

CHAPTER 2B

EARTHWORK

2B-01. GENERAL

a. Scope

This chapter covers embankments, grading and preparation of subgrade for roadways, railroads and other earthwork structures of similar nature plus excavation, filling and backfilling for building construction.

b. Survey and Soils Control

(1) A survey crew is generally assigned to conduct surveys or to check contractor*s surveys. Soils testing is usually performed by project laboratory personnel or by approved commercial laboratory.

(2) The Quality Assurance Representative normally will not physically perform surveys or soil testing. However, he must be familiar with surveys and soil testing to determine that job requirements are met as the work progresses, and to make sure that the surveying and testing is appropriately performed as required. He should record tests made and any action taken as a result of the tests.

(3) Confer with your supervisor, survey personnel, and laboratory personnel. Establish liaison so that all concerned will be continually informed of surveys and soil tests. Also arrive at a clear understanding of the nature and scope of records, reports, and other construction data required, as well as individual assignments for obtaining data, and preparation and submission of reports.

c. Samples of Material

Samples of certain types of soils, such as capillary water barrier under floor slabs and base material for roadways, are required to be tested by the contractor prior to use in the work. Use only tested and approved materials in the work.

d. Standards of Inspection

(1) Uniformly high quality earthwork construction is required. Each step of the numerous operations involved must be given close and continuous attention.

(2) Several classifications of excavation and of embankment materials are generally involved. Control can best be accomplished by maintaining a chart or tabulation of quantities and distribution of materials.

(3) If the contractor fails to operate according to specification requirements or otherwise fails to operate in a manner to produce a satisfactory end product, notify your supervisor and make recommendations for appropriate action. Keep a record of your recommendations in your daily report.

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28-02. TOPSOIL

a. Stripping

- (1) Check contract requirement for stripping of topsoil.
- (2) Verify the topsoil to be stripped meets the definition of topsoil.
- (3) verify the depth of stripping of topsoil.
- (4) Check the stripped topsoil is not contaminated with subsoil, slag or cinders.

b. Stockpiling

- (1) Determine location for stockpile.
- (2) Ensure the stockpiling is kept neat, well-drained and in a workable condition at all times.

c. Spreading

- (1) verify the total requirements for topsoil. Check the quality of topsoil meets the specifications.
- (2) Check for favorable soil and weather conditions to give beneficial results.
- (3) Verify the scarifying depth of subgrade.
- (4) Check the method and depth of placement for even distribution of topsoil over the area.
- (5) Check the stripped topsoil to see that it is free from stones, sticks, roots, trash or other material larger than one-half inch in diameter, and free from viable plants or plant parts.
- (6) Ensure compaction of the placed topsoil is prevented.

28-03. EXCAVATION

a. Earth Excavation

- (1) Prior to the start of excavation operations, take photographs of the construction area, make sure that sufficient cross-sections are taken, and continue to take progress photographs during construction.
- (2) Review the log of borings to ascertain the elevation of the water table and to determine if unsuitable soils are likely to be encountered. Dewatering equipment may be necessary, and disposal for unsuitable material must be provided.
- (3) Check Post utility maps prior to the start of excavation to ascertain existing lines not shown on contract drawings.
- (4) Evaluate materials being excavated against logs of borings. If differences are noted, consult your supervisor for determination of action to be taken.
- (5) Check that approved disposal areas and haul roads are used.

(6) Check for location of required protection to sanitary and storm drains, electrical cables, communications cables and gas lines subject to damage by heavy earth-moving equipment.

(7) Insure the utilization of satisfactory materials from excavations.

(8) Determine moisture condition of suitable excavated materials in advance of needs.

(9) Insist that excavation is performed in specified sequence.

(10) Assure that drainage is provided continually as excavation progresses.

(a) Do not permit ponded water in any construction area.

(b) Be sure that drainage ditches are maintained free flowing.

(11) Insure that required tests for soil bearing characteristics are made upon completion of excavation.

(12) Coordinate planning of borrow excavation to insure that the right materials will be available as needed for embankment construction, and that borrow will not be unnecessarily used when excavated material is available.

(13) Inspect borrow pits for:

(a) Adequate stripping.

(b) Orderly removal of materials.

(c) Satisfactory drainage.

(14) After total material removal, check borrow pit areas for conformance with final shaping and drainage requirements.

(15) Determine average volume hauled for each type of hauling equipment. Record daily load count for various classifications of excavation when required for partial payments.

(16) Take final cross-sections.

(17) Provide that quantity surveys are made for payment purposes.

(18) Examine all excavating equipment for compliance with General Safety Requirements.

b. Earth Excavation - Building

(1) Check for contractor*s location, identification and necessary protection for site utilities before operations begin.

(2) Excavated material intended for use as fill must be free of limbs, stumps, roots, brush, vegetation and debris from building foundations, pavements, utilities, etc.

(3) See that the foundation bearing materials agree with the borings.

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(4) Check for the proper fill of all depressed areas or holes. (Fill is not permitted beneath footing to correct over excavation.)

(5) Inspect sides of excavations for safe slope (angle of repose) or if sides are made vertical, check adequacy of required bracing to safely retain the sides.

(6) Define provisions made for preventing damage to adjoining property.

(7) Observe method of dewatering excavations and water disposal.

(8) Insure that footing beds in dewatered areas are not disturbed or softened.

(9) See that proper sequence of excavation is carried out for components of the building at different elevations.

(10) Inspect footing and foundation excavations for clearances sufficient to permit erection of forms, installation of services and inspection.

(11) Identify corrective methods used in cases of over-excavation.

(a) Do not modify or change established elevations without written approval of the Contracting Officer.

(b) Correct over-excavation by placing approved, compacted backfill or concrete fill, depending on location.

(c) Keep a detailed record of any such corrective work.

(12) Check provisions for preventing surface drainage into the excavated area.

(13) See that footing drains are installed where required.

(14) Determine special instructions and/or requirements when excavations require use of caissons and cofferdams.

(15) Check safety requirements for heavy equipment operating close to deep excavations.

c. Soil Poisoning

(1) Check the requirement for soil poisoning under and around building structures.

(2) Check for approval of material to be used and watch specifically for required concentration.

(3) Check application for coverage and quantity of material used.

(4) Check EPA restrictions.

d. Rock Excavation

(1) Inspect contractor*s procedures for compliance with proposed and/or approved plan of operation.

(a) Drilling and blasting are the commonly used methods for rock excavation. However, picking, barring and wedging are used to some extent.

(b) Check methods proposed for use in rock excavation for a safe operation (see below).

(2) When overburden has been removed, and prior to rock excavation, see that necessary surveys are made to determine pay quantities.

(3) Determine compliance with all Safety Regulations.

(a) Carefully inspect handling, storage and use of explosives.

(b) Insure compliance with city, county and/or state regulations relative to explosives.

(c) Abide by provisions made for warning notices prior to blasting, including: curtailment of radio transmission, protection at highway and railroad crossings, and warning system for personnel.

(d) Check compliance with restrictions on blasting near fresh concrete.

(e) Check that requirements for monitoring of blasts are being carried out.

(4) Check qualifications of contractor*s supervisor, drillers and powdermen assigned to blasting operations.

(5) Inspect drilling and blasting equipment. Do not permit use of unsafe, workout or obsolete equipment.

(6) Check drilling depth, evidence of materials encountered in drilling, water in or flowing from holes, and indications of seams or faults shown by drill drop or rate of drilling.

(7) Verify drilling pattern for blasting, quantity and firing sequence of explosives.

(8) Keep records of the quantities of explosives used.

(9) Check results of each blast, particularly as final excavation lines and/or grades are approached.

(a) Look for overbreak, damage to adjacent features, and safety. Drilling pattern and/or quantity of explosives should be modified if unsatisfactory conditions result.

(b) Observe and record overbreak that results from structural weakness of rock for which payment will be made.

(c) Examine for and correct unstable rock on sides of completed excavation.

(d) Evaluate installation of necessary rock supports and recheck periodically to see that they are secure.

(e) Insure compliance with restrictions on blasting as final grades or excavation lines are approached.

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(f) Insofar as possible, provide that the rock is left in an unshattered, solid condition.

(g) Inspect scaling and removal of loose material from slopes.

(h) Make sure that rock foundations are marked down to a satisfactory bed and side wall to receive concrete.

1. Smooth sloped surfaces are to cut into rough steps or benches. Vertical height of steps or benches should be limited to 3 feet.

2. Smooth flat surfaces are to be roughened.

(10) Evaluate trench excavation.

(a) Determine if separate trenches are needed for water and sewer lines.

(b) Insure that trenches are excavated to the minimum required depth below the bottom of pipe and to the required gradient.

(c) Examine for and correct unstable rock on sides of trench.

(11) Observe the drainage of excavated areas.

(12) Check the disposal of material from rock excavation. Be sure that satisfactory rock is handled and used as required.

(13) Implement necessary surveys for payment purposes.

(14) Watch for the excavation of trenches too far ahead of pipe laying.

(15) Make sure that the specified density is obtained when backfilling trenches.

(16) Maintain a complete record of all unusual conditions encountered.

2B-04. FOUNDATION PREPARATION

a. Foundations Other Than for Buildings

(1) Refer to Chapter 2A of this Guide for check items relative to clearing and grubbing.

(2) Observe depth of stripping and disposal of stripped material.

(3) Examine earth foundation areas for evidences of peat, mulch, humus and other unsuitable material and remove.

(4) Inspect filling and compacting of foundation depressions.

(5) Evaluate densities of earth foundation materials prior to constructing embankment.

(6) Note drainage of foundation area.

(7) Assure that scarifying of earth foundation areas or other procedures required to effect bond between foundation and embankment materials are properly employed.

(8) Insure that rock foundations to receive impervious fill have all loose rock and other foreign material removed by specified methods.

(9) Similarly, check rock foundations to receive concrete.

(10) Define special foundation treatment required.

(11) Inspect marking and protection of all features that are to remain in the construction area, such as trees, poles, and structures.

(12) Record all cracks or faults, actual or possible, by taking pictures and/or plot maps, calling them to your supervisor*s attention.

b. Building Foundations

(1) Compare foundation conditions with conditions shown on the drawings. Report and record unusual conditions.

(2) Make note of unsuitable materials in the foundation bed. Remove unsuitable materials and backfill with suitable materials. Keep accurate records of any such work.

(3) Review grade, smoothness, and compaction of bottoms of excavations.

(4) See that final grade for foundations in rock is carefully excavated so as not to cause breaking or shattering.

(5) Consider the order of footing excavation. Lowest footing areas should be placed first.

(6) Check the effectiveness of dewatering excavations. Do not permit accumulation of water in footing excavations.

(7) Insure that provisions are made to prevent surface water from entering excavations.

(8) Over-excavation at footings shall be filled with concrete during footing placement.

2B-05. EMBANKMENTS AND BACKFILL

a. Survey Control

(1) Be familiar with locations of Government-established bench marks and base lines. Be sure that all control points are protected from damage during construction.

(2) Determine that the contractor*s layout of work complies with specification requirements.

(3) Insist that all original ground surveys necessary for use as basis of payment to the contractor are made in the project area, borrow areas, etc.

(4) Assure that final surveys are made as each phase of the work is completed.

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(5) Review elevations of all completed excavations and embankments for compliance with specifications.

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b. Preparation

Prior to the placement of embankment or backfill, check:

(1) Removal of required vegetation, such as roots, brush, heavy sods, heavy growth of grass, decayed vegetable matter, rubbish and other unsuitable material.

(2) Compaction of ground surface.

(3) Plowing, stepping or benching of sloped surface steeper than 1 vertical to 4 horizontal.

(4) Determine the contractor*s plans for the installation of all drainage and drainage structures before placing embankments.

c. Haul Roads and Ramps

(1) Inspect haul road layout. Restrictions on haul road type and haul routes may be imposed.

(2) Inspect haul road construction within an embankment area and require that the same material with the same moisture density relationship be used for the embankment.

(3) View construction ramps. Do not permit cutting through a compacted embankment; construct ramps out from the embankment.

(4) Provide that original moisture content of haul road surfaces within permanent fill and excavation areas is maintained.

(5) Route vehicular traffic on embankment sections so that compactive effort will be uniformly distributed over the area.

(6) Insist that established roadways used for hauling are kept clean and smooth at all times, and that dust is kept to a minimum.

d. Ditching

(1) Maintain control of ditching operation with timely spot cross-sectioning, and the checking of grades, shapes and slopes.

(2) Area of excessive excavation should be immediately backfilled and compacted.

(3) Inspect for the complete removal of all roots, stumps, rocks and foreign matter inside the excavated area.

(4) Insure the adequate disposal of excavated material. In no case should the material be left closer than 3 feet from the edge of the ditch.

(5) Inspect the maintenance of the ditch. It is usually the contractor*s responsibility to maintain ditches until final acceptance of the work.

(6) Be sure that the excavation is carried out in such a manner as to prevent surface water from flowing into a trench or other excavation.

e. Embankments

(1) Meet classification of the soils being used for embankment formation. Dispose of all unsuitable material rapidly and check that it is not deposited in the embankment.

(2) Evaluate contractor provided hauling and compacting equipment for safety, quantity, type, and condition.

(3) Check soil moisture requirement by determining workable moisture content ranges of the soils to be used and the natural moisture content of the soils.

(4) Scrutinize the contractor*s operations to see that full advantage is taken of the soil*s natural moisture.

(5) Determine that adequate testing is performed and that results indicate that satisfactory moisture and density are obtained.

(6) Determine the need for wetting, drying, or mixing of fill obtained from excavations or from borrow pits. Insure that action is taken to uniformly moisture condition the soils as necessary in advance of needs.

(7) Note controls for spreading embankment material

(a) Insure adequate mixing equipment (such as plows, discs, etc.) on site for the mixing and breaking up of material and to provide uniformity of moisture distribution and material.

(b) Measure lift thickness.

(c) Notice uniformity of materials and moisture content.

(8) Note compaction of the material and record results.

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(a) Start compaction operations as soon as possible after soil has been placed and satisfactorily conditioned with the specified moisture content.

(b) Check rollers and roller coverage.

(c) Check for tearing action in roller turn areas. Reroll area as necessary to obtain required density.

(d) Check roller action for evidences of excessive moisture content in the soil or for evidences of exceeding the soil bearing capacity. Soil densities should increase with an increase in the number of roller passes to the point of maximum density for a fixed moisture content.

(e) Evaluate operation of land-manipulated tamping equipment for complete compaction coverage at optimum water content.

(f) Measure compacted layer thickness.

(g) Determine uniformity of density.

(9) Check for surface drainage of each lift.

(10) Insure removal of oversize stones, roots, and debris from materials as they are placed.

(11) Investigate installation of required settlement gages and piezometers.

(a) Check connections and plumbness of each section as progressively installed.

(b) Obtain and record readings each time the tubes are extended.

(12) Determine that required record tests are taken.

(13) Observe final alignment, section and grade.

(14) Seal each layer with light pneumatic equipment to preserve the moisture.

(15) Scarify and wet each layer prior to placing each succeeding layer, and check bonding between layers.

f. Backfill of Trenches and Building Excavations

(1) Analyze condition of material at bottom of trenches and/or excavations. Remove wet or unstable material and replace with compacted, suitable material.

(2) Evaluate material employed for pipe bedding. A minimum overdepth and bedding is required for rock trench bottom.

(3) Look into the shaping of pipe beds for bottom quadrant of gravity storm and sanitary pipe. See that bell holes are being excavated so that pipes are uniformly supported over their entire length at the required grade. Grading should precede bell hole excavation.

(4) Check the material for plasticity, gradation, and frost susceptibility, and see that the proper material is placed in the correct section.

(5) Check width of trench bottoms for sanitary and storm drains. Width should not be greater than the dimensions specified.

(6) Examine materials to be used for all backfill. Insure that material is compacted under pipe haunches.

(7) Inspect all excavations for removal of all debris and frozen material prior to backfilling.

(8) Notice placement of layers and uniformity of compaction and density results.

(a) Insure that precautions are observed in backfilling against walls, and that sufficient time has elapsed for curing of concrete.

(b) Assure dewatering of excavations to be backfilled.

(c) Insist that material be placed at optimum moisture content.

(d) Observe all cold weather placing requirements.

(9) See that sufficient depth of fill is over the pipe prior to permitting heavy equipment to pass.

(10) Report to your supervisor all indications of damages to walls or structures by backfilling operations, and determine if corrective action is required.

2B-06 FINAL GRADING AND SUBGRADE PREPARATION

a. Final Grading

(1) Compel conformance to required lines and grades.

(2) Insist on uniformity of smoothness and compliance with surface smoothness requirements.

(3) Check drainage of finished surfaces.

(4) Observe the functioning of ditches and drainage structures.

b. Subgrade Preparation

Note: Subgrade as used herein is defined as that portion of the surface of any embankment, fill or excavated area on which protective or base course materials are to be placed and all areas to be top-soiled and seeded.

(1) Check lines, grade and shaping of sub-grade.

(2) Check for evidence of soft, yielding or otherwise unsatisfactory material. Remove and replace as necessary.

(3) Check for boulders and ledges in cut areas. Remove or break off to required depth.

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(4) Check moisture content and compaction immediately prior to placement of protective or base course materials.

(5) For additional check items, see Chapter 20, Paving, of this guide.

2B-07. DRAINAGE FILLS FOR SLABS AND STONE PROTECTION

a. Drainage Fills for Slabs

(1) Check material for compliance.

(2) Check rolling and/or operation of hand-operated tamping equipment for complete and uniform compaction coverage. Particularly watch compaction adjacent to walls, columns and other similar areas.

(3) Check layer thickness.

(4) Check for uniform required compaction.

(5) Check shaping of surface for conformity with line, grade and surface tolerances.

b. Stone Protection

(1) Check approval of materials.

(2) Check uniformity of stone size and/or gradation prior to and after placement.

(3) Check equipment used and placement procedures.

(4) Check thickness of protection.

(5) Check lines and grades for conformity with tolerances.