

CU-STRUCTURAL SOIL[®] SPECIFICATIONS

PART 1 - DESCRIPTION AND SPECIFICATION

1.1 GENERAL

- A. The work of this section consists of all Structural Soil work and related items as indicated on the drawings or as specified herein and includes, but is not limited to, the following:

CU-Soil[™] is a proprietary material patented by Cornell University (US Patent #5,849,069) and marketed under the registered trademark, CU-Structural Soil[®]. Only licensed companies are authorized to produce this material, meeting the specifications described in this text. For a list of licensed CU-Soil[™] producers, call AMEREQ, INC. at 800-832-8788.

1.2 REFERENCES AND STANDARDS

- A. The following references are used herein and shall mean:

ASTM: American Society of Testing Materials

USDA: United States Department of Agriculture

AASHTO: American Association of State Highway and Transportation Officials

Standard Specifications: Regional or Municipal Standard Specifications Documentation for the location of proposed usage

AOAC: Association of Official Agricultural Chemists

1.3 SAMPLES AND SUBMITTALS

- A. At least 30 days prior to ordering materials, the installing contractor shall submit to the engineer representative samples, certificates, manufacturer's literature and test results for materials specified below. No materials shall be ordered until the required samples, certificates, manufacturer's literature, producer's current license and test results have been reviewed and approved by the landscape architect and/or engineer. The engineer reserves the right to reject any material that does not meet CU-Structural Soil[®] specifications. Delivered materials shall closely match the approved samples.
- B. Submit from licensed producer, 1/2 cubic foot representative sample of clay loam, one cubic foot representative sample of crushed stone, and one cubic foot representative sample of CU-Structural Soil[®] mix for approval. In the event of multiple source fields for clay loam, submit a minimum of one set of samples per source field or stockpile. The samples of all clay loam, crushed stone, and CU-Structural Soil[®] shall be submitted to the engineer as a record of the soil color and texture.
- C. Submit soil test analysis reports for sample of clay loam from an independent soil-testing laboratory. The testing laboratory for particle size and chemical analysis may include a public agricultural extension service agency.
1. Submit a mechanical analysis of the clay loam sample and particle size analysis including the following gradient of mineral content:

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USDA Designation	Size in mm.
Gravel	+2 mm
Sand	0.05 – 2 mm
Silt	0.002-0.05 mm
Clay	minus 0.002 mm

Sieve analysis shall be performed and compared to USDA Soil Classification System.

Sieve analysis shall be done by a combined hydrometer and wet sieving using sodium hexametaphosphate as a dispersant in compliance with ASTM D422 after destruction of organic matter by hydrogen peroxide.

2. Submit a chemical analysis, performed in accordance with current AOAC Standards, including the following:
 - a. pH and buffer pH.
 - b. Percent organic matter as determined by the loss of ignition of oven dried samples. Test samples shall be oven dried to a constant weight at a temperature of 230 degrees F, plus or minus 9 degrees.
 - c. Analysis for nutrient levels by parts per million.
 - d. Soluble salt by electrical conductivity of a 1:2 soil/water sample measured in Millimho per cm.
 - e. Cation Exchange Capacity (CEC).
 - f. Carbon/Nitrogen Ratio.

D. Submit one cubic foot sample of crushed stone which will be used in production of CU-Soil[™].

1. Provide particle size analysis:

USDA Designation	Size in mm.
3"	+76 mm
2 ^{1/2} "	63-76 mm
2"	50-63 mm
1 ^{1/2} "	37-50 mm
1"	25-37 mm
3/4"	19-25 mm
Fine gravel	2-19 mm

2. Provide the manufacturers analysis of the loose and rodded unit weight
3. Losses from LA Abrasion tests- not to exceed 40%
4. Minimum 90% with 2 or more fractured faces
5. Percent pore space analysis

E. At the engineer's discretion, the sample of CU-Structural Soil[®] may be tested for the following:

1. Compaction in accordance with ASTM D698/AASHTO T99 without removing oversize aggregate
2. California Bearing Ratio in accordance with ASTM D1883- soaked CBR shall equal or exceed a value of 50
3. Measured dry-weight percentage of stone in the mixture

F. The approved CU-Structural Soil[®] sample shall be the standard.

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- G. Any deviation from the specified crushed stone and clay loam specifications shall be approved by Amereq, Inc.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Delivered CU-Structural Soil[®] shall be at or near optimum compaction moisture content as determined by AASHTO T 99 (ASTM D 698) and should not be placed in frozen, wet or muddy sites.
- B. Protect CU-Structural Soil[®] from exposure to excess water and from erosion at all times. Do not store CU-Soil[™] unprotected. Do not allow excess water to enter site prior to compaction. If water is introduced into the CU-Soil[™] after grading, allow water to drain to optimum compaction moisture content.

1.5 EXAMINATION OF CONDITIONS

- A. All areas to receive CU-Structural Soil[®] shall be inspected by the installing contractor before starting work and all defects such as incorrect grading, compaction, and inadequate drainage shall be reported to the engineer prior to beginning this work.

1.6 QUALITY ASSURANCE

- A. Qualifications of installing contractor: The work of this section should be performed by a contracting firm which has a minimum of five years experience. Proof of this experience shall be submitted as per paragraph, SAMPLES and SUBMITTALS, of this section.

PART 2 - MATERIALS

2.1 CLAY LOAM

- A. Soil shall be a “loam” with a minimum clay content of 20% or a “clay loam” based on the “USDA classification system” as determined by mechanical analysis (ASTM D-422) and it shall be of uniform composition, without admixture of subsoil. It shall be free of stones, lumps, plants and their roots, debris and other extraneous matter. It shall not contain toxic substances harmful to plant growth. Clay loam shall contain not less than 2% or more than 5% organic matter as determined by the loss on ignition of oven-dried samples. Test samples shall be oven-dried to a constant weight at a temperature of 230 degrees F., plus or minus 9 degrees.
- B. Mechanical analysis for the loam or clay loam shall be as follows:

<u>Textural Class</u>	<u>% of Total Weight</u>
Gravel	less than 5%
Sand	20-45%
Silt	20-50%
Clay	20-40%

- C. Chemical analysis: Meet, or be amended to meet the following criteria:
 1. pH between 5.5 to 6.5
 2. Percent organic matter 2% - 5% by dry weight

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3. Adequate nutrient levels
 4. Soluble salt less than 1.0 mmho/cm
 5. Cation Exchange Capacity (CEC) greater than 10
 6. Carbon/Nitrogen ratio less than 33:1
- D. Loam or clay loam shall not come from USDA - classified prime farmland.

2.2 FERTILIZER (if needed)

- A. Should nutrient analysis suggest that the loam or clay loam need additional nutrients, it shall be amended by Amereq's licensed producer.

2.3 SULFUR (if needed)

- A. Sulfur shall be a commercial granular, 96% pure sulfur, with material and analysis appearing on the labeled container.
- B. Sulfur used to lower pH shall be a ferrous sulfate formulation.
- C. Application rates shall be dependent on soil test results.

2.4 LIME (if needed)

- A. Agricultural lime containing a minimum of 85% carbonates.
- B. Application rates shall be dependent on soil test results.

2.5 CRUSHED STONE

- A. The size of the crushed stone shall be 0.75 inches to 1.5 inches allowing for up to 10% being greater than 1.5 inches, and up to 10% less than 0.75 inches.
- B. Acceptable aggregate dimensions will not exceed 2.5:1.0 for any two dimensions.
- C. Minimum 90% with two or more fractured faces.
- D. Results of Aggregate Soundness Loss test shall not exceed 18%.
- E. Losses from LA Abrasion tests shall not exceed 40%.

2.6 HYDROGEL

- A. Hydrogel shall be a coated potassium propenoate-propenamide copolymer (Gelscape[®] Hydrogel Tackifier) as manufactured by Amereq, Inc. 800-832-8788.

2.7 WATER

- A. The installing contractor shall be responsible to furnish his own supply of water (if needed) free of impurities, to the site.

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2.8 CU-STRUCTURAL SOIL[®]

- A. A uniformly blended urban tree mixture of crushed stone, clay loam and Gelscape[®] Hydrogel Tackifier, as produced by an Amereq-licensed company, mixed in the following proportion:

<u>Material</u>	<u>Unit of Weight</u>
specified crushed Stone	100 units dry weight
specified clay loam	20 – 25 units (to achieve minimum CBR of 50)
Gelscape [®] Hydrogel Tackifier	0.035 units dry weight
moisture	ASTM D698/AASHTO T-99 optimum moisture

PART 3 - PRODUCTION AND INSTALLATION GUIDELINES

3.1 CU-SOIL[™] MIXING AND QUALITY CONTROL TESTING

- A. All CU-Structural Soil[®] mixing shall be performed at the licensed producer's yard using appropriate soil measuring, mixing and shredding equipment of sufficient capacity and capability to assure proper quality control and consistent mix ratios. No mixing of CU-Structural Soil[®] at the project site shall be permitted.

Maintain adequate moisture content during the mixing process. Soils and mix components shall easily shred and break down without clumping. Soil clods shall easily break down into a fine crumbly texture. Soils shall not be overly wet or dry. The licensed producer shall measure and monitor the amount of soil moisture at the mixing site periodically during the mixing process.

- B. Raw materials shall be mixed off-site, only at the licensed producer's facility, on a flat asphalt or concrete paved surface to avoid soil contamination.
- C. Should the independent laboratory test results of the clay loam reveal a need to amend it, to meet specifications, the amending materials should be added to the clay loam following the rates and recommendations provided by Amereq.

3.2 UNDERGROUND UTILITIES AND SUBSURFACE CONDITIONS

- A. The installing contractor shall notify the engineer of any subsurface conditions which will affect the contractor's ability to install the CU-Soil[™].
- B. The installing contractor shall locate and confirm the location of all underground utility lines and structures prior to the start of any excavation.
- C. The installing contractor shall repair any underground utilities or foundations damaged during the progress of this work.

3.3 SITE PREPARATION

- A. Do not proceed with the installation of the CU-Structural Soil[®] material until all walls, curb footings and utility work in the area have been installed. For site elements dependent on CU-Structural Soil[®] for foundation support, postpone installation of such elements until

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immediately after the installation of CU-Structural Soil[®].

- B. Install subsurface drain lines as shown on the plan drawings prior to installation of CU-Structural Soil[®] material.
- C. Excavate and compact the proposed subgrade to depths, slopes and widths as shown on the drawings. Maintain all required angles of repose of the adjacent materials as shown on the drawings. Do not over excavate compacted subgrades of adjacent pavement or structures.
- D. Confirm that the subgrade is at the proper elevation and compacted as required. Subgrade elevations shall slope parallel to the finished grade and/or toward the subsurface drain lines as shown on the drawings.
- E. Clear the excavation of all construction debris, trash, rubble and any foreign material. In the event that fuels, oils, concrete washout silts or other material harmful to plants have been spilled into the subgrade material, excavate the soil sufficiently to remove the harmful material. Fill any over excavation with approved fill and compact to the required subgrade compaction.
- F. Do not proceed with the installation of CU-Structural Soil[®] until all utility work in the area has been installed. All subsurface drainage systems shall be operational prior to installation of CU-Structural Soil[®].
- G. Protect adjacent walls, walks and utilities from damage. Use ½" plywood and/or plastic sheeting as directed to cover existing concrete, metal and masonry work and other items as directed during the progress of the work.
 - 1. Clean up all trash and any soil or dirt spilled on any paved surface at the end of each working day.
 - 2. Any damage to the paving or architectural work caused by the installing contractor shall be repaired, as directed by the engineer.
- H. Maintain all silt and sediment control devices required by applicable regulations. Provide adequate methods to assure that trucks and other equipment do not track soil from the site onto adjacent property and the public right of way.

3.4 INSTALLATION OF CU-STRUCTURAL SOIL[®] MATERIAL

- A. Install CU-Structural Soil[®] in 6 inch lifts and compact each lift.
- B. Compact all materials to at least 95% Proctor Density from a standard compaction curve AASHTO T 99 (ASTM D 698). No compaction shall occur when moisture content exceeds maximum as listed herein. Delay compaction if moisture content exceeds maximum allowable and protect CU-Structural Soil[®] during delays in compaction with plastic or plywood as directed by the engineer.
- C. Bring CU-Structural Soil[®] to finished grades as shown on the drawings. Immediately protect the CU-Structural Soil[®] from contamination by toxic materials, trash, debris, water containing cement, clay, silt or materials that will alter the particle size distribution of the mix with plastic or plywood as directed by the engineer.
- D. The engineer may periodically check the material being delivered, prior to installation for color and texture consistency with the approved sample provided by the installing contractor as part of the submittal for CU-Structural Soil[®]. If the engineer determines that the delivered CU-Soil[™] varies significantly from the approved samples, the engineer shall contact the

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licensed producer.

- E. Engineer shall ensure that the delivered structural soil was produced by the approved CU-Soil[™] licensee by inspecting weight tickets showing source of material.
- F. CU-Soil[™] should not be stockpiled long-term. Any CU-Soil[™] not installed immediately should be protected by a tarp or other waterproof covering.

3.5 FINE GRADING

- A. After the initial placement and rough grading of the CU-Structural Soil[®] but prior to the start of fine grading, the installing contractor shall request review of the rough grading by the engineer. The installing contractor shall set sufficient grade stakes for checking the finished grades.
- B. Adjust the finish grades to meet field conditions as directed.
Provide smooth transitions between slopes of different gradients and direction.
Fill all dips with CU-Soil[™] and remove any bumps in the overall plane of the slope.
 - a. The tolerance for dips and bumps in CU-Structural Soil[®] areas shall be a 3" deviation from the plane in 10'.All fine grading shall be inspected and approved by the engineer prior to the installation of other items to be placed on the CU-Structural Soil[®].
- C. The engineer will inspect the work upon the request of the installing contractor. Request for inspection shall be received by the engineer at least 10 days before the anticipated date of inspection.

3.6 ACCEPTANCE STANDARDS

- A. The engineer will inspect the work upon the request of the installing contractor. Request for inspection shall be received by the engineer at least 10 days before the anticipated date of inspection.

3.7 CLEAN-UP

- A. Upon completion of the CU-Structural Soil[®] installation operations, clean areas within the contract limits. Remove all excess fills, soils and mix stockpiles and legally dispose of all waste materials, trash and debris. Remove all tools and equipment and provide a clean, clear site. Sweep, do not wash, all paving and other exposed surfaces of dirt and mud until the paving has been installed over the CU-Structural Soil[®] material. Do no washing until finished materials covering CU-Structural Soil[®] material are in place.

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END OF SECTION