SECTION 30

ENGINEERED SOIL MIX

30-1 GENERAL

A. The work in this section is related to install, furnish, prepare, and compact Engineered Soil Mix (ESM) on a prepared subgrade for the purpose of compaction capacity of 95% and provide ample space in which tree roots will successfully grow.

30-2 RELATED WORK

1. Section 9, EARTHWORK
2. Section 10, SUBGRADE
3. Section 25, STREET TREE WELL
4. Section 26, TREE PROTECTION
5. Section 28, IRRIGATION

30-3 PRODUCTS

A. Engineered Soil Mix

1. Suppliers for the Engineered Soil Mix: All Engineered Soil mixing shall be performed by an agreed upon supplier 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 engineered soil mix at the project site shall be permitted. Mix suppliers include: TMT Enterprises, 1996 Old Oakland Road, San Jose, California, (408) 432-9040, or approved equal licensed by Amereq Inc. to distribute Engineered Soil according to the Cornell University patent.

2. Mix supplier shall have available at the mixing site sufficient equipment, instrumentation including qualified technicians to determine the weights and water content of the mix components immediately prior to the mixing procedure. The Contractor shall monitor these critical elements throughout the mixing process to provide adequate quality control. The supplier shall maintain a quality control log of material weight, water content and mix proportions for every fifteen (15) tons of material mixed. Maintain adequate moisture content during the mixing process. Soil and mix components shall easily shred and break down without clumping. Soil clods shall easily break down into fine crumbly texture. Soil shall not be overly wet or dry. The supplier shall measure and monitor the amount of soil moisture at the mixing site periodically during the mixing process.

3. The components for the ESM shall conform to the following specifications:

   a. Crushed granite stone: Three-quarters (3/4) inch to one-and-one-half (1-1/2) inch crushed granite quarry rock of angular, sharp texture. AASHTO #4. Stone shall be clean, sharp a free of other stone other than granite. Stone shall be angular in shape with a maximum average length, width and depth ration of 2:1:1. Stones with visible fracture lines will be rejected. Stones shall have a PH between 6.0 and 7.0, and soluble slat levels less than 300 ppm.

   b. Clay loam soil shall conform to the following requirements:

      Gradation Limits

      - Coarse sand: 10 to 15 percent
      - Medium sand: 15-20 percent
      - Fine sand: 0 to 5 percent
      - Clay 27 to 35 percent
      - Silt: 25 to 35 percent

      Chemistry Limits

      - pH between 5.5 and 7.0, and soluble salt levels less than 300 ppm.

   c. Hydrogel: Cross linked potassium copolymer hydrogel as manufactured by Gelscape by Amerq., Congers NY 10920 or Broadleaf P4 1041 W. 18th Street #A103 Costa Mesa, CA 92627, 1-800-628-7374.

   d. Filter fabric: Non-woven continuous filament polyester fabric. Weight 4.0 oz per square yard minimum. Grab strength 100 lbs. water flow rate 105 gpm/sq ft. Delivered in fifteen (15) foot wide roles minimum. Geolon 40 N as manufactured by Nicolon Corp, Valpariso, FL or approved equal.

4. Mix Proportions

   a. Approved proportion of materials in Engineered Soil shall be as follows:

Component	*By units of weight*	*By percentage*
Crushed Granite Stone	100 dry weight	70.97-74.97
Clay Loam Soil	18 – 21 dry weight	25 – 29
Hydrogel	0.03 dry weight	0.03
Water	10 ± (includes water in other ingredients)	
Other amendments	As recommended by test analysis	

b. During compaction, too much soil will separate stones and remove air spaces –too little soil will not provide adequate water retention.

30-4 EXECUTION

A. Mixing Protocol

1. Spread the crushed stone on a paved surface to maximum depth of six (6) inches. Mix the Hydrogel and sufficient water into slurry and spray over the crushed stone. After the stone is uniformly wetted by the slurry, spread the clay loam evenly over the crushed stone. Spray the remaining water over the soil and mix with a loader of other device until the mix obtains an even consistency. Do not over mix or over wet. If the mix begins to form balls or pellets of soil around the aggregate, discard the batch. Any palletized soil will be rejected.

2. ESM may alternatively be mixed in a commercial pug mill or other equipment approved by the Engineer.

3. Mixing should include any required soil amendments to alter soil fertility including fertilizers of pH adjustment.

4. After completion of the mixing and prior to installation, protect the ESM stockpiles(s) from rain and mix separation through erosion and excessive vibration during handling and placement. Cover the stockpile at all times with plastic sheeting.

5. Contractor shall procure sufficient quantities of ESM in advance of the time needed at the job site to allow adequate time for final quality control testing as required by the progress of the work. ESM shall be stored in piles no larger than 400 cubic yards and each pile shall be numbered for identification and quality control purposes. Storage piles shall be protected from drying out, rain and erosion by covering with plastic sheeting.

B. Delivery Storage and Handling

1. Prior to any delivery of ESM, Contractor shall hold a preconstruction meeting with the Engineer, mixers and operators and submit a logistics plan to discuss schedules, methods and techniques for mixing, delivery and installation of material.

2. Do not deliver or place soils in wet, muddy or frozen conditions. Materials shall be delivered at or near optimum compaction moisture content as determined by ASTM D 698 (AASHTO T 99). Do not delivery or place materials in an excessively

moist condition (beyond 2% above optimum compaction moisture content as determined by ASTM D698 (AASHTO T 99). Protect ESM from drying out, absorbing excess water and from erosion at all times. Do not store materials unprotected from large rainfall events. Do not allow excess water to enter site prior to compaction. If water is introduced into material after grading, allow material to drain or aerate to optimum compaction moisture content. ESM stored longer than two (2) days shall be inspected for water content, rehydrated and remixed as required to meet optimum compaction moisture content.

C. Site Preparation

1. Do not proceed with installation of ESM material until all subsurface drainlines, walls, curb footings, irrigation lines and utility work in the area have been installed. For site elements dependent on ESM for foundation support, postpone installation until immediately after the installation of ESM. All subsurface drainage systems shall be operational prior to the installation of ESM.

2. Excavate and compact the proposed sub-grades to depths, slopes and widths as shown on 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. Confirm that the subgrade is at the proper elevation and compacted as required. Subgrade elevations shall slope parallel to the finish grade or toward subsurface drain lines.

3. Excavate existing native soil so that the finish grade of the bottom of the structural soil will be the same grade as the bottom of the planted tree or minimum depth as shown on drawings, whichever depth is deeper. Contractor to verify with tree nursery the depths of the proposed tree rootballs, submit average depths of rootballs to Engineer so that final depth of excavation can be determined.

4. Clean the excavation of all construction debris, trash, rubble and any foreign materials. In the event that fuels, oils, concrete washout silts or other materials 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.

5. Protect adjacent walls, walks and utilities from damage or staining by soil. Clean up all trash and any soil or dirt spilled on any paved surface at the end of each working day. Any damages to the paving or architectural work caused by the installation of ESM shall be repaired or replaced by the Contractor at no additional cost. Maintain silt and sediment control devices, and provide adequate methods to assure that trucks and other equipment do not track soil from the site.

D. Installation of Engineered Soil Mix

1. Install ESM in six (6) inch lifts and compact every twelve (12) inches to eighteen (18) inches as required. Compact all materials to 95% peak dry density as defined by ASTM D 698 (standard AASHTO compaction curve AASHTO T 99). Hand tamp as necessary to protect utilities, irrigation lines and other subsurface features. Compaction testing procedures and equipment shall be calibrated for non-cohesive soils. No compaction shall occur when moisture content exceeds maximum as listed therein. Delay compaction twenty-four (24) hours if moisture content exceeds maximum allowable and protect ESM during delays in compaction with plastic or plywood as directed by the Engineer.

2. The ESM shall be able to maintain drainage of water at three-quarters (3/4) inch per hour after completion of compaction. Test the completed installation with a minimum of one random percolation test per 300 square feet of area as follows: Dig a hole in the compacted ESM ten (10) inches in diameter and ten (10) inches deep. Fill with water and let it drain completely. Immediately refill with water and time the rate of fall of the water in the hole. The water shall recede at a minimum rate of three-quarters (3/4) inch per hour. All testing shall be done in the presence of the Engineer. In the event that the installation fails to percolate at the required rate, the soil in the area shall be re-tested to determine if it meets the particle size distribution specified. Material that does not meet the specifications shall be removed at no extra cost to the City.

3. Bring ESM to finished grades as shown on the drawings. Immediately protect the ESM material from contamination by toxic materials, trash, debris, water containing cement, clay, silt or material that will alter the particle size distribution of the mix. After the ESM is installed, do not significantly delay, schedule or phase the progress or installation of the next layer of paving and planting above/in the ESM.

4. The Engineer may periodically check the material being delivered and installed at the site for color and texture consistency with the approved sample provided by the Contractor as part of the submittal for ESM. In the event that the installed material varies significantly from the approved sample, the Engineer may request that the Contractor test the installed ESM. Any soil that varies significantly from the approved testing results, as determined by the Engineer, shall be removed and new ESM installed that meets these specifications.

E. Fine Grading

1. After the initial placement and rough grading of the ESM but prior to the start of fine grading, the Contractor shall request review of the rough grading by the Engineer. The Contractor shall set sufficient grade stakes for checking the finished grades. Adjust the finish grades to meet field conditions as directed. Provide smooth transitions between slopes of different gradients and direction. Fill all dips and remove any bumps in the overall plane of the slope. The tolerance for dips and bumps in the ESM areas shall be a three (3) inch deviation from the plane in ten (10) feet. All fine grading shall be inspected and approved by the Engineer prior to the installation of other items to be placed on the ESM.

F. Installation of Filter Fabric

1. After the installation is completed and reviewed by the Engineer, install Filter Fabric on top of ESM in all areas that will be located below paving. Cut off excess fabric at the edge of the Engineered Soil.

G. Clean up

1. Upon completion of ESM installation, clean areas. Remove all excess fill soils, mix stockpiles and legally dispose of all waste materials, trash, and debris. Sweep, do not wash, all paving and other exposed surfaces of dirt and mud until the final paving has been installed over the mix. Avoid washing the area until all paving has been completed.

H. Procedure for Installation of Street Trees in Engineered Soil Mix

1. After the installation of the ESM and Filter Fabric is completed and adjacent pavement has cured and been approved by the Engineer, the street trees can be installed. Do not excavate planting holes until irrigation and drainage systems are tested and approved by Engineer. Locate planting holes in the center of tree well as shown on the plans or required by the Engineer. Notify any conflicts with underground utility lines to the attention of the Engineer. Excavate holes to diameter and depth shown on plans. Avoid over excavating or contaminating ESM with native soil. Stockpile excavated ESM to use as backfill. Cover with plastic sheeting to protect stockpile from contamination and drying out. ESM stockpiled longer than two (2) days shall be inspected for water content, rehydrated and remixed as required to meet optimum compaction moisture content. See Drawing Number 602 for details.

2. Prior to planting, test drainage of plants pits by filling with water twice in succession. Conditions permitting the retention of water in tree pits for more than twelve (12) hours shall be brought to the attention of the Engineer.

3. Handle the tree carefully. Set rootball on bottom of pit and center it in tree well opening. Backfill with ESM and settle with watering. Raise rootballs that settle below accepted finish grade as required by the Engineer.

END OF SECTION