

### SECTION 3 EARTHWORK

**3-1 GENERAL** - Earthwork shall consist of all excavation, embankment and grading construction, except structural excavation and backfill thereof. Work under this section shall consist of performing all operations necessary to:

1. Excavate earth and rock, regardless of character and subsurface conditions, from the roadway prism or adjacent thereto;
2. Excavate all materials, of whatever nature, necessary for the construction of foundations for structures and other facilities;
3. Excavate drainage and irrigation ditches; to excavate drainage channels;
4. Excavate select material and borrow material for use as specified;
5. Construct embankments including the placing of select material in connection therewith as specified;
6. Place backfill for structures, and other facilities;
7. Backfill trenches and depressions;
8. Remove and replace unsuitable material;
9. Excavate and grade road approaches, driveways, and connections; to construct protection dikes;
10. Remove unstable material, slide material which has come into the graded area, and material which has slipped from embankments;

All Work shall be as shown on the Contract Plans and as specified in these City Standard Specifications and as directed by the Engineer.

Excavation trenching and backfilling for sewer, storm drain pipes, underground utilities, and other subsurface pipes shall be as specified in other sections of these Technical Provisions.

Whenever reference to finished grade is made, it shall be considered to be the finished surface of the completed facility. When the work covered by the Contract is stage construction, the relation between finished grade and the work covered by the Contract will be as shown on the Contract Plans.

Unless otherwise specified, quantities of all type of existing subbase, base, surfacing, or pavement removed will be included in the quantities of the type of excavation where they are located, and no separate payment will be made therefor.

Any excavation adjacent to a roadway traveled lane that is not backfilled prior to the end of a work day shall be sloped with a temporary earthen ramp starting at the edge of the traveled lane. The ramp slope shall be 6:1 or flatter, horizontal to vertical. Contractor shall place Type II barricades with flashing lights at least every twenty-five (25) feet along the excavated edge adjacent to the traveled way.

When hauling is done over highways or City streets all loads shall be trimmed and all material removed from shelf areas of vehicles in order to eliminate spilling of material. If necessary, loads shall be watered after trimming to eliminate dust. When in transit all loads shall be covered.

**3-2 CONTROL OF SURFACE AND GROUND WATER** - The Contractor shall provide and maintain slopes, crowns, and ditches on all excavations, fills and embankments to ensure satisfactory drainage at all times during the construction period. The Contractor shall be responsible for the construction of temporary dams, silting basins, and other facilities as required to prevent damage to the work, and eroded earth and silt from being deposited in streams or on adjacent properties. The finished subgrade shall not be disturbed by traffic or other operations and shall be protected and maintained by the Contractor in a satisfactory condition until subbase, base or pavement is placed. No separate payment will be made for this work, full payment shall be considered as being included in the unit bid price for the earthwork involved. The storage or stockpiling of materials on the finished subgrade will not be permitted. No subbase, base or pavement shall be laid until the subgrade has been checked and approved.

The Contractor shall take such measures as may be required, and shall furnish, install and operate such pumps or other devices as may be necessary to remove any seepage, storm water or sewage of any kind that may be found or may accumulate in the excavations during the progress of the work. The Contractor shall keep all excavations entirely free from water at all times during the construction of the work and until the Engineer gives permission to cease pumping.

**3-3 TOPSOIL** - When so specified in the Special Provisions or directed by the Engineer, topsoil shall be stripped to a depth of 4 to 6 inches and shall be either spread on areas indicated or shall be transported and deposited in stockpiles convenient to

areas that are to receive application of the topsoil later. Topsoil shall be kept separate from other excavated materials and stockpiled free of roots, stones, and other undesirable materials.

**3-4 CLASSIFICATION OF EXCAVATION** - Unless otherwise specified in the Special Provisions, all excavation shall be unclassified. When excavation is classified in the Special Provisions as rock or common excavation and separate payment items have been established for the same, then all excavation shall be done on a classified basis.

No consideration will be given to the nature of the materials under the designation of unclassified excavation. Earth and rock, regardless of character and subsurface conditions shall be excavated to the lines and grades as established by the Contract Plans.

**3-5 UNSUITABLE MATERIAL** - Material below the natural ground surface in embankment areas and basement material in excavation areas below the limits specified in Section 3-14, "Compaction," of these Technical Provisions, that is unsuitable for the planned use, shall be excavated and disposed of as approved by the Engineer.

If removal of such unsuitable material is not shown on the Contract Plans or specified in the Special Provisions, the removal and disposal of such unsuitable material will be paid for at the contract prices for roadway excavation for the quantities involved. If there is no contract bid price for roadway excavation, or removal of unsuitable material is not paid for under other contract bid items, the removal and disposal of such unsuitable material will be paid for as extra work as provided by Section 9-3, "Extra Work," of the General Provisions of the City Standard Specifications or other basis as approved by the Engineer.

When unsuitable material is removed and disposed of, the resulting space shall be filled with material suitable for the planned use. Such suitable material, upon approval of the Engineer, may be placed and compacted in layers as hereinafter specified for constructing embankments.

In place materials or native materials that, in the opinion of the Engineer, would have been suitable had they not been damaged by the Contractor's operations shall be removed and replaced to the satisfaction of the Engineer at no expense to the City.

**3-6 SLIDES AND SLIPOUTS** - Material outside the planned roadway or ditch slope which is unstable and constitutes a potential slide in the opinion of the Engineer, material which has come into the roadway or ditch, and material which has slipped out of new or old embankments shall be excavated and removed. The material shall be excavated to designated lines or slopes either by benching or in such manner as approved by the Engineer. Such material may be used in the construction of the embankments when approved by the Engineer.

The removal and disposal of slide and slip-out material as above specified, and not resulting from any act or failure to act on the part of the Contractor, will be paid for at the contract prices of roadway excavation for the quantities involved. However, if in the opinion of the Engineer the character of the work, the removal and disposal of such material cannot be properly compensated at the contract prices for roadway excavation, the work may be paid for as provided by Section 9-3 "Extra Work" of the General Provisions of the City Standard Specifications, provided the Contractor requests in writing such payment prior to performing any such work.

Only those quantities of slide or slip-out material, which are actually removed as ordered by the Engineer, will be paid for.

**3-7 SLOPES** - Excavation slopes shall be finished in conformance with the lines and grades shown on the Contract Plans. All debris and loose material shall be removed. When completed, the average plane of the slopes shall conform to the slopes indicated on the Contract Plans and no point on the completed slopes shall vary from the designated plane by more than 6 inches measured at right angles to the slope. Where excavation is in rock no point shall vary more than 2 feet from the designated plane of the slope. In no case shall any portion of the slope encroach on the roadbed or interfere with the planned use of the facility.

**3-8 SURPLUS MATERIALS** - Unless otherwise shown on the Contract Plans or specified in the Special Provisions, no surplus excavated material may be disposed of within the right-of-way or on adjacent property within the project area. Unless otherwise specified in the Special Provisions, surplus excavated material to be disposed of shall become the property and responsibility of the Contractor and shall be disposed outside the City at the Contractor's expense, unless otherwise provided otherwise in the Specific Provisions.

Quantities of surplus material, if any shown on the Contract Plans or in the Special Provisions, are approximate only. The Contractor shall satisfy himself that there is sufficient material available for the completion of the embankments before disposing of any indicated surplus material. Any shortage of material, caused by premature disposal of the indicated surplus material by the Contractor, shall be replaced by him and no compensation will be allowed for such replacement.

**3-9 SELECT MATERIAL** - Shall be defined as materials which are excavated from the project site and which are satisfactory for use in fills, embankments, as backfill or other uses as specified or approved, insofar as such material is suitable for compaction, contains no cemented lumps or rocks larger than 3 inches in greatest dimension, is free of topsoil, organic and other deleterious materials, and is approved by the Engineer.

Select material, excluding topsoil, encountered in the excavation may be used in roadway embankments or other embankments where approved by the Engineer. Topsoil excavated within the limits of the project may be used only in areas to be planted.

When practicable, select material shall be hauled directly from excavation to its final position in the embankment and compacted in place. Select material may be stockpiled by the Contractor, for Contractor's convenience, with approval of the Engineer.

Full payment for hauling, compacting, stockpiling, re-handling or other work involved in the use or disposal of select material shall be considered as included in the various contract bid items of work and no additional compensation shall be made therefor.

**3-10 MEASUREMENT** - Roadway excavation shall be paid for by the number of cubic yards of material excavated, as classified or unclassified excavation, as defined in these Technical Provisions. Quantities shall be measured in the original position and computed by the average end area method. The following types of excavation will be measured as roadway excavation:

- 1) Excavating for the Roadway Prism
- 2) Excavating Public and Private Road Approaches
- 3) Excavating for Roadside Shoulders
- 4) Over-Excavating of Unsuitable Materials
- 5) Channels and Creeks

Excavating in excess of the planned or authorized cross sections will not be paid for. The Contractor shall backfill and compact unauthorized excavated areas to the original ground elevation or authorized section at no expense to the City.

The measurement will not include the yardage of subgrade material or other material that is scarified or plowed and reused in place by road mixing or other similar in place method of operation.

Where due to changed conditions or the nature of a particular operation or for any other reason, it is impossible or impractical to measure quantities of common excavation by means of average areas, the Engineer will compute the quantities of material excavated by a method which in the Engineer's opinion is best suited to obtain an accurate determination.

When quantities of roadway excavation are computed by means of average end areas and centerline distances, a correction for curvature will not be applied to quantities within the roadway prism.

The final estimate of roadway excavation quantities shall be the quantities included within the planned or authorized cross section, excluding the rounding of the tops of excavation slopes and ends of excavations, and the quantities involved in the removal of slides and slipouts.

### **3-11 PAYMENT**

Quantities of classified or unclassified roadway excavation will be paid for at the contract unit price per cubic yard for the respective classification. Such contract unit price shall be considered as full compensation for excavating, loading, hauling, depositing, spreading, grading, watering, and compacting as embankment construction, including but not limited to; sloping, rounding tops and ends of excavations and no additional compensation shall be made therefor. If there is no bid item for Roadway Excavation, full payment shall be considered as included in the other contract items of work.

**3-12 STRUCTURE EXCAVATION AND BACKFILL**

**3-12.1 General** - Structure excavation and backfill shall consist of the removal of material for the construction of foundations for bridges, box culverts, retaining walls, headwalls and endwalls for culverts, reservoirs, buildings, and other structures, and other excavation designated on the Contract Plans or in these Specifications, or in the Special Provisions as structure excavation.

Structure backfill shall consist of furnishing, placing and compacting backfill material around structures to the lines designated on the Contract Plans or specified or directed by the Engineer.

Structure excavation and structure backfill shall include the furnishing of all materials and equipment and the construction or installation of all shoring, cofferdam and sheeting and/or other facilities which may be necessary to perform the excavations and place and compact the backfill, and the subsequent removal of such facilities, except where they are required or permitted by the Contract Plans or Specifications to remain in place.

When shown on the Contract Plans or directed by the Engineer, recesses of culvert inlets shall be excavated in excavation slopes to the dimensions designated and the resulting material disposed of as approved by the Engineer. Such work will be paid for as structure excavation for the quantities involved.

Surplus material from structure excavation may be placed in embankments as provided for in Section 3-13, "Embankment Construction," or disposed of as provided for in Section 3-8, "Surplus Material," as approved by the Engineer. No additional compensation will be allowed for disposal of surplus material or its incorporation into the work.

**3-12.2 Foundation Subgrade Treatment** - When footing concrete or masonry is to rest upon rock, the rock shall be fully uncovered and the surface thereof shall be removed to a depth sufficient to expose sound rock. The rock shall be roughly leveled off or cut to approximate horizontal and vertical steps, and shall be roughened. Seams in the rock shall be grouted under pressure or treated as the Engineer may direct and the cost thereof will be paid for as extra work.

When no piles are used and footing concrete or masonry is to rest on an excavated surface other than rock, care shall be taken not to disturb the bottom of the excavation and final removal of the foundation material to grade shall not be made until just before the concrete or masonry is placed. Except when over-excavation is directed by the Engineer, excavation below grade shall be replaced at the Contractor's expense with the same class of concrete specified for the structure and at the time the concrete for the structure is being placed.

The excavation for piers and abutments shall be completed to the bottom of the footings before any piles are driven therein, and excess material remaining in the excavation after pile driving shall be removed to the elevation of the bottom of the footings.

When piles are used and ground displacement results from pile driving operations, the Contractor, at no expense to the City, shall excavate or backfill the footing areas to the grade of the bottom of the footing as shown on the Contract Plans with structure backfill material.

**3-12.3 Foundation Inspection** - Whenever any structure excavation is completed, the Contractor shall notify the Engineer who will conduct a construction review of the foundation. No concrete or masonry shall be placed until the Engineer has approved the foundation.

**3-12.4 Structure Backfill** - Shall not be placed until the structure footings or other portions of the structure or facility have been reviewed by the Engineer and approved for backfilling. No backfill material shall be deposited against the back of concrete abutments, concrete retaining walls, foundation walls, or the outside walls of cast-in-place concrete culverts until the concrete has developed a strength of not less than 2,500 psi in compression as determined by test cylinders cured under conditions similar to those prevailing at the site.

Unless otherwise specified in the Special Provisions, structure backfill shall consist of approved select material from excavation, free from stones or lumps exceeding 3 inches in greatest dimension, vegetable matter, or other unsatisfactory material and having a minimum Sand Equivalent (per CA Test 217) of 20. When in the opinion of the Engineer the material from excavation is unsuitable for use as backfill, it shall be disposed of as provided for by Section 6-16, "Disposal out Side of Project Limits," of the General Provisions of the City Standard Specifications.

Suitable material, as approved by the Engineer, shall be furnished by the Contractor as replacement for unsuitable material.

Consolidation of structure backfill by pounding and jetting will be permitted when, as determined by the Engineer, the backfill material is of such character that it will be self-draining when compacted and that foundation materials will not soften or be otherwise damaged by the applied water, and no damage to the structure from hydrostatic pressure will result. Pounding and jetting of the upper 2 feet below finish subgrade will not be permitted in roadway areas. When ponding and jetting is permitted, material for use as structure backfill shall be placed and compacted in layers not exceeding 4 feet in thickness. The work shall be performed without damage to the structure or softening of the embankment, and in such a manner that excess water will not be impounded. Pounding and jetting methods shall be supplemented by the use of vibratory or other consolidation equipment when necessary to obtain the required consolidation.

**3-12.5 Pervious Material** - Pervious backfill material shall be placed behind bridge abutments, wingwalls, and retaining wall as show on the Contract Plans and as provided for herein.

Sieve Size	Percentage Passing
3/4"	100
3/8"	80-100
No. 100	0-8
No. 200	0-3

That portion of the filter material passing a No. 4 sieve shall have a Sand Equivalent (per CA Test 217) of not less than 60. All weep holes shall be backed with 2 cubic feet of pervious material conforming to the requirements of Section 17-1.2, "Aggregates," of these Technical Provisions. The pervious material shall be securely tied in a burlap sack; and placed in such a manner that the backing covers the weep holes and extends at least 12 inches above the bottom of the opening.

An 8-inch-square section ¼-inch galvanized or aluminum screen having a minimum wire diameter of 0.03 inch shall be firmly attached at the back of each weep hole before the material is placed.

Pervious backfill material shall be placed in layers along with and by the same methods specified for structure backfill. Pervious backfill material at any one location shall be approximately the same grading, and at locations were the material would otherwise by exposed to erosion, shall be covered with a 1-foot layer of impervious soil.

There shall be no measurement or payment for furnishing and placing previous material or weep hole backing. Full compensation for furnishing and placing all pervious material, as provided for herein, shall be considered as included in the other contract bid items of work.

**3-12.6 Measurement** - Unless provided for otherwise in the Special Provision, there shall be no separate measurement for Structure Excavation and backfill.

**3-12.7 Payment** - Unless otherwise provided in the Special Provisions, no separate payment will be made for structure excavation or backfill. The cost thereof shall be considered as included in the price bid for the construction or installation of the items to which such excavation or backfill is incidental or appurtenant

### **3-13 EMBANKMENT CONSTRUCTION**

**3-13.1 General** - Shall consist of constructing embankments and fills, including the preparation of the areas upon which they are to be placed; buttress fills; dikes; the placing and compacting of approved material within areas where unsuitable material has been removed; and the placing and compacting of material in holes, pits and hole depressions.

Areas over which fills are to be placed shall be cleared and scarified to provide a bond between the existing ground and the material to be deposited thereon. When fills are to be placed over existing surface improvements that are to remain in place, such clearing and scarifying will not be required. Whenever a fill is constructed upon an existing structure or pavement, 4 inch drainage holes shall be drilled through the structure on 5 foot centers each way or the pavement shall be broken by stomping in a grid pattern of 5 feet each way.

Rocks, broken concrete, or other solid materials which are larger than 4 inches in greatest dimension, shall not be placed in fill areas where piles are to be placed or driven, or that would interfere with the construction for other structures.

When fill is to be made and compacted on hillsides or where new fill is to be compacted against existing fill or where embankment is built one-half width at a time, the slopes of original hillsides and old or new fills shall be benched a minimum of 4 feet horizontally as the fill is placed. A new bench shall be started where the vertical cut for the next lower bench intersects the existing ground.

Materials thus cut out shall be re-compacted along with the new embankment material at the Contractor's expense unless the width of the bench required by the Engineer exceeds 4 feet, in which case the excavated material in excess of 4 feet will be measured and paid for as excavation.

Clods or hard lumps of earth of 6 inches in greatest dimensions shall be broken up before compacting the materials in embankment. When rocks, boulders, or hard lumps greater than 12 inches in greatest dimension are encountered and cannot be broken down with conventional equipment they may be incorporated in embankments when authorized by the Engineer, and provided, they are well distributed throughout the embankment. Sufficient earth or other fine material shall be placed around the large material as it is deposited so as to fill the interstices and produce a dense, compact embankment.

When structure footings are to be constructed in embankment, the embankment shall be constructed to the elevation of the grading plane before excavating for the footing, or when foundation piling is shown on the Contract Plans, before driving the piles or excavating for the footing.

**3-13.2 Compacting** - Embankment shall be constructed in compacted layers of uniform thickness and each layer shall be compacted in accordance with the requirements herein specified with the following exception: where embankments are to be constructed across low, swampy ground which will not support the weight of hauling equipment, the lower part of the embankment may be constructed by dumping excessive loads in a uniformly distributed layer of a thickness not greater than that necessary to support the equipment while placing subsequent layers. The remainder of the embankment shall be constructed in layers and compacted as specified.

The construction of dikes, the placing and compacting of approved material where unsuitable material has been removed, and the filling of holes, pits and other depressions shall conform to all of the requirements specified herein for compacting embankments. Trenches, holes, depressions and pits outside of areas where embankments are to be constructed shall be graded to provide a presentable and well-drained area.

Embankments shall be constructed so that each layer shall have a cross fall of at least 2% but not more than 5%.

The loose thickness of each lift of embankment material shall not exceed that which will provide the specified relative compaction through the full depth of the lift by the specific compaction equipment being utilized. Each lift shall be compacted in accordance with the requirements of Section 3-14, "Compaction," of these Technical Provisions.

When embankment material contains by volume, in the Engineer's estimate, over 25% of rock larger than 6 inches in greatest dimension, it may only be used 3 feet below the finished grade

The interstices around the rock in each layer shall be filled with earth or the fine material and compacted. Broken Portland Cement concrete and bituminous type pavement obtained from the project excavations will be permitted in the embankment with the following limitations:

- 1) The maximum dimension of any piece used shall be six inches.
- 2) Pieces larger than 4 inches shall not be placed within 12 inches of any structure.
- 3) Pieces larger than 3 inches shall not be placed within 12 inches of the subgrade for paving.
- 4) "Nesting" of pieces will not be permitted.

At locations where it would be impracticable to use mobile power compacting equipment, embankment layers shall be compacted to the specified requirements by any approved method that will obtain the specified relative compaction.

At the time of compaction, the moisture content of embankment material shall be such that the specified relative compaction will be obtained and the embankment will be firm, hard and unyielding. Embankment material, which contains excessive moisture, shall not be compacted until the material is dry enough to obtain the required relative

compaction. Full compensation for any additional work involved in drying embankment material to the required moisture content shall be considered as included in the contract unit prices and no additional compensation will be allowed therefor.

**3-13.3 Measurement** - There shall be no separate measurement for embankment.

**3-13.4 Payment** - Full compensation for constructing embankments, preparing subgrade at the grading plane, doing necessary plowing or benching, constructing all dikes, placing and compacting approved material where unsuitable and unstable embankment foundation material has been removed, filling and compacting holes, pits, and other depressions, backfilling excavations resulting from the removal of structures and other facilities, placing select material where required, placing topsoil excavated from within the project limits on slopes, placing select material and topsoil in stockpiles, all as shown on the plan and as specified in these Specifications and the Special Provisions, shall be considered as included in the contract price paid per cubic yard for excavating the material or the contract price paid for furnishing and placing the material, as the case may be, and no additional compensation will be allowed for such work.

Where embankment is specified in the bid schedule or in the Special Provisions full compensation for constructing such embankments shall include the cost of all the necessary excavation in connection therewith, both within the limits of the project or otherwise, together with the cost of all grading, shaping, and other work that is required under this Section 3-15, "Embankment Construction," of these Technical Provisions. The quantities used in determining payment for embankment bid items shall be those of the completed embankments in place within the limit of dimensions shown on the Contract Plans.

### **3-14 COMPACTION**

**3-14.1 General** - Earthwork compaction consists of obtaining the required compaction in all earthwork described in these Specifications or the Special Provisions, except structure backfill.

Embankments shall be constructed in layers. The loose thickness of each layer of embankment material before compaction shall not exceed 0.67 foot, except as provided for rocky material.

When necessary to protect existing trees the Engineer may require compaction to be reduced below that specified herein. To protect existing trees the Engineer may require the Contractor to use smaller compaction equipment including hand operation tools. Existing trees within the limits of construction not to be removed shall be protected and treated in accordance with Section 22-3, "Tree and Plant Protection," of these Technical Provisions.

**3-14.2 Relative Compaction (95 Percent)** - Unless otherwise specified in the Special Provisions, whether in excavation or embankment, when subbase, base, pavement, or curb and gutter is to be placed directly on subgrade material, the top 6 inches of subgrade material shall be compacted to a relative compaction of 95 percent. After compaction and trimming, the subgrade shall be firm, hard, and unyielding. When expansive soils are encountered, the Engineer may require that 6 inches of expansive soils be removed and replaced with either aggregate base or subbase, this will be in lieu of the 95 percent subgrade compaction requirement. This provision does not waive the requirement in regard to "Unsuitable Material".

In addition, relative compaction of not less than 95 percent shall be obtained under subbase, base, pavement, sidewalks, curb ramps, driveways, and curbs and gutters for a minimum depth of 2.5 feet below finished grade in embankment areas.

Relative compaction of not less than 95 percent shall be obtained for embankment under wall footings without pile foundations within the limits established by inclined planes sloping 1:1 out and down from lines one foot outside the bottom edges of the footing.

**3-14.3 Relative Compaction (90 Percent)** - Relative compaction of not less than 90 percent shall be obtained in all layers of material in embankment, except as specified herein to be 95 percent, for a minimum depth of 2.5 feet below finished grade.

**3-14.4 Measurement** - There shall be no separate payment for compacting earthwork.

**3-14.5 Payment** - Compaction will be considered as included in the various contract items of work requiring compaction and no separate payment will be made therefor

**3-15 FINISH AND TOLERANCE** - The surface of all excavations, fills, embankments, and subgrade shall be finished to a reasonably smooth and compact surface, substantially within 0.10 foot above or below the planned elevation, the lines,

grades, and cross sections or elevations, except for roadways, parking areas, sidewalks, and other paved areas, the finished subgrade of such areas shall not vary more than 0.03 foot above nor 0.05 foot below the planned elevation.

All other site areas that have been excavated, or that have received fill or embankments (excluding roadways and other paved areas), shall be finished within a tolerance of plus or minus 0.2 foot.