtaining representative soil-cement samples from the placement locations.

2. Temperature:

At least one test of temperature shall be made at the placement location on a randomly selected batch of each mix design of concrete used per shift of placement. Additional tests shall be made when rapid set time or workability loss is reported or when cold weather problems occur.

3. Moisture Content:

At least once during each four hours at the placement site (immediately after compaction), the moisture content shall be determined on the soil-cement mix using a nuclear gauge in the direct transmission mode. The probe shall be driven to a depth of at least 10 inches for each reading. The gauge shall be calibrated against oven-dry samples of each mix design used. If, after three days of production placement, consistent moisture control is achieved, the rate of testing may be decreased to one test per eight hours at the placement.

In any case, at least three tests shall be made in different areas of each layer of soil-cement placed.

4. Density:

At least once every two hours during placement, but not less than once every 500 cubic yards of soil-cement, the density and moisture content of soil-cement after compaction shall be determined with a nuclear density gauge in accordance with AASHTO Designation T-238, previously calibrated against sand

cone densities. Each lift of soil-cement shall be tested by the nuclear gauge in at least six separate locations for density. The direct transmission mode shall be used and readings shall be taken in each quadrant of a circle obtained by rotating the gauge 90° each after each reading around the transmission probe. The probe shall be inserted into pre-driven holes of diameter recommended by the manufacturer to a depth of at least 10 inches for each reading.

5. **Soil-Cement Compressive Strength:**

The Engineer shall cast, transport, and cure specimens for compressive strength tests and test the specimen for compressive strength at time intervals as directed by the Engineer, but not less than one set of three cylinders per 500 cubic yards of soil-cement placed. The cylinders shall be prepared and tested in accordance with the requirements of Arizona Test Method 241a.

(B) **Acceptance of Soil-Cement:**

Acceptance and penalties for placed soil-cement which meets the above mixture requirements or is allowed to remain in place shall be determined by the results of the 7 day compressive strength. Soil-Cement represented by compressive strength tests which do not meet the minimum compressive strength specified may be allowed to remain in place at the discretion of the Engineer. No payment will be made for such soil-cement.

221.12 - Control Strips:

A soil-cement control strip shall be constructed at the beginning of work on the soil-cement. The control strip construction shall be used to demonstrate equipment and procedures necessary to attain the required densities for the specified course.

Each control strip, if constructed to acceptable density and surface tolerances, shall remain in place and become an integral part of the completed levee protection. Unacceptable control strips (i.e., those that fail to meet the specified requirements for density or compressive strength) shall be replaced at the Contractor's expense. A control strip shall have an area of not less than 500 square yards and the compacted thickness specified for the construction of the course which it represents.

Compaction equipment shall be capable of obtaining the specified compaction requirements without detrimentally affecting the compacted material. The equipment shall be modern, efficient compacting units meeting the requirements of this section.

Rollers shall be the self-propelled drum drive vibratory type which will be capable of transmitting dynamic impact to the surface to be compacted through a steel drum by means of revolving weights, eccentric shafts, or other equivalent methods. The compactor shall have a gross weight of not less than 21,000 pounds and shall produce a dynamic force of at least 400 pounds per lineal inch of drum width at the operating frequency which is used during construction. The roller shall have a vibrating frequency of at least 1,800 CPM (cycles per minute). The roller shall have a smooth drum or drums with a drum diameter between 4 and 5.5 feet and a width of between 5.5 and 8 feet. The engine driving the eccentric mass shall have a rating of not less than 125 horsepower. Heavier compacting equipment may be required to achieve the soil-cement density requirements.

The equipment used in the construction of the control strip shall be of the same type and weight to be used on the remainder of the course represented by the control strip.

The materials used in the construction of the control strip shall conform to the specification requirements. They shall be furnished from the same source and shall be of the same type used in the remainder of the course represented by the control strip. The underlying surface upon which a control strip is to be constructed shall have the prior approval of the Engineer.

221.13 - Soil-Cement Strength Requirements:

Soil-cement shall have the following minimum required compressive strength at seven (7) days of not less than 750 psi when tested in accordance with the requirements of Arizona test Method 241a.

A minimum of three (3) cylinders shall be taken for testing purposes per 500 cubic yards of material placed, but not less than three (3) cylinders per day shall be made.

Test results which indicate strength below 750 psi shall be the basis of rejection of the defective soil cement. Defective material shall be removed and replaced at the Contractors expense.

221.14 - Measurement:

This work shall be measured 1) in cubic yards of complete-in-place soil-cement between the limits shown by the specified lines, grades, and cross-sections shown

on the Plans. The Contractor shall compute the volume of soil cement placed by the average end area method from the cross-sections taken for the Foundation Excavation and Fill Embankment and placing the neat line soil cement limits on the cross-sections and 2) in tons of cement incorporated into the soil-cement, as determined by tests.

221.15 - Payment:

This work shall be paid for at the Contract unit price per cubic yard for soil-cement as set forth in the Bid Schedule under Item 221-1. Such payment shall constitute full reimbursement for performing all work and for furnishing all equipment, labor, and materials necessary to complete the soil-cement bank protection, bank transition, dewatering, trench excavation and toe excavation fill, watering, mixing, placing, compacting, curing, inspection, and testing assistance and all other incidental operations.

Cement furnished will be paid for at the Contract unit price per ton under Item 221-2 of the Bid Schedule. Any waste of cement and/or soil cement by the Contractor during the handling, mixing, placing, etc., operations shall not be paid for. Unbalancing of unit price bid or any material bid below market cost shall be the basis for rejection of the bid.

SECTION 225 - WATERING

In addition to the requirements of the MAG Standard Specifications.

225.1 - Description:

Replace Section 225.1 of the MAG Standard Specifications with the following:

The work under this section shall consist of furnishing and applying all water required for the control of dust, for the safety and convenience of the traveling public, and for the reduction of the dust nuisance to adjacent property.

The Contractor shall obtain the necessary permits required under the County Air Pollution Statutes. It shall be the responsibility of the Contractor to keep the construction site moistened to prevent pollution of air, water and adjacent property.

225.3 - Construction Equipment:

The use of pressure pumps and spray bars on all sprinkling equipment used for the application of water will be required. The use of gravity flow spray bars and splash plates will not be permitted.

225.5 - Payment:

There is no pay item for watering.

SECTION 310 - AGGREGATE BASE COURSE

Replace Section 310 of the MAG Standard Specifications with the following:

310.1 - Description:

Aggregate Base Course, also referred to as ABC, shall be placed in a 4-inch layer for the maintenance roads and turn around areas, where shown on the design plans.

310.2 - Materials:

Materials for use as ABC shall be in accordance with Section 702 - Base Materials of the MAG Standard Specifications.

310.3 - Placement:

The ABC may be placed and compacted in a single layer. After distributing, the base material shall first be watered and then immediately bladed to a uniform layer that will net, after rolling, the required thickness. If the materials deposited are not uniformly blended together, the blading operation shall be continued to such extent as may be necessary to eliminate segregation. The quantity of water applied shall be that amount which will assure proper compaction resulting in a relative density of not less than 100 percent as determined under Section 301 of the MAG Standard Specifications. Care shall be exercised in connection with watering operations to avoid wetting the subgrade or any lower base course to detrimental extent.

Upon completion, the base surface shall be true, even and uniform conforming to the grade and cross-section shown on the design plans.

ABC may vary not more than ½ inch above or below required grade and cross-section.

310.4 - Measurement:

Quantities of ABC shown on the design plans are measured by the square yards, based upon the actual dimensions shown. No allowance is made for spalling or waste beyond those limits.