

PART 00300 - ROADWORK

Section 00310 - Removal of Structures and Obstructions

Description

00310.00 Scope - This work consists of removing and disposing of man-made materials and cleaning up areas they occupy. Provisions for removing bridges, including payment, are given in Section 00501.

00310.01 Area of Work - Perform removal work in the same areas as specified in 00320.01.

If a building to be removed lies partly within the right-of-way, remove the entire building unless otherwise designated on the plans or stated in the Special Provisions.

00310.02 Exclusions - Removal work does not include removal or disposal of materials which are:

- Designated to remain
- Included in earthwork as given in 00330.41
- Specifically indicated by the Specifications, plans, or Special Provisions to be removed incidental to other items of work under the Contract
- Owned or controlled by third parties

00310.03 Definitions:

Track - The parallel rails of a railroad

Tie - One of the transverse supports to which railroad rails are fastened to keep them in line.

Construction

00310.40 Restrictions on Removal Work - In those areas where guard rail, median rail or concrete barrier are to be removed and replaced with new or salvaged rail or barrier, do one of the following:

- Install the new or salvaged units the same working shift the existing unit is removed
- Protect the area with temporary, precast concrete barrier units with appropriate end treatment satisfactory to the Engineer, until the new or salvaged unit is installed

00310.41 Removal Work:

(a) General - Where an abutting structure or a part of a structure is to be left in place, make cuts that protect remaining structures and allow for specified connections. When removing pavements, curbs, sidewalks and other similar structures, all cuts where an abutting structure is to be left in place shall be clean, smooth, vertical cuts made with a concrete saw or other approved cutting device to the lines as established.

Do not remove sidewalk corners until any historic dates and/or street names are documented for replacement under 00759.50(d).

(b) Guard Rail Posts - Remove posts completely and backfill holes with selected granular backfill material meeting the requirements of 00330.14.

(c) Drainage Structures - Remove drainage structures, such as box culverts, down to a depth 2 feet below ground, slope or waterway bed. Remove culverts, sewers, siphons, and other conduits according to 00330.41(a)(7).

(d) Materials Within Construction Areas:

(1) General - Remove materials within construction areas entirely or break down the materials to an elevation at least 2 feet below subgrade or slope surface as allowed below.

(2) Bituminous Treated Surfaces - Scarify and break up existing bituminous treated surface when it lies under subgrade and is not salvaged. Incorporate the scarified material into the embankment. Pieces of existing pavement shall not exceed 15 inches in any dimension.

(3) Concrete Floors, Slabs and Walls - Before placing material in basements or over concrete slabs, remove or break through the floors, slabs and walls so no fragments have a dimension in excess of 15 inches. The broken concrete and masonry shall not have protruding reinforcement.

(4) Railroad Track and Ties - Break up existing grout or concrete between and below the ties when it lies under the subgrade. Pieces of grout or concrete shall not exceed 15 inches in any dimension. Provide written documentation of where the ties were disposed.

(5) Cobblestones (Belgian Paving Blocks) - Salvage quantities of 150 or more of Belgian Paving Blocks, commonly known as cobblestones, which may be removed in the course of excavation. The cobblestones shall be cleaned and delivered to Chimney Park at 9360 N Columbia Blvd. or other designated site. Notify the Operations Division of the Bureau of Parks and Recreation at 503-823-3643 a minimum of 48 hours prior to delivery. Assume ownership of quantities less than 150 cobblestones.

(6) Horse Rings - Salvage any metal horse rings encountered during curb removal. Reinstall horse ring assembly back at the same project stationing or as close as practical. If no new curb is constructed, deliver horse ring assemblies to the City's Maintenance Bureau at Stanton Yard located at 2835 N Kerby Ave.

(e) Materials Outside of Construction Areas - Remove materials which lie outside of construction areas to an elevation at least 2 feet below the surface elevation to which the affected area is to be finished.

00310.42 Salvaging Drainage Structure Fittings - Metal grates, frames, rings, covers, and other metal fixtures or fittings for drainage structures may be salvaged and used on new structures if the Engineer determines they are reusable. [Any excess materials not needed on the Project, but deemed usable, shall be delivered to the City's Maintenance Bureau located at 2929 N Kerby Avenue.](#)

00310.43 Disposal of Material:

(a) Burnable Material - [Burning is not allowed.](#) Dispose of burnable material according to [00310.43\(d\).](#)

(b) Concrete and Masonry - Concrete and masonry, when not salvaged, may be used to fill basements or be buried in embankments on the Project provided that the materials are broken into pieces not exceeding 15 inches in any dimension, and placed so that:

- No part of any piece is within 2 feet of the top, side or end surface of the basement, embankment, or other structures
- The fill or embankment is constructed and compacted according to 00330.42 and 00330.43

(c) Disposal on City-Owned Lands - Do not dispose of materials on [City-owned](#) or [City-controlled](#) lands except when shown on the plans, specified or permitted in writing. If permitted, place the materials only at specified locations, as directed.

(d) Other Disposal - All other materials not covered in 00310.43(a), (b), and (c) become the property of the Contractor at the place of origin. Dispose of at own expense.

Subject to local zoning codes and the requirements of 00280.03, materials may be placed on other properties in a manner consistent with environmental requirements, and with written permission of the property owner. Furnish the Engineer a copy of the signed agreement with the owner before any disposal of material. Do not place these materials in a location visible from a public highway, road, or street, unless the site is zoned and licensed for landfill.

00310.44 Earthwork in Connection with Removal - Excavation required to perform removal of structures and obstructions will be considered Incidental to the removal work, unless it is within the measurement limits for an excavation Contract pay item.

Backfill holes according to 00330.45. The backfill will be measured for payment according to 00330.82, when there is an embankment measure basis pay item for earthwork and that material is used for backfilling, otherwise no separate payment will be made for this work.

Maintenance

00310.60 Repair of Damages - Repair promptly any breakage or damage to materials or items not intended to be removed. Complete replacement of the affected materials may be required if the Engineer determines it is necessary. Make all repairs and replacements at no cost to the City.

Measurement

00310.80 Lump Sum Basis - If the Special Provisions or Contract bid schedule items indicate that payment for part or all of the removal work is to be done on a lump sum basis, there will be no measurement of removal work. *The estimated quantities of man-made material removals will be listed in the Special Provisions.*

00310.81 Separate Item Basis - If the Special Provisions or Contract bid schedule items indicate a unit basis of payment, measurement of quantities will be made as follows:

- **Length and Area** - The length or area of the structure or item actually removed, measured along the line and grade of the structure or item for each continuous structure or item removed. Measurement will be limited to the neat lines shown on the plans or as directed.
- **Each** - Items will be measured on a unit basis, per each, by actual count of units removed.

00310.82 Temporary Precast Concrete Barrier - No separate measurement will be made for barriers used for temporary protection in median and guardrail areas according to 00310.40.

Payment

00310.90 Lump Sum Basis - The accepted quantities of removal work done on a lump sum basis will be paid for as follows:

Pay Item	Unit of Measurement
(a) Removal of Structures and Obstructions	Lump Sum
(b) Removal of _____	Lump Sum

Item (a) applies to all removal work done on a lump sum basis, except as covered under pay items given in the form of (b).

Items in the form of (b) will have the specific kind or description of removal work inserted in the blank.

Payment will be payment in full for furnishing all equipment, labor, and incidentals necessary to complete the work as specified.

00310.91 Separate Unit Basis - The accepted quantities of removal work done on a unit basis will be paid for at the Contract price per unit of measurement for the following items:

Pay Item	Unit of Measurement
(a) Removal of Pipes.....	Foot
(b) Removal of Curbs	Foot
(c) Removal of Walks and Driveways	Square Yard
(d) Removal of Surfacing.....	Square Yard
(e) Removal of Inlets	Each
(f) Removal of Manholes	Each
(g) Removal of Concrete Stairs.....	Cubic Yard
(h) Removal of Railroad Track and Ties	Foot
(i) Salvaging and Stockpiling of Cobblestones.....	Square Yard
(j) Remove and Reinstall Existing Horse Rings	Each

Item (d) applies to removal of all surfacings, except for walks and driveways, as defined in 00110.20 under "Existing Surfacing".

Item (g) includes removal of handrail.

Item (h) includes all track and tie appurtenances.

Item (i) applies to the separation, cleaning, delivering and stockpiling of the cobblestones as specified.

Item (j) applies to horse ring assemblies remove from existing curb and reinstalled in new curb or delivered as specified.

Payment will be payment in full for furnishing all equipment, labor, and incidentals necessary to complete the work as specified.

00310.92 Temporary Precast Concrete Barrier - No separate or additional payment will be made for barriers used for temporary protection where guard rail, median rail or concrete barriers have been removed. Providing protection will be incidental to the work.

Section 00320 - Clearing and Grubbing

Description

00320.00 Scope - This work consists of removing and disposing of vegetation and buried matter within a specified area or as directed. The work also includes preserving vegetation and objects designated to remain in place and cleanup of the work area.

00320.01 Areas of Work - The areas to be cleared and grubbed are shown on the plans, or if not shown on the plans, the clearing lines are 10 feet outside the following:

- Top of side slopes of ditches and channel changes
- Top of cut slope
- Top of cutbank rounding if rounded
- Toe of fill slope
- Outside edge of structure
- Other work areas shown on the plans, such as material sources, borrow areas and road connections
- Tree, plant, or natural areas to be preserved

00320.02 Definitions:

(a) Clearing - Clearing consists of:

- Preserving trees and other vegetation designated to remain in place
- Salvaging marketable timber, when required by the Special Provisions
- Cutting and removing vegetation, such as weeds, grasses, crops, brush, and trees
- Removing down timber and other vegetative debris

(b) Grubbing - Grubbing consists of removing:

- Brush stems remaining above the ground surface after the clearing work
- Tree Stumps
- Roots and other vegetation found below ground surface
- Partially buried natural objects

(c) Clear Zone - The clear zone is the roadside border area, starting at the edge of the traveled way, available for safe use by an errant vehicle. The minimum clear zone line, for purposes of this Section, is 30 feet from the edge of the traveled way, but this distance may vary depending on design speed, horizontal alignment and side slope requirements.

Construction

00320.40 Clearing Operations:

(a) Clearing Trees and Other Vegetation - Cut trees and brush so they fall into the areas specified to be cleared.

Cut off tree stumps, not required to be grubbed under 00320.41:

- Flush with the ground surface if within the clear zone
- No higher than 4 inches above the ground surface if between the clear zone and the clearing line

Remove all evidence of clearing matter and debris. This work includes removal of:

- Sod, weeds and dead vegetation
- Down timber, brush and other vegetation
- Sticks and branches with diameters greater than 1/2 inch
- Dead trees, down timber, stumps, and specified trimmings from areas where live trees and other vegetation are designated to remain

(b) Preserving and Trimming Vegetation:

(1) Within the Work Areas - Avoid injuring vegetation designated to remain in place. Preservation of this vegetation includes protection and special care.

(2) Outside the Work Areas - Avoid injuring any vegetation. Confine operations which may injure vegetation to areas that have no vegetation or to the work areas.

Remove hazardous, dead and damaged trees outside the clearing limit as directed.

(3) Tree Trimming - Trim trees according to good tree surgery practices and as directed to remove safety hazards such as:

- Unsound branches of trees to remain in place
- Branches over roadways and bridges to provide at least 20 feet of clearance above the roadway surface
- Branches over walks to provide at least 8 feet of clearance above the walk surface

- Branches obstructing sight distance at intersections or impairing visibility of signs

Preserving vegetation includes keeping equipment and materials off of the critical root zone as directed.

(4) Tree Protection - Trees noted on the plans to remain will be marked to be protected within the work areas. Provide and place orange plastic fencing, as specified in 00270.11, around the critical root zones of marked trees or tree groups as directed. Do not begin construction activity or move equipment into tree areas until plastic mesh fencing is in place. Any necessary work within the critical root zone shall be done only with written approval. Be responsible for any damage to marked trees. Tree damage will be determined by a certified arborist selected by the Engineer.

(c) Timber Salvage - The property owner has the right to any trees 6 inches in caliper or larger felled in the right-of-way adjacent to owner's property. Notify the property owner(s) by mail or door hanger at least 48 hours prior to felling the trees. The property owner(s) have 7 calendar days after timber is felled to remove timber from the right-of-way. If timber is not removed after 7 calendar days, the ownership of the timber shall revert to the Contractor.

00320.41 Grubbing Operations - Within excavation limits, remove tree stumps, roots, and other vegetation to a depth of at least 6 inches below excavation subgrade or sloped surfaces.

Within embankment limits, remove tree stumps, roots, and other vegetation.

00320.42 Ownership and Disposal of Matter - All matter and debris accumulated from clearing and grubbing operations become the Contractor's property. Dispose of this matter and debris by one or more of the following methods:

(a) Burning - Not allowed.

(b) Chipping - Woody matter may be disposed of by chipping and spreading the chips uniformly over selected areas, as directed, in loose layers. Wood chips shall be no more than 3 inches in any dimension.

(c) Burying:

(1) Required Conditions - Stumps may be buried in the areas specified by 00320.42(c)(2) if, in the opinion of the Engineer, all the following requirements are met:

- Future construction in the burial area is not anticipated
- Burial would not interfere with highway drainage, existing waterways, groundwater or areas subject to erosion
- Roots extending from stumps are removed

- Stumps are buried with at least 4 feet cover and 3 feet clear of adjacent stumps in any direction. The contour of the cover over the stumps is blended into the existing terrain
- All disturbed areas are seeded and mulched according to Section 01030.

(2) Burial Areas - Stumps may be buried in the following areas if all the requirements of 00320.42(c-1) are met:

- Under embankments outside of a 2V:1H slope line projected from the edge of the subgrade shoulder
- Under random fills used to correct drainage of low spots
- Between toes of embankment slopes and highway right-of-way lines
- Between interchange ramp toes of embankment slopes

Do not bury stumps in areas to be planted or anywhere else on the Project unless permitted.

(d) Other Disposal Methods - Dispose of all other material or debris, not disposed of according to 00320.42(a), (b), or (c), according to 00310.43(d).

00320.43 Backfilling Holes - Except in areas to be excavated, backfill holes remaining after grubbing operations according to 00330.45. Backfill will be measured for payment according to 00330.82 if there is an embankment measure basis pay item for earthwork and that material is used for backfilling.

Measurement

00320.80 Measurement - Work covered under this Section will be measured for payment by one of the following methods:

- **Lump Sum Basis** - Under this method, no measurement will be made.
- **Area Basis** - Under this method, clearing and grubbing will be the ground surface, limited to the areas shown on the plans or directed, measured by the foot and converted to the acre.

Payment

00320.90 Payment - Payment for the clearing, grubbing, disposal, and cleanup work specified to be done will be made at the Contract lump sum amount or the Contract unit price per acre for the item "Clearing and Grubbing". Payment will be payment in full for furnishing all equipment, labor, and incidentals necessary to complete the work as specified.

Plastic mesh fencing required in 00320.40(b)(4) and seeding and mulching required in 00320.42(c)(1) are considered Incidental to the work and no separate or additional payment will be made.

00320.91 Incidental Basis - When neither the Special Provisions or the Schedule of Items indicate separate payment for the work under this Section, perform the work as Incidental work for which no separate payment will be made.

Section 00330 - Earthwork

Description

00330.00 Scope - This work consists of excavation, ditching, backfilling, embankment construction, grading, leveling, borrow, and other earth-moving work required in the construction of the Project, excepting such work specifically included and provided for as:

- A pay item elsewhere in the Contract Specifications
- Incidental work in the detailed Specifications for other Contract pay items

The term "earthwork" will be used as a general term to designate the work included within the scope of this section.

00330.01 Lines, Grades and Cross Sections - All earthwork shall conform to the lines, grades and cross sections established.

Roadbed cross sections shall be subject to variation from the typical sections shown on the plans, if directed, to:

- Provide superelevation on curves
- Take care of special conditions at intersections and elsewhere
- Balance earthwork quantities

00330.02 Definitions:

Abandoned Pipes and Miscellaneous Matter - Sewers, pipes, conduits, logs, timbers, concrete and other structures, materials, objects, and matter encountered in the work, excepting only items identified for removal or preservation.

General Excavation - All excavation covered by this section, except foundation, toe trench, and borrow excavation.

Overbreak - Material beyond and outside of the slope limits established by the Engineer, which becomes displaced or loosened during excavation and is excavated.

Selected Materials - Those materials with pertinent characteristics that are preserved and sorted as directed from specified excavations and handled for specific uses.

Stone Embankment Material - Rock used in specific embankment applications including buttresses, inlays, shear keys, and erosion control applications.

00330.03 Basis of Performance:

(a) **General** - Except as provided in 00330.00, all earthwork shall be performed on either an excavation basis or on an embankment basis. The basis of performance for each earthwork pay item will be indicated in the Special Provisions and the Schedule of Items. [The estimated quantities of excavation and embankment are as shown.](#)

(b) **Excavation Basis** - Earthwork performed under this provision including excavation, haul, and embankment construction, unless otherwise specified, will be paid for by excavation measurement. (See 00330.80 and 00330.81)

(c) **Embankment Basis** - Earthwork performed under this provision, including excavation, haul and embankment construction, unless otherwise specified, will be paid for by embankment measurement. (See 00330.80 and 00330.82)

00330.04 Sources of Borrow:

(a) **City Furnished Borrow** - Use materials obtained from [City](#) furnished sources lying outside of, separated from and independent of planned roadbed excavations, or other required excavations within the Project limits, only when called for by the Contract or when specifically directed. See 00330.41(d).

(b) **Contractor Furnished Borrow** - Unless otherwise specified or directed, all borrow shall be furnished by the Contractor. Sources shall lie wholly outside of and beyond the limits of [City](#)-controlled lands. Acquire at Contractor's own expense. The provision of 00160.60 shall apply.

Materials

00330.10 Selected Materials - When the Contract contains a pay item "Extra for Selected _____ Material", provide the material from required excavations. The Specifications for the selected materials will be in the Special Provisions, if different than specified in these Specifications. If other provisions of this Section call for selecting or sorting material for various parts of the work, select and sort the materials to meet the directed requirements.

00330.11 Selected Topsoil - Topsoil selected for use according to 00330.10 shall meet the requirements of 01040.14.

00330.12 Borrow Material - Borrow materials provided for general embankment construction shall be soil that is free of unsuitable materials or other characteristics detrimental to the construction of firm, dense and sound embankments. Borrow materials provided for other uses shall meet the specified requirements for the use intended.

00330.13 Selected General Backfill - Soil, selected as directed from specified excavations, and containing no particle with any dimension greater than 3 inches, or other unsuitable material.

00330.14 Selected Granular Backfill - Durable sand, gravel or combinations of these, selected as directed from specified excavations, and containing no particle with any dimension greater than 3 inches, or other unsuitable material.

00330.15 Selected Stone Backfill - A combination of durable sand, gravel and cobbles, selected as directed from specified excavations, which contains no particle with any dimension greater than 6 inches, and no unsuitable material.

00330.16 Stone Embankment Material:

(a) Requirements - An unweathered, hard, durable, free draining material, visibly well graded from coarse to fine with the maximum size between 15 inches and 3 inches. Rock fragments larger than 15 inches but not larger than 36 inches may be included if placed as directed in 00330.42(c)(2).

If the 1" - 0 portion exceeds 10% of the total volume by the Engineer's visual examination, the 1" - 0 material will be randomly sampled for testing. The wet sieve test (AASHTO T 11) will be performed on the sampled material. The amount of material passing the No. 200 sieve shall not exceed 5% by weight.

(b) Control Sample - Provide, at a location acceptable to the Engineer, in close proximity to the Project, at least a 5 cubic yards sample of stone embankment meeting the gradation specified. This sample will be used as a frequent reference for judging the gradation of the material supplied.

(c) Sampling and Testing Assistance - If the Engineer visibly determines the material furnished justifies sampling and testing, dump and check the gradation of two random loads of stone embankment material. Provide a sorting site, mechanical equipment and labor to assist in checking gradation at no additional cost to the [City](#).

00330.17 Quality Control - Provide quality control according to Section 00165.

Equipment

00330.20 Tamping Foot Rollers - If specified, use tamping-foot rollers with a weight of at least 15 tons, with each tamping-foot protruding from the drum at least 4 inches.

00330.21 Vibratory Rollers - If specified, use vibratory rollers having a smooth drum and exerting a dynamic force of at least 30,000 pounds per impact and operating at a frequency of at least 1000 vibration per minute. Limit roller speed to no more than 1 1/2 mph.

Labor

00330.30 Quality Control Personnel - Provide certified technicians in the following fields:

- CEBT ([Certified Embankment and Base Technician](#))
- CDT ([Certified Density Technician](#))

Construction

00330.40 **General:**

(a) Quantities - Quantities and locations of earthwork materials shown are approximate only. Make sure there is enough suitable material available to complete embankments and other required fillings before disposing of any excavated materials. Make up any shortage of materials caused by premature disposal at Contractor's expense.

The City makes no guarantee or representation by implication or otherwise, that any material available on the Project site is suitable for incorporation into any portion of the Project. No material will be considered unsuitable on the sole basis that special or additional processing or handling is required to make it suitable for incorporation into the Project.

(b) Preservation of Existing Surfacing - In addition to the cautions in Sections 00150 and 00170, protect existing surfacings of all types which are to remain in place from being damaged or fouled with undesirable material. Repair or replace damaged or fouled surfaces as directed at Contractor's expense.

(c) Avoidance and Correction of Detrimental Operations - Perform all operations involved in excavating, hauling and placing of earthwork materials so no damage or detriment to the completed or partially completed work results. At all times provide sufficient drainage of completed or partially completed earthwork to prevent damage or loss due to rainfall, surface water or any other cause. In all cases, take proper precautions to ensure that embankment construction and filling does not move, endanger or cause undue strain or stress to any structure or adjacent ground. Temporary and final embankment slopes within any cross section shall not be constructed steeper than the slope staked for that cross section.

Recondition or remove unstable materials resulting from improper operations, inadequate drainage or over watering, and restore or replace with stable material at Contractor's expense.

00330.41 Excavations - Perform excavation of earthwork as shown or as directed and according to the following:

(a) General:

(1) Selection and Sorting of Excavated Materials - All materials available from excavations, including borrow materials, are subject to selection and separate handling for their best utilization in various parts of the work. The types of materials to be selected and their uses shall be according to 00330.42, 00330.44, 00330.45, 00330.47, the Special Provisions and as directed. Select and sort excavated materials, as necessary, to meet Contract requirements.

(2) Selected Topsoil - Stockpile and place selected topsoil according to 01040.43.

(3) Unsuitable Materials - Unsuitable materials encountered in required excavations shall be classed as waste material and disposed of according to 00330.41(a)(5).

(4) Excess Materials - If the quantities of excavated materials are greater than required to construct embankments and to do all filling and backfilling, the remaining materials shall be classed as waste materials and be disposed of according to 00330.41(a)(5).

(5) Waste Materials - Waste materials under 00330.41(a)(3) and (a)(4) become the property of the Contractor at the point of excavation. Unless otherwise specifically permitted and subject to the requirements of 00280.03, dispose of waste materials outside and beyond the limits of the Project and City controlled property, shaped to drain, contoured, trimmed, and seeded in a manner satisfactory to the Engineer. Do not dispose of any materials on any wetland, either public or private or within 300 feet of any river or stream. Dispose on private property according to 00310.43(d).

(6) Excavation of Existing Surfaces - Unless otherwise specified, earthwork includes excavating, hauling and depositing of existing surfacings which are within the limits of the excavation work.

If an abutting roadway or structure, or part of a roadway or structure, is to be left in place, make cuts according to 00310.41(a).

(7) Abandoned Pipes and Miscellaneous Matter - Remove and dispose of abandoned pipes and miscellaneous matter encountered in the work as a part of the earthwork, unless otherwise specified.

Remove ends of remaining abandoned pipe or portions of other miscellaneous matter remaining exposed in slopes or at subgrade after excavation work to at least 2 feet back of the finished slope or below subgrade.

For sewers and other drainages pipes, fill and plug pipes according to 00490.44. Place a watertight cap or plug in the inlet and outlet ends of abandoned pipes. Take measures, as directed, to allow for free passage of drainage at outlet ends. Shape and finish the affected area so no evidence of their existence is apparent upon completion of the work.

For out-of-service potable water pipe and fillings, remove or abandon according to 01140.49 or as directed.

(8) Ditches, Channel Changes, Approaches, Connection, etc. - Perform excavations to construct ditches and channel changes according to 00330.00, approach roadways, road connections, or other items, as required, to provide a complete Project.

(9) Excavation Below Grade:

- **Rock** - If directed, excavate rock found in roadbed excavation to a depth of 12 inches below subgrade or as directed. Backfill to subgrade elevation with selected granular backfill material as directed.

- **Selected Material** - Where the plans indicate the placement of a selected material below subgrade in excavation areas, excavate to the depth necessary to place the material to its specified compacted thickness.
- **Unstable Subgrade Material** - Where unstable material is encountered below subgrade in roadbed excavations, excavate such material below subgrade as directed. Dispose of these unstable materials according to 00330.41(a)(5). Backfill with selected general backfill, or selected granular backfill material to provide a firm roadbed as directed. A geotextile may be required before backfilling.

(10) Protection of Excavation Side Slopes - Use methods in making roadbed excavations that will not shatter or loosen excavation slopes, avoid overbreaks, and leave slopes accurately and smoothly trimmed. As far as practical, excavate materials without previous loosening and in limited layers or thickness to avoid breaking the material back of the established slope line. Overbreak is incidental to the work except in cases where the Engineer determines that such overbreak was unavoidable.

After the main excavation in rock or rocky cuts is completed, thoroughly test the slopes with bars or by other approved means and remove all loose, detached, broken, or otherwise unstable material. Remove jutting points, scale slopes using mine scaling rods or other approved methods to remove loose or overhanging materials and provide a safe, trim, neat and stable condition. Dispose of the materials removed under this provision in the same manner as other excavated material. Remove all exposed roots, debris and all stones more than 3 inches in size which are loose or could become loosened.

(11) Rounding of Cutbanks - As part of the earthwork, blend the tops of cutbanks with the adjacent ground by rounding as shown. Rounding will not be required when rock requiring blasting to excavate extends to the top of cutbanks, and makes rounding impractical.

(12) Outside Earthwork Limits - Outside earthwork limits but within the clear zone, (See 00320.02(c)), remove partially buried natural objects, such as boulders, which the Engineer determines would be dangerous to an errant vehicle. Place them within embankments as specified or dispose of them as directed.

(b) Foundation Excavation - Excavate unsuitable materials in embankment foundations and elsewhere as designated. This work will be classed as "Foundation Excavation". Dispose of these materials according to 00330.41(a)(5) and replace with selected general backfill, selected granular backfill or other suitable materials as directed.

(c) Toe Trench Excavation - Excavate trenches at the toe of slopes that are to be protected with stone embankment, riprap or other protective material, as shown or directed, to provide a suitable foundation. Maintain the toe trenches until the geotextile or filter blanket, if any, and stone embankment, riprap or other protective materials are placed.

(d) Borrow Excavation - Whenever the Specifications or Contract plans call for a [City](#) furnished borrow source for earthwork materials, the material excavated from such source and used in the work as earthwork materials will be classed as "Borrow Excavation". Excavate and use these materials according to the Contract provisions, or as directed.

(e) Blasting - Avoid the use of explosives as far as practical. If blasting must be done and is not included in the Schedule of Items or covered in [the Special Provisions](#), perform blasting as follows:

(1) Methods - Do not use tunnel blasting methods. Use blasting methods that:

- Do not shatter or loosen the backslopes
- Produce smooth specified slopes
- Satisfactorily loosen the rock for excavation

(2) Safety - Be responsible for the storage of explosives, their use, and the results of all blasting operations according to 00170.94.

(3) Preblast Survey - Conduct a preblast survey of nearby buildings, structures, and utilities which could be at risk of damage from the blasting. Notify occupants and owners of those facilities at least 48 hours before drilling and blasting begins, and again on the day of the blast before its occurrence.

(4) Blasting Plan - Provide a blasting plan prepared by a person qualified and experienced in blasting work. Submit the blasting plan for the Engineer's review at least seven calendar days before beginning drilling and blasting work. Review of the plan by the Engineer does not relieve the Contractor of responsibility for accuracy and adequacy of the plan of the operation.

The blasting plan shall contain full details of the drilling and blasting patterns, explosives information, loading information, and blasting delays.

(5) Test Section - When blasting is done on an area over 300 feet in length, demonstrate the adequacy of the blasting plan by performing a test blast on a section not exceeding 100 feet in length. If results of the test blast are unacceptable, revise the blasting plan, review with the Engineer, and perform another test blast. Acceptable test blast results shall be demonstrated before the Engineer will allow the remaining drilling and blasting to occur.

(6) Scaling - Scale slopes using mine scaling rods or other approved methods to remove loose or overhanging materials.

00330.42 Embankment, Fills and Backfills - Consider the nature, characteristics, and qualities of the materials to be selected before performing embankment, fill, and backfill work. Select and use excavated materials in various parts of the work according to 00330.41(a). Use all materials originating from required excavations, as far as practical, in the formation of embankments and subgrade, and for bedding, backfilling and other purposes shown on the plans, as directed, and according to the following:

(a) Embankment Foundation Preparation - In addition to the excavation and replacement of unsuitable materials as provided in 00330.41(b), and before constructing embankments, prepare the areas on which embankments are to be constructed as follows:

(1) Unstable Areas - Where the embankment foundation will not support hauling or compaction equipment and only if directed, place an initial layer of selected materials. Place the initial layer by dumping successive loads in a uniformly distributed layer of a thickness not greater than necessary to support the equipment and not greater than 3 feet, unless otherwise authorized. Do not place the initial layer higher than 3 feet below subgrade. Commence consolidation of the initial layer by routing construction equipment uniformly over the entire layer. The initial layer shall meet the compaction requirements of 00330.43 except for layer thickness. Subsequent layers shall meet all requirements of 00330.43.

(2) Ends of Abandoned Pipe - Place a watertight cap or plug in the inlet ends of remaining abandoned sanitary, storm or culvert pipes. Place a screen over the outlet ends of remaining abandoned pipes, and if directed, place free draining cover material and/or take other measures as directed to allow for free passage of drainage.

(3) Drainage - Provide drainage and drainage structures as shown or as directed.

(4) Backfilling Inside Roadbed Limits - Break up concrete or asphalt floors, slabs, or walls, as specified in 00310.41(d), before backfilling or placing embankment. Backfill basements, trenches and holes within embankment limits with selected stone backfill material. Backfill material placed in basements may include pieces of broken concrete and masonry not exceeding 15 inches in any dimension provided they are placed and compacted according to 00330.42(c). The broken concrete and masonry shall not have protruding reinforcement.

(5) Existing Surfacing - Scarify and break up existing surfacings according to 00310.41(d) before placing embankment material.

(6) Roughen Ground Surface - Break up, roughen or scarify the ground surface if the slope is 1V:5H, or less, to positively bond embankment materials with the existing ground with benching permitted as a supplement.

(7) Foundation Benching - If existing ground surfaces or existing embankment surfaces are steeper than 1V:5H, bench the existing ground or embankment.

Make the bottom bench at least 10 feet wide. Each succeeding bench shall penetrate the slope at least 3 feet horizontally beyond the vertical side of the previous bench, and be wide enough to operate placing and compaction equipment. Each bench and embankment layer surface shall be brought to a slope flatter than 1V:10H. The benching, placing and compaction operation shall be performed simultaneously from the bottom up.

Place and compact the bench excavation material combined with new embankment material in layers to the thickness and compaction required in 00330.43.

(8) Compact Existing Ground - After roughening the existing ground surface and/or benching, compact the top 1 foot of existing ground and embankment in place to the density specified and with compaction equipment specified, according to 00330.43.

(b) Excess Moisture - Do not place material in final position in embankments or as backfill until excess moisture has been removed to within minus 4% to plus 2% of optimum moisture as required in 00330.43. Remove excess moisture by manipulation, aeration, drainage, rehandling or other means, at Contractor's expense.

(c) Embankment Construction:

(1) General - Except as provided in 00330.42(a)(1), do not construct embankments or fillings when the embankment material, the foundation or the embankment on which it would be placed is frozen, not stable or not compacted, unless otherwise directed.

Make roadbed embankment slopes as smooth, safe and slightly as practical with the materials used to construct the embankments.

Route hauling equipment over the full width of embankments. Traveling over the same areas repeatedly will not be permitted unless approved by the Engineer as unavoidable.

Place embankments and all fillings in nearly horizontal layers not more than 8 inches thick, except as provided in 00330.42(c)(2). Compact each layer separately and to the density required in 00330.43.

Place slope berms, if required, according to 00280.

(2) Rock in Embankment Construction:

a. General - Retrieve cobbles and boulders that fall or roll outside embankment limits and place them within embankments as specified, or dispose of them as directed.

b. Limited Quantities of Rock - If embankment materials contain up to 50% rock, sort the materials until they can either be placed in 8 inches layers, or meet the requirements of and be placed according to 00330.42(c)(2)(c).

c. Oversize Durable Rock Fragments - Placing isolated individual durable rock fragments having dimensions greater than the specified layer thickness will be permitted if:

- Clearance between adjacent fragments provides adequate space for placement and compaction equipment between rock fragments to place materials in horizontal layers as specified and for compaction according to 00330.43
- No part of the fragment comes within 36 inches of subgrade

d. Durable Rock - If embankment materials contain more than 50% durable rock, distribute and manipulate the rock so that the voids between the larger pieces are filled with smaller pieces forming a dense and compact mass. Durable rock is defined in 00110.20. In the absence of two cycle slake durability test results, the rock durability will be visually evaluated.

When such embankments cannot be placed in 8 inches horizontal layers, place the embankment in nearly horizontal layers of the thickness directed, but not more than 15 inches).

If the visible quantity of silt and clay materials (passing the No. 200 screen) is less than 20% by volume, as determined by the Engineer, the maximum rock fragment size and layer thickness may be increased to 36 inches, but the layer thickness shall not exceed the average maximum size of the rock fragments.

e. Nondurable Rock - In the absence of two cycle slake durability test results, the Engineer will visually evaluate if the rock is potentially degradable. If embankment materials contain more than 50% nondurable rock, as defined in 00110.20, process the material as follows:

- Pulverize nondurable rock to 12" - 0 size and place in nearly horizontal layers not more than 12 inches thick
- Water to promote slaking and breakdown of the nondurable material according to Section 00340
- The moisture content of the material at the time of compaction shall be within the requirements of 00330.43
- Compact the material to density/deflection requirements specified in 00330.43 with a tamping-foot roller that meets the requirements of 00330.20. Each embankment layer shall receive a minimum of three coverages with the tamping-foot roller. Operate the roller at a uniform speed not exceeding 3 mph. No additional compensation will be made for additional roller coverages to meet the requirements of 00330.43.

(3) Embankment Slope Protection - Construct outer portions of embankments exposed to erosion by stream flow or other erosive action with rock fragments, or other desirable materials, if directed, and such are available in the excavations. Also, if directed, place similar material as a protective layer on the outside of the regular embankment slopes as embankment widening. Placement shall closely follow construction of the embankment when directed. Protective materials placed as embankment widening need not be compacted but shall present a reasonably smooth surface, resistant to washout or slippage.

(4) Embankments for Approaches, Connections, Etc. - Construct embankments as required and as directed to provide a complete Project. Construct according to 00330.42(c) and (d).

(5) Embankment Construction Around Minor Structures - Backfill prior excavations in the vicinity of curbs, walks, driveways, inlets, manholes and other such minor structures with selected general backfill, or selected granular backfill material as directed with no particles larger than 1 inch and that is compatible with the adjacent material, unless otherwise specified. The material shall have a moisture content as specified in 00330.43, and be placed in layers according to 00330.42(c)(1) and compacted according to 00330.43.

(6) Embankment Construction at Pipes - Before installing any pipes with 72 inch or smaller, inside nominal diameter that will protrude above the existing ground surface:

- Provide temporary drainage at Contractor expense, unless provided for in the Special Provisions
- Construct specification embankments at least five pipe diameters each direction from the pipe centerline and to a height equal to the following:
 - For pipes less than 48 inch inside nominal diameter, to the outside top of pipe elevation
 - For 48 inch to 72 inch inside nominal diameter pipes, 48 inches high
 - A higher height if called for on the plans or directed
- Then trench, bed, and install the pipe, and backfill around all pipes according to Section 00405.

(7) Embankment Construction at Bridge Ends - At the ends of bridges and for a distance of at least 100 feet from the bridge, place and compact the embankments before beginning bridge construction, unless otherwise directed. Unless the embankment is constructed according to 00330.42(c)(8), provide and place selected stone backfill material, meeting the requirements of 00330.15 when such is available from excavations, in all embankments within 100 feet of bridges, or as directed.

(8) Engineered Fills - In areas designated on the plans as "Engineered Fills", place selected stone backfill material in maximum 8 inch lifts from the existing ground up to the base of granular structure backfill. Compact to 95% maximum density according to 00330.43.

If the existing ground line is within the limits of the granular structure backfill, subexcavate the area beneath the footing in order to place the full depth of granular structure backfill shown or specified.

Place the granular structure backfill, meeting the requirements of 00510.13, in maximum 6 inch lifts and compact to 100% maximum density from the top of the selected stone backfill to the footing elevation shown. The thickness and extent of these materials shall be according to the details shown or as directed.

The foundation compaction requirements in 00330.43 shall be subject to the higher requirements of this provision. Compact according to the percentages required above.

(d) Stone Embankment - If the Contract plans or Specifications require embankments, or parts of embankments, to be constructed of stone embankment material, furnish and place the stone embankment material according to this provision and as directed. Furnish materials from Contractor provided sources which conform to the requirements of 00330.16, unless otherwise specified.

Construct these embankments according to the other provisions of 00330.42, unless otherwise specified or directed, and as follows:

- Material placed in the upper 1 foot of embankments or within 1 foot of a culvert or other structure, shall not be more than 3 inches in size
- If placement in water is permitted, construct the first layer of embankment to an elevation 2 feet above water. Continue thereafter as specified or directed
- Some rock fragments larger than 15 inches, but not larger than 36 inches may be placed provided they are placed and compacted according to 00330.42(c)(2)(c)

00330.43 Earthwork Compaction Requirements:

(a) General - Compact natural ground, embankment foundations, foundations for structures, each layer of embankment, fills, and backfills, the upper 1 foot of roadbeds in cuts and other earthwork which is to support any part of the roadbed prism according to this subsection.

Unless otherwise specified, compact in place the entire surface of each layer of all specified materials with a minimum of three coverages, using equipment made specifically for compaction. Select compaction equipment based on the type of material being compacted and the layer thickness. Normal compaction equipment consists of sheeps-foot rollers, tamping-foot rollers, grid rollers, pneumatic-tired rollers, and vibratory rollers. Routing of hauling and grading equipment will not be accepted as adequate to achieve compaction, except as provided in 00330.42(a)(1).

In the immediate vicinity of minor structures as provided in 00330.42(c)(5), in holes, around and under isolated individual rock fragments, and elsewhere where embankment and filling materials can or cannot be reached by normal compaction equipment, compact with machine-operated pneumatic or mechanical tampers, or by hand methods if permitted, as required to ensure intimate contact between the backfill material and the structure or fragment and provide thorough compaction.

(b) Moisture-Density Testable Materials:

- (1)** Test in-place materials for compaction according to the MFTP.
- (2)** In-place materials shall meet the following moisture content, density, and deflection requirements, each of which has equal weight and each of which must be satisfied:

a. Moisture Content - Moisture content at the time of compacting the materials shall be prepared to within minus 4% to plus 2% of optimum moisture content. Material which does not contain sufficient moisture to obtain proper compaction shall be wetted and thoroughly mixed as directed. Material containing an excess of moisture shall be dried by manipulation, aeration, drainage or other means before being compacted.

b. Density - After compaction of each layer the density shall be at least:

- 95% of maximum density in roadbed cuts, to a depth of 1 foot below established subgrade elevation
- 95% of maximum density in embankments, fills, backfills, and specified portions of existing ground

c. Deflection Requirement - In addition to moisture-density testing, each compacted layer will be observed for deflection or reaction under moving loaded equipment to verify that no soft or pumping areas remain in any layer or foundation soil. Correct any such areas.

(c) Non-Moisture-Density Testable Materials - When material is not moisture-density testable because rock fragments in the material prevent moisture-density testing, place and compact the material as follows:

- Place non-moisture density testable material in nearly horizontal layers with thickness not exceeding 12 inches.
- Water or aerate the material to ensure each layer can be compacted to form a dense mass, free of pumping.
- Compact each layer uniformly with a minimum of four full coverages using a smooth drum vibratory roller.
- Conduct at least one deflection test for each layer of embankment placed according to ODOT TM 158. If the layer being tested exhibits any yielding, deflection, reaction or pumping, rework the area to provide acceptable test results prior to placement of any additional material.

(d) Small, Irregular Fill Areas - The Density requirements of 00330.43 do not apply to irregular fill areas that have total volume of no more than 150 cubic yard outside of the travel lanes. Construct these areas according to the following:

- Place embankment material in nearly horizontal layers with thickness not exceeding 8 inches.
- Water or aerate the material to ensure each layer does not deflect under the action of the roller used for compaction.
- Compact each layer using a roller appropriate to the material being placed and as directed. Use a smooth drum vibratory roller for sands and gravels; use a

- sheepsfoot or tamping foot roller for silts and clays. The Engineer will determine the classification of the embankment soil.
- Compact each layer uniformly with a minimum of five full coverages of the specified roller.
- In areas not accessible to rollers, use compaction equipment suitable for the area and compact each layer with sufficient coverages to produce a firm unyielding

00330.44 Butress, Inlay or Shear Key - Remove the designated materials and construct the butress, inlay or shear key as follows:

(a) Preparation - Do not start excavation for each segment until a stockpile of stone embankment material is immediately available at or near the site. Locate the stockpile at a site approved by the Engineer. The size of the stockpile shall be sufficient to fill one excavated segment.

(b) Sequence of Construction - Excavate the area according to 00330.40 and 00330.41 to provide a backslope to the lines, slopes and details indicated on the plans or as directed. Excavate and backfill in segments to minimize aggravating stability conditions. Each segment shall not exceed 75 feet in length as measured across the top of each open excavation segment, unless otherwise specified or directed.

(c) Unsuitable Materials - Sort and dispose of unsuitable materials as waste material according to 00330.41(a)(5).

(d) Foundation - Excavate to a depth of at least 5 feet into firm, stable, undisturbed materials as shown on the plans or as directed. Remove soft or loose materials. The Engineer will verify sufficient excavation into firm, stable, undisturbed materials in each segment before allowing the backfill. Where called for in the plans or as directed, place riprap geotextile against the excavated backslope. Remove water from the excavation before placing stone embankment material.

(e) Drainage - Provide drainage as shown or as directed.

(f) Placement of Stone Embankment - After excavation of each segment according to 00330.44(b) and (d), place the stone embankment material to fill the excavated segment before excavating the next segment. Backfill all segments on the same day they are excavated. Place and manipulate the stone embankment material in the butress, inlay or shear key to provide a dense and well-filled mass to the lines, slopes and cross-sections indicated on the plans or as directed.

00330.45 Filling of Holes - Backfill holes outside the limits of required excavation or embankment construction that result from grubbing and removal work, basements, trenches and other such holes as directed. Smooth and shape to blend with the surrounding area. Payment for this work will be made on the same basis as for required roadway earthwork.

00330.46 Watering of Materials - Water materials as directed to provide compaction and required density to embankments and backfills and to alleviate dust nuisance according to Section 00340.

00330.47 Specified Selected Courses or Layers of Materials - In addition to the requirements of 00330.42, select, sort, and place courses or layers of materials if called for by the plans or Special Provisions. Select and sort the materials obtained from required excavations to meet the requirements of the Special Provisions, and place in locations and thicknesses specified or as directed.

Place and construct selected courses or layers to conform to the requirements of 00330.42 and 00330.43, unless otherwise specified.

The work covered by this provision may include, but is not limited to:

- Selected Embankment Material
- Selected Subgrade Material
- Selected Stone Embankment Material
- Selected Topsoil

00330.49 Construction Slide Removal and Repair - Remove construction slide materials and repair construction slide damages to the work according to Specifications, or as directed, and as follows:

(a) Definition - For the purposes of this provision:

(1) Slide - A slide is a lateral movement of earth materials.

(2) Construction Slide - A slide outside the designated limits of excavations, or below the foundation within designed limits of embankments or within embankments, which occur after excavation or embankment construction starts and before final acceptance of the Contract.

(3) Slide Materials - Materials displaced as the result of a slide.

(b) Remove Construction Slide Materials - Within the limits of established or reestablished lines, grades and slopes, do the following:

- Excavate and remove construction slide materials
- Sort and dispose of unsuitable materials
- Use excavated slide materials, to the extent practical, in embankments, fills, backfills, widenings, and for flattening slopes within the Project limits
- Dispose of excess material according to 00330.41(a)(4)

(c) Construction Slide Repair - Reconstruct or restore subgrade and slopes to the established or reestablished lines, grades and slopes. Reconstruct or repair damaged structures or facilities within construction slide areas.

(d) Responsibility for Construction Slide Removal and Repair:

(1) Contractor Responsibility - Perform construction slide removal and repair work at Contractor's expense when caused by any of the following:

- Embankment foundation conditions or pre-existing subsurface conditions that were reasonably anticipated in the Contract
- Contractors method and manner of operations
- Contractors failure to perform or to protect the work according to plans and Specifications

(2) City Responsibility - Slide removal and repair work will be paid for according to 00330.90 when all of the following apply:

- Caused by embankment foundation conditions or pre-existing subsurface conditions that were not reasonably anticipated in the Contract
- Not caused by Contractor's method and manner of operation
- Not caused by Contractor's failure to perform or to protect the work according to plans and Specifications

Finishing and Cleaning Up

00330.70 General - Immediately before completing the earthwork:

- Blend the tops of cutbanks with the adjacent terrain
- Trim and finish all roadbeds, ditches, waterway channels, and other excavations and embankments to the lines, grades, and cross sections established
- Clean up debris and foreign matter of all kinds on the entire right-of-way area. Dispose of materials as directed
- Finish the subgrade to be within a tolerance of plus or minus 3/4 inch and to be free of ruts, depressions and irregularities
- In planting and seeding areas, remove all rocks, boulders, and vegetative matter
- Remove all litter, debris and obstructions

Measurement

00330.80 General - Quantities of earthwork measured for payment will:

- Be volumes, cubic yard, computed by the average end area method from cross section measurements, or by other methods of equivalent accuracy. When the Special Provisions so state, corrections for curvature will be made.
- Be the volume, cubic yard, of materials handled and placed in the work as required by Contract provisions and as directed
- Not include material handled, removed, placed, or used contrary to Specifications or directions
- Not include rehandling and reshaping of materials previously excavated, except where called for in the Specifications, plans, or Contract change orders
- Not include excavation for forms to construct curbs, gutters, walks and like structures unless specified
- Not include the volume of any free water or liquid
- Be only for those pay items listed in 00330.93 and 00330.94 that are actually included as an item in the Schedule of Items. All other earthwork, including cutbank rounding, foundation benching, and constructing outer portions of embankment with suitable material for slope stabilization will be considered Incidental to the work and will not be separately measured.

The hauling, moving, or transporting of earthwork materials is considered Incidental to the work and no measurement will be made.

The removal of excess moisture according to 00330.42(b) is considered Incidental to the work and no measurement will be made.

The retrieval or removal of cobbles and boulders according to 00330.42(c)(2)(a) is considered Incidental to the work and no measurement will be made.

Materials subexcavated from beneath footings as required by 00330.42(c)(8) will be measured for payment according to 00510.82. Granular structure backfill will be measured according to 00510.86.

00330.81 Excavation Basis Measurement - When the payment for earthwork Contract items is on the excavation basis, the materials will be measured in their original positions before excavation. Measurement will be limited to the lines, grades, and slopes as established.

The quantities of excavation measured for payment will include:

- The volumes of abandoned pipe and miscellaneous matter within excavation limits
- The volumes of materials removed below subgrade in roadbed excavations according to 00330.41(a)(9) and 00330.91(e)
- The volumes of overbreak determined to be unavoidable according to 00330.41(a)(10)

The following earthwork items, if included in the Schedule of Items, will be measured on the excavation basis:

- Borrow Excavation
- Ditch Excavation
- Foundation Excavation
- General Excavation
- Toe Trench Excavation

Embankments required or necessary to perform earthwork on the excavation basis are incidental to the excavation and will not be measured separately.

00330.82 Embankment Basis Measurement - When the payment for earthwork Contract items is on the embankment basis, the materials will be measured in their final embankment position. Measurement will be limited to the lines, grades, and slopes of the original ground contours before embankment construction begins.

The quantities of embankment measured for payment will include the volumes of materials used to backfill excavations below subgrade and holes when called for or directed.

The quantities of embankment measured for payment will not include the volumes of:

- Any additional quantities required due to subsidence, settlement of the ground or base, settlement within embankments, or to shrinkage, settlement, washout, slippage, or loss regardless of cause, subject however to 00170.80 or 00170.82
- Any additional quantities required due to compaction efforts that are required in 00330.43
- Slide materials paid for as Extra Work
- Any materials for which payment is made for completed embankments or backfills under other Contract provisions

The following earthwork items, if included in the Schedule of Items as a Contract item, will be measured on the embankment basis:

- Embankment In Place
- Stone Embankment
- Extra For Selected _____ Material

Excavations, including cutbank rounding, overbreak whether avoidable or not, and foundation benching, required or necessary to perform earthwork on the embankment basis, and retrieval or removal of cobbles and boulders according to 00330.42(c)(2)(a) are considered to be Incidental to the embankment and will not be separately measured.

If an excavation basis pay item is included in the Contract and selected materials are obtained from the excavation for use as "Extra for Selected _____ Material", measurement will be made for both pay items.

Payment

00330.90 General - Payment for earthwork performed under this section will be made at the Contract price per unit of measurement for each pay item that appears in the Schedule of Items. The pay quantities for each pay item will be as determined under 00330.80, 00330.81, and 00330.82.

Payment will be payment in full for all equipment, labor, and incidentals necessary to complete all Contract work specified for performance under this section, except that:

- Watering of materials performed according to 00330.46 will be measured and paid for as specified in Section 00340
- Slide removal and repair work determined under 00330.49(d)(2) to be [City](#) responsibility will be measured and paid for as Extra Work under Section 00196

Work that is required to be done under these Specifications that does not appear as a separately listed pay item in the Schedule of Items is considered to be Incidental, including cutbank rounding, foundation benching, removal of excess moisture, and retrieval or removal of cobbles and boulders according to 00330.42(c)(2)(a). The cost of this work is included in the Contract unit price for one or another of the pay items listed in the Schedule of Items.

Materials subexcavated from beneath footings as required by 00330.42(c)(8) will be paid for according to 00510.91. Granular structure backfill will be paid for according to 00510.96.

Unless a pay item is included in Section 00335, all blasting done according 00330.41(e) will be considered Incidental with no separate or additional payment being made for this work.

00330.91 Kinds of Pay Excavation - The kinds of pay excavation on a Project will be indicated by the pay items and are defined as follows:

(a) Ditch Excavation:

- Limited to the lines, grades, and cross sections shown or established with bottom widths of 8 feet and less that lie outside of and separate from roadbed cross sections
- Includes canals, channels, and inlet, outlet, diversion, drain, and other open ditches to carry water

(b) Structure Excavation:

- Limited to the lines, grades, and cross sections shown on the plans or established
- For the construction of foundations and substructures for bridges, grade separation structures, retaining walls, rigid frame structures and other major structures see Section 00510

(c) Foundation Excavation:

- Limited to the lines, grades, and cross sections shown on the plans or established
- To remove soft materials for preparation and stabilization of areas below embankments

(d) Toe Trench Excavation:

- At the toe of riprap slopes as shown on the plans and elsewhere as directed to provide a suitable foundation toe trench on which to place riprap geotextile or filter blanket, and riprap material

(e) General Excavation:

- Other than ditch, trench, structure, foundation, toe trench, and borrow excavation
- Includes cut ditches, borrow ditches, and roadside ditches in the roadway section as staked or established, or shown as being a part of the typical roadway cross sections
- Includes other ditches with bottom widths greater than 8 feet
- Includes unsuitable material excavated below subgrade in roadbed excavations according to 00330.41(a)(9), when determined that such excavation is neither more **nor** less difficult to remove than the material above subgrade in the whole of the cut. When determined that such excavation is either more or less difficult to remove than the material above subgrade in the whole of the cut, payment will be according to Section 00196.

(f) Borrow Excavation:

- Obtained from specifically designated and authorized sources lying outside of, separated from, independent of, and beyond the roadway cross sections, unless otherwise directed

00330.92 Kinds of Incidental Earthwork - Payment will be included in the payment made for one or more affected pay items without measurement of the following Incidental earthwork:

(a) Removal Excavation:

- Removal of overburden from pits and quarries
- Excavation of rock and other material for use in surfacings or structures
- Excavation for haul roads
- Other excavation (borrow excavation excepted) which is not directly a part of the finished work

(b) Rounding Cutbanks:

- Blend tops of cutbanks with adjacent ground according to 00330.41(a)(11)
- If shown on the plans

(c) Overbreak - Incidental, except on excavation basis earthwork and the Engineer determines that overbreak was unavoidable.

(d) Foundation Benching - According to 00330.42(a)(7).

(e) Below Grade in Rock - Rock excavated below the excavation plane established by 00330.41(a-9) and the specified backfill required to fill up to the excavation plane, to the satisfaction of the Engineer.

(f) Forms Excavation - As required for forms to construct curbs, gutters, walks, and like structures, unless specified.

(g) Smoothing and Maintenance Excavation - Smooth and maintain foundations, roadbeds, and haul roads.

(h) Rehandling Excavation - Rehandling and reshaping of materials previously excavated, except where called for in the Specifications, plans, or where directed.

00330.93 Excavation Basis Payment - When listed in the Schedule of Items, the following pay items will be paid for on the excavation basis:

Pay Item	Unit of Measurement
(a) Ditch Excavation	Cubic Yard
(b) Foundation Excavation	Cubic Yard
(c) Toe Trench Excavation	Cubic Yard
(d) General Excavation	Cubic Yard
(e) Borrow Excavation	Cubic Yard

Payment will be payment in full for excavating, selecting, handling, hauling, placing, and compacting the materials as specified.

00330.94 Embankment Basis Payment - When listed in the Schedule of Items the following pay items will be paid for on the embankment basis:

Pay Item	Unit of Measurement
(a) Embankment In Place	Cubic Yard
(b) Stone Embankment	Cubic Yard
(c) Extra For Selected _____ Material	Cubic Yard

Payment for item (a) will be payment in full for excavating, selecting, handling, hauling, placing, and compacting of the materials as specified and all other costs incurred in furnishing required embankment materials.

Payment for item (b) will be payment in full for furnishing, selecting, handling, hauling, placing, and compacting the material as specified.

In item (c) above the type of material will be inserted in the blank.

Payment for item (c) will be payment in full for any and all additional costs involved in preserving, sorting, stockpiling, and handling of the specified selected materials as described in 00330.41(a)(1) and (a)(2), selected and placed according to 00330.42, 00330.47 and the Special Provisions.

Unless a specific pay item in the form of item (c) appears in the Schedule of Items, there will be no extra payment for any additional costs involved in the preserving, sorting and handling of selected materials. These costs will be considered Incidental to the work and included in one or another of the listed pay items.

There will be no separate payment for cutbank rounding, foundation benching, and removing boulders from the clear zone. However, earthwork materials obtained from such excavations and incorporated into specified embankments will be paid for at the Contract unit price for the applicable pay item, if any.

Excavation of unstable material that is below subgrade in roadbed excavation areas, according to 00330.41(a)(9), will be paid for according to 00195.20.

Section 00331 - Subgrade Stabilization

Description

00331.00 Scope - This work consists of excavating and disposing of unstable materials in excavation areas only and, placing subgrade geotextiles and stone embankment and/or aggregate backfill to the lines and grades as shown or directed.

Materials

00331.10 General - Provide materials meeting the following requirements:

Aggregate Base	02630
Aggregate Subbase	00641.10(c)
Stone Embankment	00330.16
Subgrade Geotextiles, Level B	02320
Water	00340

00331.16 Acceptance of Backfill - The backfill material will be accepted based on visual inspection. The Engineer may perform tests if deemed necessary.

Equipment

00331.20 General - Provide all equipment necessary to perform the work according to Sections 00330, 00340, 00350, and 00641.

Construction

00331.40 Excavation - Excavate unstable material to the lines and grades as shown or directed. Dispose of the excavated material according to 00330.41(a)(5).

00331.41 Geotextile - Place geotextile as shown.

00331.42 Backfill - Place the backfill material to lines and grades as shown or directed, to provide a homogeneous mixture. Compact the backfill until there is no reaction or yielding under the compactor.

Measurement

00331.80 General - Subgrade stabilization will be measured by the square yard of subgrade surface area stabilized to the full depth. The depth of stabilization will be indicated on the plans. The surface area will be determined by horizontal measurements. In areas where directed to stabilize to a depth other than indicated on the plans, the areas will be adjusted by converting to an equivalent number of square yards on a proportionate volume basis.

Excavation, geotextile, backfill material, and water will not be separately measured.

Payment

00331.90 General - The accepted quantity of subgrade stabilization will be paid for at the Contract unit price per square yard for the item "_____ inch Subgrade Stabilization". The depth of stabilization will be inserted in the blank.

Payment will be payment in full for furnishing all materials, equipment, labor, and incidentals necessary to complete the work as specified.

No separate or additional payment will be made for excavation, geotextile, stone embankment or aggregate backfill material, or water. These items will be included in the subgrade stabilization item.

Section 00332 - Surfacing Stabilization

Description

00332.00 Scope - This work consists of excavating and disposing of unstable surfacing materials and subgrade and placing subgrade geotextiles, stone embankment, aggregate subbase or base material, and EAC or HMAC to the lines and grades shown or directed.

Materials

00332.10 General - Provide materials meeting the following requirements:

Aggregate Base	02630
Aggregate Subbase	00641.10(c)
EAC	00735
HMAC	00744
Stone Embankment	00330.16
Subgrade Geotextiles, Level B	02320
Water	00340

00332.16 Acceptance of Backfill - The backfill material will be accepted based on visual inspection. The Engineer may perform tests if deemed necessary.

Equipment

00332.20 General - Provide all equipment necessary to perform the work according to Sections 00330, 00340, 00350, 00641, 00735, and 00744.

Construction

00332.40 Excavation - Excavate unstable material to the lines and grades as shown or directed. Dispose of the excavated material according to 00330.41(a)(5).

00332.41 Geotextile - Place geotextile as shown.

00332.42 Backfill - Place the backfill to lines and grades as shown or directed, to provide a homogeneous mixture. Compact the backfill until there is no reaction or yielding under the compactor.

Measurement

00332.80 General - Surfacing stabilization will be measured by the square yard of surfacing area stabilized to the full depth. The depth of stabilization will be indicated on the plans. The surfacing area will be determined by horizontal measurements. In areas where directed to stabilize to a depth other than indicated on the plans, the areas will be adjusted by converting to an equivalent number of square yards on a proportionate volume basis.

Excavation, geotextile, stone embankment, aggregate, and water will not be separately measured. EAC and HMAC used will be measured according to 00735.80 or 00744.80 or 00747.80 as applicable.

Payment

00332.90 General - The accepted quantity of surfacing stabilization will be paid for at the Contract unit price per square yard for the item "_____ inch Surfacing Stabilization". The depth of stabilization will be inserted in the blank.

Payment will be payment in full for furnishing all materials, equipment, labor, and incidentals necessary to complete the work as specified.

No separate or additional payment will be made for excavation, geotextile, stone embankment, aggregate, or water. These items are included in the surfacing stabilization item. EAC and HMAC will be paid for according to 00735.90 or 00744.90 or 00747.90.

Section 00335 - Blasting Methods and Protection of Excavation Backslopes

Description

00335.00 Scope - This work consists of excavating in rock using controlled blasting methods to achieve smooth, unfractured backslopes and produce a free surface or shear plane in the rock along the specified excavation backslope, and production blasting to facilitate excavation.

00335.01 Definitions:

Controlled Blasting - The use of explosives and blasting accessories in carefully spaced and aligned drill holes. Controlled blasting techniques include presplitting and trim (cushion) blasting.

- **Presplitting** - Controlled blasting in which the detonation along the specified excavation backslope is at least 25 milliseconds before the detonation of any production holes.
- **Trim (Cushion) Blasting** - Controlled blasting in which the detonation along the specified excavation backslope is performed to trim the slope after the main excavation has been performed.

Production Blasting - Fragmentation blasting in the main excavation area, usually using more widely spaced drill holes than controlled blast holes.

Buffer Row - The first row of production holes immediately adjacent to and drilled on a plane parallel to the controlled blast line.

Construction

00335.40 Blasting Methods:

(a) General - Use methods in making excavations that do not shatter or loosen the backslopes and result in smooth specified slopes. This includes:

- **Controlled Blasting** - Use on the entire length of cut section in rock or cemented materials which have backslopes of 1V:1.33H or steeper, even if the main excavation can be ripped.
- **Production Blasting** - Avoid as far as practical. Use only if necessary to loosen rock not affecting backslopes.

(b) Safety and Flyrock Control - Use techniques that effectively control flyrock. Following every blast, observe the entire blast area for a minimum of five minutes before reentering or commencing work in the area.

Be responsible for the storage of explosives, their use, and the results of all blasting operations according to 00170.94.

Discontinue blasting operations, as directed, if it is apparent that the methods employed are not producing acceptable results or the safety of the public, the Contractor's employees or adjacent property is being jeopardized.

(c) Preblast Survey - Make a preblast survey of the nearby buildings, structures and utilities which may potentially be at risk from blasting damage. Before beginning blasting operations, certify to the Engineer in writing that the preblast survey has been completed.

Notify occupants of the buildings and owners of structures and utilities which have been identified in the preblast survey, a minimum of 48 hours before drilling or blasting begins, and notify again on the same day of the blast before its occurrence.

(d) Blasting Plan - Provide a separate blasting plan for each cut that requires blasting. Submit the blasting plan(s) to the Engineer not less than 14 calendar days before beginning drilling and blasting operations. The blasting plan(s) will be reviewed for conformance with the Specifications and any concerns will be discussed with the Contractor as soon as possible. Submit any proposed changes to the blasting plan(s) in writing to the Engineer for review before implementation. Submittal of blasting plan(s) is for quality control and record keeping purposes.

Review of the blasting plan(s) by the Engineer does not relieve the Contractor of full responsibility for the accuracy and adequacy of the plan and the resulting safety when implemented in the field.

Each blasting plan shall contain the full details of the drilling and blasting patterns, controls the Contractor proposes to use, and the following information:

- Station limits of proposed shot
- Removal of overburden
- Plan and cross section diagrams of proposed drill pattern for controlled and production blast holes including buffer rows, free face, burden, blast hole spacing, blast hole diameters, blast hole angles, lift height and subdrill depth. Accurately draw to scale and show each cut area to be blasted.
- Loading diagram showing the type, amount and specific gravity of explosives, primers, and initiators, and location and depth of stemming
- Initiation sequence of production and controlled blast holes including delay times and delay system
- Manufacturer's product data sheets for all explosives, primers and initiators to be used in the work

(e) Blasting Test Section(s) - Demonstrate the adequacy of each proposed blasting plan by means of test shot(s) in each cut before beginning full scale blasting. Drill and blast short representative test sections not exceeding 100 feet in length. Excavate a section not less than 20 feet wide exposing the full height of the lift for examination. Do not drill ahead of the test blast area, except as provided in 00335.41(a)(6), until the test section has been evaluated.

If the results of the test shot(s) are unacceptable revise the methods, techniques and procedures at the Contractor's expense so that the results achieved will be acceptable. No further drilling and blasting will be permitted until the revised methods are reviewed according to 00335.40(d) and verified by additional test shot(s).

If, during the progress of the work, the methods of drilling and blasting do not produce acceptable results within the tolerances specified, drill, blast and excavate additional test sections until a technique is determined that will produce acceptable results.

(f) Blasting According To Plan - After the blasting plan has been reviewed and test sections have demonstrated acceptable results, perform all controlled and production blasting according to the plan which produced acceptable results. Notify the Engineer when any changes in conditions or results are observed.

00335.41 Controlled Blasting Methods:

(a) Presplitting:

(1) Attach mechanical devices to all drilling equipment used to drill the presplit holes to determine, within an accuracy of 1°, the angle at which the drill steel enters the rock.

(2) Do not drill presplit holes more than 3 inches in diameter.

(3) Start presplit drill holes along the presplit line within 3 inches of the dimensions shown on the blasting plan. Holes located beyond this tolerance will be rejected. Completely fill the rejected holes with stemming material at the Contractor's expense. Drill new presplit holes with the proper spacing. Rejected holes will not be measured for payment.

(4) Control the drilling operations to insure that presplit hole alignment does not vary from the plane of the planned slope by more than 9 inches either parallel or normal to the slope. Presplit holes exceeding these limits will not be paid for unless, in the Engineer's opinion, satisfactory slopes are being obtained.

(5) The length of presplit holes for any individual lift shall not exceed 30 feet unless the Contractor can demonstrate to the Engineer that hole alignment can be maintained within the above tolerances. Upon satisfactory demonstration, and with written permission of the Engineer, the length of holes may be increased to a maximum of 60 feet. If more than 5% of the presplit holes are misaligned in any one lift, reduce the height of the lifts until the 9 inch alignment tolerance is met.

(6) Drill presplit holes a minimum of 30 feet longitudinally beyond the limits of the production holes to be detonated or to the end of the cut. Unless otherwise permitted by the Engineer in writing, remove all overburden, including any loose or decomposed rock, before drilling the presplitting holes.

(7) When the cut height will require more than one lift, a maximum offset of 18 inches between lifts will be permitted to allow for drill equipment clearance. Adjust the slope angle of lower lifts to compensate for drill offsets and any drift which may have occurred in upper lifts.

(8) Use only explosives manufactured especially for presplitting in the presplit holes. The maximum diameter of explosives used in presplit holes shall not be greater than half the diameter of the presplit hole.

(9) Determine that the presplit hole is free of obstructions for its entire depth before placing charges. Exercise all necessary precautions so the placing of the charges will not cause caving of material from the walls of the holes.

(10) The detonating of each hole in a presplit shot may be delayed, providing the hole-to-hole delay is no more than 25 milliseconds.

(b) Trim (Cushion) Blasting - When the horizontal distance from the new proposed slope face to the existing rock face is less than 15 feet, the Contractor may trim blast instead of presplitting. The requirements in 00335.41(a) for presplitting also apply to trim blasting, by changing the words presplit and presplitting to trim blasting.

If there is production blasting, the detonation of trim blasting holes shall be at least 25 milliseconds after the detonation of any production holes.

00335.42 Production Blasting - Do not drill the buffer row of production blast holes closer than 6 feet to the controlled blast line. Where necessary to minimize damage to the rock backslope, load this row of holes lighter than other production holes. Except for the bottom lift, do not extend production holes below the bottom of the controlled blast holes. Do not exceed 6 inch diameter for production holes. Detonate production holes on a delay sequence documented in the blasting plan.

00335.43 Scaling - Remove all rock on the cut face that is loose or overhanging by scaling during or upon completion of the excavation of each lift. Drilling of the next lift will not be allowed until this work has been completed, as directed.

Scale the slopes throughout the Contract at the frequency required to remove loose or overhanging material.

Use a suitable standard steel mine scaling rod to hand scale the slopes. Other methods such as machine scaling, hydraulic splitters or light blasting may be used instead of, or to supplement, hand scaling, if allowed.

Measurement

00335.80 General - The quantities of controlled blast holes will be measured on the length basis by dividing the cut slope surface area by the controlled blast hole spacing. The cut slope surface area will be determined by cross section measurement from the top of the blasted rock to the finished ditch bottom elevation.

The quantities shown in the Schedule of Items have been computed from a theoretical plan length using a 30 inch hole spacing. The actual quantities measured for payment will depend on field conditions and results from blasting test sections.

Payment

00335.90 General - Payment for controlled blast holes will be paid for at the Contract unit price per unit of measurement for the following item:

Pay Item	Unit of Measurement
Controlled Blast Holes	Foot

Payment will be payment in full for all materials, equipment, labor, and incidentals necessary to drill the controlled blast holes as specified.

No separate or additional payment will be made for the costs involved in blasting, scaling or loosening materials for excavation. The work will be Incidental to the kind of excavation involved.

Section 00340 - Watering

Description

00340.00 Scope - This work consists of furnishing and applying water or combinations of water and additives for:

- Compacting and preparing roadbed excavations, roadbed embankments, backfills, subgrades, subbases, bases and surfacings
- Preventing or alleviating dust nuisance originating within the highway right-of-way and the Project limits, which is not caused by Contractor operations at the Contractor's plants or plant setups
- Other watering when ordered, except for Extra Work

00340.01 Definitions:

Additives - Emulsified asphalt, magnesium chloride or other materials added to water for the purpose of aggregate binder or dust control.

00340.02 Exclusions - Watering which is specified as Incidental and included in payment for other items or parts of work is excluded from measurement under this Section.

Materials

00340.10 Water - Provide water free of silts and other matter harmful to the quality of the material to which it is applied or with which it is mixed.

Comply with the "Water Laws of Oregon," which are administered by the Water Resources Department, and specifically Chapter 537 covering the appropriation of water. There will be no separate payment for obtaining permits, water rights or any other costs involved to comply with these laws.

Most adjudicated water is limited to agricultural uses, so there may not be any water sources in the immediate area of the Project available for the Contractor's use.

00340.11 Water Mixtures:

(a) Use of Additives - When called for by the Special Provisions, or ordered, perform watering with a mixture of water and additives. Use an additive from the CPL and mix according to the manufacturer's recommendations.

(b) Magnesium Chloride - When required, furnish Magnesium Chloride ($MgCl_2$) in brine solution at 28% to 35% concentration by weight.

Equipment

00340.20 Watering Equipment - Perform uniform and controlled application of watering by one or more of the following methods:

- Tank trucks equipped with spray bars
- Hose and nozzle
- Wetting materials in stockpile or in excavation areas before excavating
- Other means, as directed

The use of splash boards will not be permitted without prior approval. When required, provide a metering device for water measurement.

Construction

00340.40 Watering:

(a) General - Make all necessary arrangements to obtain water and pay all costs involved in its procurement. Maintain an adequate supply of water at all times.

Perform watering only when and where directed at an approved rate and manner of application. Water at any hour of the day, and on any day of the week, as directed, for proper performance or protection of the work and for alleviation of dust nuisance.

(b) Use of Additives - If an additive is combined with water in the watering work, mix it in the proportions and manner specified, and use in the work as directed.

Maintenance

00340.60 Avoidance of Detrimental Operations - Avoid wasting water or watering detrimental to other work. Cease such operations until corrective measures are directed.

Measurement

00340.80 Watering - The pay quantities of water will be determined by any of the following measurements:

- Weight or volume, or both
- In tanks or tank trucks of predetermined capacity
- By approved meters

Measurement will be M-gallons (1000 gallons = 1 M-gallon) not including the additives used in the watering as specified or ordered. For conversion purposes, water weighs 8.34 pounds/gallon or 62.4 pounds/cubic foot. Only quantities acceptably used in the work, as specified, will be measured for payment.

00340.81 Additives in Water - Quantities of additives combined with water for watering purposes will be determined separately from the water and will be measured in gallons.

Payment

00340.90 General - The accepted quantities of water and additives will be paid for at the Contract unit price per unit of measurement for the following items:

Pay Item	Unit of Measurement
(a) Watering	M-gallon
(b) _____ in Watering	M-gallon

Payment for item (a) will be payment in full for furnishing and developing the water supply, hauling and applying the water, and for all materials, equipment, labor and incidentals required or used in performing the watering work as specified, except for furnishing, combining and mixing additives with the water when required.

In item (b), the name of the additive will be inserted, with a separate pay item provided for each additive.

Payment for item (b) will be payment in full for furnishing the specified additive, for combining and mixing it with the water, and for all extra costs involved in the use of the additive in the watering work not included in item (a).

00340.91 Quantity Variations - Payment for watering pay items performed beyond 25% of the quantity shown in the Schedule of Items will be made at the Contract unit price if the Engineer determines that the Contract unit price does not exceed the value of the work as determined on the basis of rates given in Section 00197. If the Engineer determines that the Contract unit price exceeds the value of the work, payment for the additional work will be made according to Section 00196.

00340.92 Incidental Basis - When neither the Special Provisions or Schedule of Items indicate separate payment for the work under this section, perform the work as Incidental work for which no separate payment will be made.

Section 00350 - Geosynthetic Installation

Description

00350.00 Scope - This work consists of furnishing and placing geotextile in drains, under embankments, for embankment reinforcement, under riprap, buttresses, inlays, shear keys, over roadbed subgrades, and beneath pavement overlays as shown or directed.

00350.01 Definitions - Terms not defined in this subsection may be found in ASTM D 123 and ASTM D 4439. If there is a conflict, definitions in this subsection take precedence.

Cross-Machine Direction - The direction in the plane of the fabric perpendicular to the direction of manufacture.

Drainage Geotextile - For installation as a filter in subsurface drains or other drainage locations.

Embankment Geotextile - For installation as a reinforcement within embankments and/or as a separator under embankments.

Geosynthetics - A planar product manufactured from polymeric material used with soil, rock, earth or other geotechnical, engineering related material as an integral part of a man-made product, structure or system.

Geogrid - A geosynthetic used for reinforcement which is formed by a regular network of tensile elements with apertures of sufficient size to allow strike-through of surrounding soil, rock or other geotechnical material.

Geomembrane - For Installation as a liner in a swale or other stormwater facility to prevent contaminated stormwater runoff from entering the groundwater.

Geotextile - A permeable geosynthetic comprised solely of textiles.

Nonwoven Geotextile - A textile produced by bonding and/or interlocking of fibers by mechanical, heat or chemical means.

Woven Geotextile - A textile comprising of two or more sets of filaments or yarns interlaced in such a way that they result in a uniform pattern.

Machine Direction - The direction in the plane of the fabric parallel to the direction of manufacture.

Pavement Overlay Geotextile - For installation as a reinforcement beneath an asphalt concrete overlay.

Riprap Geotextile - For installation as a filter and/or separator behind or beneath riprap, buttresses, inlays, shear keys and/or erosion control applications.

Roll - Unit of continuous geosynthetic without transverse seams as furnished by the manufacturer. Roll sizes may vary between manufacturers and types of geosynthetics.

Roll Values:

- **Average Roll Value** - The average roll value for each property is determined by testing a representative number of samples in a roll according to the test methods specified in Section 02320. An average of these tests becomes the average roll value for each roll tested.
- **Minimum Average Roll Value** - The minimum average roll value for each property is the mean of the average roll values for all rolls tested minus two standard deviations, all as determined by the manufacturer. The minimum average roll value for each property is determined by testing a representative number of rolls in a production run according to ASTM D 4354 sampling procedures and the test methods specified in Section 02320.
- **Minimum Value** - The minimum value is the specified value for each geosynthetic property that shall be met or exceeded by the manufacturer's minimum average roll value for the production run and, if sampled and tested by the [City](#), by the average roll value for any roll.

Seam Allowance - The minimum distance from the edge of a geotextile to the stitch line nearest to that edge.

Seam Type - A designation relating to the essential characteristics of geotextile positioning and rows of stitching in a specified sewn seam as shown on the plans.

Selvage - The finished edge of a geotextile parallel to the machine direction.

Stitch Type - A designation relating to the essential characteristics of the interlacing of sewn thread(s) in a specified seam as shown on the plans.

Subgrade Geotextile - For installation as a separator and/or reinforcement on subgrades and in other material separation applications.

Ultraviolet (UV) Rays - Direct radiation from the sun during daylight hours, even on cloudy days.

Ultraviolet Stability - The ability of a geosynthetic to resist deterioration when exposed to UV radiation.

Materials

00350.10 General - Provide materials conforming to Section 02320.

Equipment

00350.20 Field Seam Stitching Equipment - Use field seam stitching equipment that provides an acceptable lock-type stitch as recommended by the geotextile manufacturer and approved by the Engineer.

00350.21 Asphalt Distributor - Design, equip, maintain and operate the asphalt distributor according to 00730.22.

Construction

00350.40 General - Provide geosynthetic as furnished by the manufacturer and protect against damage and deterioration. Prevent excessive mud, wet concrete, epoxy and like materials from coming in contact with the geosynthetic. Store all geosynthetics in a dry place and off the ground at all times according to ASTM D 4873. Cover all geosynthetics with a dark protective covering when received. The geosynthetic will be rejected for use if the Engineer determines it has defects or deterioration, or has been damaged.

00350.41 Geotextile Installation Requirements:

(a) General:

(1) Placement:

a. Surface Preparation - Prepare the surface receiving the geotextile to a smooth condition free of obstructions, depressions and debris unless otherwise directed. Do not drag the geotextile on the ground or mishandle in any way.

Loosely place the geotextile without wrinkles so placement of the overlying material will not tear the geotextile. Lap or sew the geotextile at the ends and sides of adjoining sheets as specified.

b. On Slopes - Place the geotextile with the machine direction oriented up-down the slope. Lap the upper sheets over the lower sheets. When the geotextile is placed on a slope steeper than 6V:1H, securely anchor the laps to the ground surface with pins or stakes as necessary to prevent the slippage and tearing of the geotextile. Start placement of fill material on the geotextile at the toe of the slope and proceed upwards.

c. Where Exposed To Water - If geotextiles are placed under water or in areas where water will flow, the geotextile may be placed with the machine direction parallel to the direction of water flow instead of the placement direction specified in 00350.41(a)(1)(b). Overlap sheets so the upstream sheet is placed over the top of the downstream sheet. Adequately secure the geotextile to prevent slippage. As the geotextile is placed under water, place the backfill material on it to the required thickness. Do not place geotextile more than 50 feet ahead of the specified cover material.

(2) Overlaps - Minimum overlap requirements for geotextiles are:

Application	Minimum Overlap Requirements, inch
Drains	12
Embankment Stabilization	24
Pavement Overlays	*
Riprap and Rock Buttresses	24
Roadbed Subgrade Stabilization	24

* Use sufficient overlap to ensure closure, but not more than 6 inches.

If the Engineer determines the specified overlap is not sufficient, increase the overlap to provide adequate coverage or, if approved by the Engineer, sew the geotextile together in the field. If field sewn, the provisions of 00350.20 and 00350.41(a)(3) apply.

(3) Field Seams:**a. General** - When field sewn seams are required, make them as follows:

Sew field seams with polymeric thread consisting of polypropylene, polyester or kevlar, and as resistant to deterioration as the geotextile being sewn. Use a color of thread that contrasts with the geotextile being sewn so the stitches are exposed for inspection when the geotextile is placed. Seams shall meet the testing requirements of 02320.11(b).

b. Stitch Requirements - Use two rows of lock-type stitching, Type 401, to make the seams, as shown. The two rows of stitching shall be 1/2 inch apart with a tolerance of plus or minus 1/4 inch and not cross except for restitching.

c. Minimum Seam Allowance - The minimum seam allowance (the minimum distance from the edge of geotextile to the nearest stitching) is:

Seam Type (See Plans)	Minimum Seam Allowance, inch
Flat or Prayer Seam, Type SSa-1	1 1/2
"J" Seam, Type SSn-1	1
Butterfly-folded Seam, Type SSd-1	1

d. Seam Type - Obtain the geotextile manufacturer's recommendation for the type of seam and stitch to be used. If the Contractor does not obtain and provide the foregoing technical information use a "J" seam with at least three stitches per 1 inch. The flat, or prayer, seam may be used for repair of damaged in-place geotextile.

(4) Protection of Geotextile - Protect the geotextile at all times from ultraviolet (UV) rays, contamination by surface runoff and construction activities.

Traffic or construction equipment will not be permitted directly on the geotextile except as authorized in 00350.41(f)(5) or as directed.

During installation cover the geotextile with specified cover material as soon as possible. Do not leave in uncovered condition for more than five days, except when used with temporary, wrap-faced, mechanically stabilized earth walls and asphalt overlays as required in Section 00596 and 0350.41(f), respectively.

Place cover material on the geotextile in such a manner that the geotextile is not torn, punctured or shifted. Use a minimum 6 inch thick cover layer or twice the maximum aggregate size, whichever is thicker. Do not end-dump cover material directly on geotextiles other than riprap geotextile.

Limit construction vehicles in size and weight so rutting in the initial layer above the geotextile is not more than 3 inches deep or half the layer thickness, whichever is lesser. Do not turn vehicles on the first layer.

(5) Repair of Geotextile - Repair or replace all torn, punctured or contaminated geotextiles during construction at no cost to the City. Repair by placing a patch of the specified geotextile over the affected area. Overlap the existing geotextile with the patch according to 00350.41(a)(1). Where geotextile seams are required to be sewn, repair any damaged sheet by sewing unless otherwise indicated on the plans or Special Provisions, or as directed.

(b) Drainage Geotextile - When used in trenches for drains, place the geotextile in the trench as shown on the plans to loosely conform to the shape of the trench with no wrinkles or folds.

(c) Embankment Geotextile - Construct embankment stabilization according to details shown on the plans. Place the geotextile layers so the geotextile machine direction is transverse to the embankment centerline. Spread the geotextile so all slack and wrinkles are eliminated. Construct embankment in uniform layers according to Section 00330.

(d) Riprap Geotextile - Place geotextile behind and beneath riprap, buttresses, inlays, shear keys and erosion control applications according to the details shown. Demonstrate to the satisfaction of the Engineer that the combination of the rock-fill drop height and the thickness of any aggregate cushion, when specified or required, is adequate to prevent puncturing or damaging the geotextile when placing the riprap or stone embankment material. If an aggregate cushion is used, place according to 00350.41(a)(4). In addition, the following limits apply:

Size of Rock	Maximum Drop Height, feet	
	Onto Geotextile Material	Onto an Aggregate Cushion Blanket
Greater than 200 pounds	0	3
200 pounds or less	3	3

After placing the riprap, backfill all voids in the riprap face so the geotextile is completely covered and not visible.

(e) Subgrade Geotextile - For roadbed subgrade separation, prepare the subgrade according to Section 00330.

Correct geotextile failures, as evidenced by soil pumping or roadbed distortion, by removing any covering material in the affected area and placing a geotextile patch on the exposed geotextile according to 00350.41(a)(5). Cover the patch with the specified cover material and compact before proceeding.

(f) Pavement Overlay Geotextile:

(1) General - Place geotextile and pavement overlay in four basic steps:

- Surface preparation
- Sealant application
- Geotextile placement
- Overlay placement

(2) Weather Limitations - Do not place sealant and geotextile unless the weather limitations of 00745.40 are met, as appropriate, except the minimum air temperature shall be 50° F for paving grade asphalt sealant placement and 60° F for asphalt emulsion sealant placement.

(3) Surface Preparation - Prepare the pavement surface on which the sealant is to be placed according to 00730.42 and the following:

- Clean and fill cracks exceeding 1/8 inch width with a bituminous crack filler from the CPL
- Repair minor irregularities or depressions as directed
- Allow crack filling material to cure before placing geotextile
- Where the pavement is severely cracked, rutted, deformed or otherwise distressed, place a leveling course as directed instead of extensive surface preparation

(4) Sealant Application - Use a normal paving grade asphalt. A cationic or anionic emulsion may be used as approved. Do not use cutbacks or emulsions that contain solvents.

Uniformly spray the asphalt sealant at normal application temperature by means of a pressure distributor conforming to 00350.21 on the prepared dry pavement surface. Apply at the rate of 0.20 - 0.30 gallon/square yard, or as recommended by the geotextile manufacturer or as directed.

If using emulsions, increase the application rate 50% or as directed. Some underlying surfaces may require a higher application rate. Within street intersections, on steep grades or in other zones where vehicle speed changes are commonplace, reduce the normal application rate by 20% or as directed.

The target width of the sealant application shall be the geotextile width plus 6 inches. Apply the sealant only as far in advance of the geotextile installation as appropriate to ensure a tacky surface at the time of geotextile placement. Place the geotextile the same day as the sealant. Do not allow traffic on the sealant. Clean excess asphalt from the road surface.

(5) Geotextile Placement - Place the geotextile into the sealant using mechanical or manual laydown equipment capable of providing a smooth installation with a minimum amount of wrinkling or folding from the water (break) before placing the geotextile.

Slit wrinkles or folds exceeding 1 inch and lay flat. Shingle-lap not more than 6 inches in the direction of the paving. Broom and/or pneumatic roll to maximize geotextile contact with the pavement surface. Additional hand-placed sealant material may be required at laps as determined.

Limit traffic to necessary construction equipment and emergency vehicles on the geotextile before and during paving unless otherwise directed. Turn the paver and other vehicles gradually. Keep turning to a minimum to avoid geotextile movement and damage. Avoid abrupt starts and stops.

(6) Overlay Placement - Place the overlay the same day the geotextile is placed. Remove sealant that bleeds through the geotextile. Do not windrow asphalt concrete material on the geotextile ahead of the paving machine. Do not use an asphalt concrete material pickup machine.

(g) Geomembrane Deployment:

(1) Preparation - Prior to installing the geomembrane, inspect the sub-grade, remove all foreign matter and sharp, protruding or loose material that could penetrate or otherwise damage the geomembrane, and compact the sub-grade to specifications.

(2) Inspection - During installation, visually inspect the geomembrane for imperfections, defects, holes, blisters, undispersed raw materials, and any sign of contamination by foreign matter. Mark and repair faulty or suspect areas.

(3) Cuts and Welds - Perform all cuts, welds and penetrations per manufacturer's specifications. Shingled overlaps shall be a minimum of three feet in the downslope direction.

(4) Cover - Cover fill material shall be free of foreign objects or sharp material that could penetrate or otherwise damage the geomembrane. Place and spread over the geomembrane in a manner that prevents punctures or other damage to the geomembrane.

Measurement

00350.80 Square Unit Basis - Each geosynthetic installation will be measured along the lines and grades of the surface area actually covered according to the plans or as required, except for drainage applications.

The number of square yards of drainage geotextile will be computed by multiplying the length of the trench where geotextile is used by the perimeter of the trench as determined from the neat lines shown, or as directed.

No separate measurement will be made for constructing laps, seams, joints, or patches unless more than the specified lap is ordered, in which case the added lap width will be measured.

Payment

00350.90 Square Unit Basis - The accepted quantities for geosynthetics will be paid for at the Contract price per unit of measurement for the following items:

Pay Item	Unit of Measurement
(a) Drainage Geotextile, Type ____	Square Yard
(b) Embankment Geotextile	Square Yard
(c) Riprap Geotextile, Type ____	Square Yard
(d) Subgrade Geotextile	Square Yard
(e) Pavement Overlay Geotextile	Square Yard
(f) Geomembrane	Square Yard

In items (a) and (c), the type of geotextile will be inserted in the blank, with a separate pay item provided for each type.

Item (e) includes preparation work, sealant, and geotextile.

Payment will be payment in full for all equipment, labor, and incidentals necessary to complete the work. No separate payment will be made for constructing laps, seams, joints, and patches unless the Engineer orders additional amounts over the minimum. For laps wider than the minimum or specified width, payment will be made for the added lap width at the Contract unit price.

If the Engineer orders geosynthetics with properties more stringent than specified, a price adjustment will be allowed only for the difference in material cost.

Section 00360 - Drainage Blankets

Description

00360.00 Scope - This work consists of furnishing and placing drainage blanket material to the lines, grades and dimensions shown on the plans or as directed.

Materials

00360.10 Sand Drainage Blanket - The sand drainage blanket material shall conform to the following gradation limits determined by AASHTO T 11/T 27:

Sieve Size	Percent Passing
No. 10	95 - 100
No. 40	50 - 100
No. 60	20 - 40
No. 200	0 - 5

00360.11 Granular Drainage Blanket - The granular drainage blanket material shall be clean, free draining, durable crushed or uncrushed rock, conforming to the following gradation limits determined by AASHTO T 27:

(a) General:

Sieve Size	Percent Passing
6"	100
4"	90 - 100
1/2"	60 - 80
No. 10	0 - 10
No. 100	0 - 5

(b) Pervious Pavement – Under pervious pavement, furnish crushed rock conforming to the following gradation limits:

Sieve Size	Percent Passing
2"	100
1-1/2"	95 - 100
3/4"	35 - 70
3/8"	10 - 30
No. 4	0 - 5

Granular drainage blanket material will be accepted without testing if the Engineer visually determines the material meets the above requirements.

00360.15 Quality Control - Provide quality control according to Section 00165.

Equipment

00360.20 General - Use equipment capable of hauling, spreading and compacting the material to specified density without segregation.

If drainage blanket material is used to drain areas described in 00360.41, hauling with end dump trucks and spreading with bulldozers and other appropriate equipment will be permitted.

Labor

00360.30 Quality Control Personnel - Provide certified technicians in the following fields:

- CEBT (Certified Embankment and Base Technician)
- CAgT (Certified Aggregate Technician)
- CDT (Certified Density Technician)

Construction

00360.40 Planned Locations - On prepared excavations or embankments constructed as shown on the plans or as directed, place the drainage blanket as follows:

- Spread and compact to required depth with no layer exceeding 3 feet
- If a subsurface drain system is installed immediately under or adjacent to the drainage blanket, place the drainage blanket directly against the subsurface drain system
- Prevent contamination of drainage blanket material

00360.41 Other Locations - When used to drain an unstable or wet area, excavate or trench the existing low areas as directed for positive drainage before placement of drainage blanket material.

00360.42 Compaction and Density Requirements - Compact the drainage blanket according to 00330.43.

Measurement

00360.80 Measurement - The quantities of sand or granular drainage blanket material will be measured on the volume basis in place and be limited to the neat lines, grades and dimensions shown on the plans or as directed, or on the weight basis.

Payment

00360.90 General - The accepted quantities of sand and granular drainage blankets will be paid for as follows:

	Pay Item	Unit of Measurement
(a)	Sand Drainage Blanket	Ton or Cubic Yard
(b)	Granular Drainage Blanket.....	Ton or Cubic Yard

Payment for items (a) and (b) will be payment in full for furnishing, hauling, handling, placing and compacting the materials including all equipment, labor, and incidentals necessary to complete the work as specified.

Section 00390 - Riprap Protection

Description

00390.00 Scope - This work consists of furnishing and placing an erosion resistant cover material for protecting slopes and basins at locations shown or as directed.

00390.01 Definitions:

Riprap Geotextile - A geotextile placed between the area prepared for it and the riprap.

Filter Blanket - A layer of graded granular material placed between the area prepared for it and the riprap.

Riprap Backing - An option of using either riprap geotextile or a filter blanket placed between the area prepared for it and the riprap.

Loose Riprap - Specified classes of graded rock placed on prepared slope, riprap geotextile or filter blanket, as specified.

Keyed Riprap - Loose riprap placed on prepared slope, riprap geotextile or filter blanket, as specified, and keyed in place by slapping the surface with a piece of armor plating.

Grouted Riprap - Loose riprap with all or part of the spaces filled with Portland cement mortar.

Riprap Basin - Energy dissipater consisting of loose riprap placed at pipe outlets as specified.

Materials

00390.10 Riprap Geotextile - Riprap geotextile shall meet the requirements of 02320.

00390.11 Riprap Requirements:

(a) General - Rock for loose riprap shall:

- Meet the test requirements of 00390.11(b)
- Be angular in shape. Thickness of a single rock shall not be less than one-third its length. Rounded rock will not be accepted unless authorized by the Engineer.
- Meet the gradation requirements for the class specified
- Be free from overburden, spoil, shale and organic material. Non-durable rock, shale or rock with shale seams is not acceptable

(b) Test Requirements - The rock shall conform to the following test requirements:

Material Test	Requirement
Apparent Specific Gravity (AASHTO T 85)	2.50 Min.
% Absorption (AASHTO T 85)	6.0 Max.
Degradation (ODOT TM 208A)	
Passing No. 20 Sieve	35.0% Max.
Sediment Height	8.0" Max
Soundness (AASHTO T 104)	
Average Loss of 2 1/2" - 1 1/2" and 1 1/2" - 3/4" fraction after 5 alternations	16.0% Max.

(c) Gradation Requirements - Grade loose riprap by class and weight of rock according to the following:

Class 50	Class 100	Class 200	Class 700	Class 2000	
					Percent (by weight)
Weight of Rock (pounds)					
50 - 30	100 - 60	200 - 140	700 - 500	2000 - 1400	20.0
30 - 15	60 - 25	140 - 80	500 - 200	1400 - 700	30.0
15 - 2	25 - 2	80 - 8	200 - 20	700 - 40	40.0
2 - 0	2 - 0	8 - 0	20 - 0	40 - 0	10.0 - 0

Uniformly grade each load of riprap from the smallest to the largest weight specified. Control of gradation will be by visual inspection.

(1) Control Sample - If directed, provide, at a satisfactory location near the Project, a rock sample of at least 5 tons meeting the gradation for the class specified. This sample will be used as a frequent visual reference for judging the gradation of the riprap supplied.

(2) Sampling and Testing Assistance - Any difference of opinion between the Engineer and the Contractor shall be resolved by dumping and checking the gradation of two random truck loads of rock. Mechanical equipment, a sorting site and labor needed to assist in checking gradation shall be provided by the Contractor at no additional cost to the [City](#).

00390.12 Grouted Riprap - Rock for grouted riprap shall conform to the requirements of 00390.11, and the Portland cement grout shall conform to the requirements of 02080.40.

00390.13 Filter Blanket - Filter blanket material shall conform to the following requirements according to riprap class:

Riprap Class	Filter Blanket
Class 2000	16 inch layer of Class 50 riprap conforming to 00390.11
Class 700	9 inch layer of 6" - 0 stone embankment meeting the test requirements of 00330.16
Class 200	6 inch layer of 4" - 0 stone embankment meeting the test requirements of 00330.16
Class 100	No filter blanket required
Class 50	No filter blanket required

Construction

00390.40 Preparation - Remove brush, trees, stumps and other organic material from slopes to be protected by riprap and dress to a smooth surface. Remove all unsuitable material to the depth shown or directed and replace with approved material. Compact filled areas as specified in Section 00330.

Provide riprap protection as early as the structure foundation construction permits. Prepare the surfaces to be protected as shown. Maintain the trench slopes, riprap geotextile or filter blanket until the riprap is placed.

00390.41 Riprap Geotextile - If required, install riprap geotextile according to the requirements of Section 00350 and as shown or directed.

00390.42 Filter Blanket Construction - If required, place the filter blanket on the prepared area to the full specified thickness in one operation, using methods which will not cause segregation. The surface of the finished layer shall be reasonably even.

00390.43 Riprap Backing - When allowed in the Special Provisions or indicated on the plans, the Contractor shall have the option of placing either riprap geotextile or a filter blanket behind the riprap. Install the backing according to 00390.41 or 00390.42.

00390.44 Riprap:

(a) General - Unless otherwise directed, place the riprap protection as the embankment is constructed. Its placement shall lag behind embankment construction only as necessary to allow proper embankment construction and prevent mixture of embankment and riprap material.

(b) Loose Riprap - Place riprap on the prepared area:

- With a clam-shell, orange-peel bucket, skip or similar approved device which will contain the riprap material to its final destination. Do not open the bucket until it has been lowered to the slope on which the material is being placed
- To its full course thickness in one operation
- According to 00350.43, if riprap is placed on geotextile
- By methods that do not cause segregation of riprap or displace the underlying material
- To produce a compact riprap protection in which all sizes of material are placed in their proper proportion
- With some hand placing, or rearranging of individual stones by mechanical equipment, or some other approved means to provide a smooth finished surface

Where filter material and/or riprap are placed under water, increase their thicknesses as shown or as directed.

(c) Keyed Riprap - After placing loose riprap material according to 00390.44(a), and (b), key the riprap into place by slapping the surface with a piece of armor plating (approximately 4' x 5' in size with a weight of approximately 5,000 pounds) or other approved means which will produce a nearly smooth surface.

(d) Grouted Riprap - Place loose riprap material according to 00390.44(a) and (b). If the depth specified for grouting is more than 12 inches, place the riprap in lifts of 12 inches or less and grout each lift before placing the next lift. Construct and grout the succeeding lifts before the grout in the previous lift has hardened.

Thoroughly moisten the stones and sluice any excess fines to the underside of the riprap before grouting. Deliver the grout to the place of final deposit by any means that will ensure uniformity and prevent segregation of the grout. Spade or rod the grout into the spaces to completely fill the voids in the riprap. Control pressure grouting and do not unseat the stones. Penetration of the grout shall be to the depth shown on the plans. If a rough surface is specified, brush the stone until 25% to 50% of the depth of surface stone is exposed. For a smooth surface, grout the crevices to within 5/8 inch of the surface.

Provide weep holes through the riprap as shown or as directed.

Place and cure grout according to 00440.40(d) and (e) except as provided above.

(e) Riprap Basins - Excavate, backfill and construct riprap basins, without a riprap geotextile or filter blanket, at pipe outlets with Class 50 riprap as shown or as directed.

Maintenance

00390.60 General - Maintain the riprap protection until accepted. Replace any material displaced by any cause at no additional cost to the City.

Measurement

00390.80 Filter Blanket - The quantities of filter blanket will be measured on the area basis of the finished surface within the neat lines shown or directed.

00390.81 Riprap Backing - The quantities of riprap backing, will be measured on the area basis of finished geotextile or filter blanket surface, within the neat lines shown or directed.

00390.82 Riprap - The quantities of riprap will be measured on the volume in place basis or on the weight basis as given by the appropriate pay item in the Schedule of Items.

When measurement of riprap is given on the volume in place basis and the Engineer determines that this basis is impractical, the pay volume will be determined by loose measure in the hauling vehicles on the basis that cubic yard, vehicle measure, is equivalent to cubic yard in place.

00390.83 Riprap Basins - The quantities of riprap basins will be measured on a unit basis per each by actual count of basins constructed and accepted.

Payment

00390.90 General - The accepted quantities, measured according to 00390.80 through 00390.83, will be paid for at the Contract unit price per unit of measurement for the following items:

Pay Item	Unit of Measurement
(a) Filter Blanket.....	Square Yard
(b) Riprap Backing	Square Yard
(c) Loose Riprap, Class ____	Cubic Yard or Ton
(d) Grouted Riprap, Class ____	Cubic Yard or Ton
(e) Keyed Riprap, Class ____	Cubic Yard or Ton
(f) Riprap Basins	Each

Riprap geotextile will be separately paid for under Section 00350, except when included in item (b).

In items (c), (d) and (e), the class of riprap will be inserted in the blank, with a separate pay item being provided for each class.

No separate or additional payment will be made for the grout in item (d).

Payment will be payment in full for furnishing all material, equipment, labor and incidentals necessary to complete the work as specified.

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