

4.3 EARTHWORK. This subsection defines the requirements for excavation and backfill for structures, preparation of embankments and fills, and subgrade preparation for pavement and other surface improvements.

4.3.1 MATERIALS. Earthwork materials shall conform to the following:

4.3.1.1 EXCAVATION. All structures shall be founded on prepared original soil or engineered fill. Unauthorized excavation below the specified structure subgrade shall be replaced with concrete, untreated base course, or approved engineering fill thoroughly compacted to a minimum of ninety five percent (95%) of maximum dry density. Subgrade soil for all concrete structures, regardless of type or location, shall be firm and thoroughly compacted to a minimum of ninety-five percent (95%) of maximum dry density for granular soils or ninety percent (90%) of maximum dry density for silty/clay (fine-grained) soils.

4.3.1.2 SUBSOIL REINFORCEMENT. Coarse gravel, crushed stone, or a geotextile may be used for subsoil reinforcement when approved by the City Engineer. Coarse gravel or crushed stone shall be applied in six (6) inch layers, each layer being embedded in the subsoil by thorough tamping. Approved geotextile shall be installed in accordance with manufacturers recommendations. All excess soil shall be removed. The finished elevation of any subsoil shall not be above the specified sub-grade elevation.

4.3.1.3 BACKFILL. Backfill shall be placed to the lines and grades shown on the approved drawings, or as directed by the City's Representative. Prior to backfilling any construction work, the excavation shall be cleaned of all forms, trash and debris, and such material shall be removed from the site. Backfill material shall be approved and consist of excavated material or clean imported materials such as sand, gravel or other suitable material.

Backfill shall be placed in layers compatible with the equipment and not exceeding six (6) inches in compacted thickness. Each layer shall be compacted to a minimum density of ninety-five percent (95%) of maximum dry density for granular soils or ninety percent (90%) of maximum dry density for silty/clay (fine-grained) soils.

4.3.2 CONSTRUCTION METHODS. The methods employed in performing the work shall be the responsibility of the Contractor. These methods shall include, but are not limited to, the following:

4.3.2.1 CONSTRUCTION OF EMBANKMENTS. Unsuitable materials that occur in the foundations for embankments shall be removed by clearing, stripping and/or grubbing. When required by the City Engineer, the embankment and the materials used shall be approved by a Geotechnical Engineer. All materials in embankments shall be placed, moistened, and compacted as outlined in the following paragraphs.

When the material needed for embankment exceeds the amount of material available from excavation, sufficient additional materials shall be provided by the Contractor. All materials used for embankment construction shall be free from deleterious materials and rocks larger than three inches in diameter and all other material unsuitable for construction of embankments. Rocks larger than three inches may be used when recommended by the Geotechnical Engineer and approved by the City Engineer.

Grading of completed embankments shall bring the surfaces to a smooth, uniform condition with final grades being within 0.1 foot of the design grade. Cut and fill slopes shall be a 2 horizontal to 1 vertical maximum (2h:1v). Construction of slopes steeper than 2h:1v or fills in excess of five feet, or when placement is on a slope of greater than 5h:1v, shall be reviewed and recommended by the Engineer.

4.3.2.2 COMPACTION OF EARTH MATERIALS. The fill material shall be deposited in horizontal layers having a thickness of not more than eight (8) inches and then compacted to the density as herein specified. Moisture content during compaction operations shall be within two percent (2%) of optimum for granular soils and shall be two to five above (2%-%5) optimum for fine-grained soils unless otherwise directed by the Geotechnical Engineer. The moisture content shall be uniform throughout the layers.

If the moisture content is greater than specified for compaction, the compaction operations shall be delayed until such time as the material has dried to the specified moisture content. When the material has been conditioned as herein specified, the backfill or embankment shall be compacted as directed below.

Under roadways, curb and gutter, sidewalks and driveways, and extending one foot beyond the proposed construction (or to a distance equal to the depth of the embankment material, whichever is greater), the embankment material shall be compacted to a density equal to not less than ninety five percent (95%) for granular soils and ninety (90%)

percent for fine-grained soils. Other fills and embankments not noted above shall be compacted to ninety (90) percent maximum dry density. When compaction cannot be met with native or imported materials, a sand slurry mix (no gravel) may be used in lieu of compacted materials for backfill which is above the six to eight (6-8) inch zone above the pipe.

Exposed natural soils within construction areas, beneath walkways, slabs and pavement shall be scarified to a depth of twelve (12) inches, moisture conditioned, and compacted to the specified density. Where rock or other acceptable material is exposed, scarification may not be necessary.

Foundations for structures shall be uniform throughout and shall not be placed partially on undisturbed soil or compacted fill and partially on cemented deposits or rock.

Foundation soils should not be allowed to become saturated during construction.

4.3.2.3 SUBGRADE PREPARATION. As a minimum, the original soils under roadways, curb and gutter, sidewalks, and driveways shall be scarified to a depth of one foot prior to compaction operations. All scarified soils shall be compacted to the equivalent of ninety five percent (95%) of maximum dry density for granular soils or ninety percent (90%) of maximum dry density for fine grain soils. Additional overexcavation and recompaction of original soils due to poor subgrade conditions may be required. Subgrades shall be shaped and graded to the design grade. Drainage shall be maintained at all times. Subgrades shall be stabilized and compacted as directed. When springs or underground water is encountered during construction the Engineer and the City's Representative shall be notified immediately. Work shall not proceed until an acceptable mitigation plan is approved. Ground water discovered during construction shall not be ignored!

The subgrade preparation requirements listed above are considered to be the minimum. When required, the subgrade shall be overexcavated and the material removed from the site. Select borrow material may be imported, placed and compacted as directed by the City's Representative.

To demonstrate the stability and compaction of the subgrade, the Contractor may be required to proof-roll the subgrade prior to placing any base gravel. The subgrade shall be proof-rolled with at least one pass coverage with a rolller with pneumatic tires or other acceptable equipment of at least ten ton capacity. All proof-rolling shall be accomplished in the presence of the City's Representative. Ground contact pressure for all tires shall be eighty five to

ninety (85-90) psi unless otherwise recommended. When the proof-rolling shows an area to be unstable, it shall be brought to satisfactory stability by additional compaction, reworking, or removal of unsuitable material and replacement with acceptable material.

4.3.2.4 CONSTRUCTION OF NON-STRUCTURAL FILLS. Fills shall be placed to the lines and grades shown on the approved drawings and shall include all areas not specifically designated for support of structures, roads, utilities, easements, drainage ways, etc. (such as landscape areas, open space areas, etc.). Fill material shall generally be compacted to a minimum of ninety percent (90%) of maximum density and shall consist of material that can be compacted to prevent settlement such as soil, rocks, blocks, crushed stone, broken concrete, etc. Fill material shall not include broken asphalt, toxic or hazardous materials waste sludge, deleterious materials such as muck, ash, sod, grass, trash, tree stumps, lumber, dead animals, etc.

4.3.3 QUALITY CONTROL. All earthwork shall be performed in accordance with these standards and shall be tested and accepted as follows:

4.3.3.1 TESTING. Minimum testing of earthwork shall be as follows:

Soil Classification - One per material source. Soil classifications shall be in accordance with AASHTO M-145. For determination of granular soils or fine grained soils use ASTM D-2487 (Unified Soil Classification System). The sieve analysis shall be according to ASTM C-136 and C-117.

Soil Proctor - One determination for each significant change in soil type as necessary to provide required compaction testing. Tests shall be ASTM D-1557 method A or D (modified proctor).

Earth fill moisture/
density
determination - One test per five hundred (500) cubic yards of fill placed in an embankment. Tests shall be ASTM D-1556 or D-2922 and D-3017.

Subgrade moisture/
density
determination - One test per seven hundred fifty (750) square yards of surface area. Tests shall be ASTM D-1556 or D-2922 and D-3017. Additional moisture density determinations may be made when required by the City's Representative.

4.3.3.2 ACCEPTANCE. Any earthwork determined not to be in compliance with these standards shall be removed and replaced or reworked until compliance is obtained. Costs for the rework or testing the rework shall be paid for by the Contractor.

4.3.4 SPECIAL REQUIREMENTS. The requirements outlined in this section are only a minimum. When a geotechnical investigation is required, the recommendations of the geotechnical report shall be followed unless said recommendations are less than minimum standards.

All development projects shall submit a final soils engineering and engineering geology report in accordance with Uniform Building Code, 1994 Edition, Appendix Chapter 33, or as subsequently modified.