

200 EARTHWORK

ITEM 204 - SUBGRADE COMPACTION AND PROOF ROLLING / TEST ROLLING

- 204.01 Description**
- 204.02 Materials**
- 204.03 Compaction of the Subgrade**
- 204.04 Soft Subgrade**
- 204.05 Rock, Shale or Coal Subgrade**
- 204.06 Proof Rolling**
- 204.07 Test Rolling**
- 204.08 Spreading and Placing of Materials**
- 204.09 Method of Measurement**
- 204.10 Basis of Payment**

204.01 Description. This work consists of preparing suitable subgrade material by drying, compacting, proof rolling, and grading. This work also consists of removing unsuitable subgrade material and constructing new embankment in the limits shown on the plans.

Unsuitable subgrade material includes wet or soft subgrade and rock, shale, and coal subgrade.

Use all suitable excavated material in the work. Alternatively, legally use, recycle, or dispose of all excavated materials according to federal, state, and local regulations.

204.02 Materials. Furnish embankment material conforming to 203.02, 203.03 and 703.11, except use soils in the top 12 inches (0.3 m) of the subgrade that have a maximum dry weight of at least 100 pounds per cubic foot (1602 kg/m³).

Furnish material that conforms to 703.11.B or 703.11.C when Granular Embankment is specified. Furnish material that conforms to 703.11.C when Granular Material is specified.

Do not use Granular Material Type C or D in the location where an underdrain is to be constructed.

Furnish geotextile fabric that conforms to 712.09 Type D. Do not use geotextile fabric in the location where an underdrain is to be constructed.

204.03 Compaction of the Subgrade. The Engineer will perform the compaction testing according to City of Columbus Supplement Specification 1501. The City may check for compaction before or after the fine grading operation.

Compact the subgrade materials that have a maximum laboratory dry weight of 100 to 105 pounds per cubic foot (1602 to 1682 kg/m³) to not less than 102 percent of maximum dry density. Compact all other subgrade materials to not less than 100 percent of maximum dry density. The Engineer will determine the maximum dry density using AASHTO T 99,

AASHTO T 272 or by test section method in City of Columbus Supplemental Specification 1501.

When a test section method is used for compaction acceptance, use the following:

- 1. Use a minimum of eight passes with a steel wheeled roller having a minimum weight of 10 tons (9 metric tons).*
- 2. Use at least 98 percent of the test section maximum dry density for acceptance of the production subgrade compaction.*
- 3. Use at least the same number of passes and compactive effort used to construct the test section for the production subgrade compaction.*
- 4. Construct a new test section when the material, supporting foundation or embankment changes.*
- 5. Reduce the moisture content if the material becomes unstable.*

Use the moisture controls specified in 203.07.A.

Compact the subgrade under pavements to a depth of 12 inches (0.3 m) below the subgrade surface and 18 inches (.45 m) beyond the edge of the surface of the pavement, paved shoulders, or paved medians. Compact all subgrades under paved driveways, paved mailbox turnouts, curbs and gutters to a depth of 12 inches (0.3m) below the subgrade surface.

When the contract documents specifies subgrade compaction and drying to a depth greater than 12 inches (300 mm), manipulate the soil by plowing, dozing, or turning the soil to dry and compact to the specified depth.

Maintain and drain the subgrade according to 203.04.A.

204.04 Soft Subgrade. *If satisfactory subgrade stability cannot be obtained by moisture control and compaction according to 204.03, the Engineer will direct the Contractor to remove the soft material and to construct the replacement material to the finished grade within the tolerances specified in 203.08.*

Conduct the removal and replacement operations to allow the Engineer to measure the cross-sections before placing the replacement material.

Remove the soft subgrade material to the depth determined by the Engineer or specified in the contract documents. Replace with suitable material according to 204.08.

If soft subgrade results from inadequate surface drainage or lack of maintenance, as required by 203.04.A, replace the soft subgrade, and dispose of the soft subgrade material.

204.05 Rock, Shale, or Coal Subgrade. *If an aggregate base is not a part of the pavement design, undercut the subgrade 2 feet (0.6 m) below the final subgrade elevation where rock, shale, or coal is encountered. If an aggregate base is part of the pavement design, reduce the above 2 foot (0.6 m) undercut by the thickness of the aggregate base or*

bases. Maintain a total undercut depth of 2 feet (0.6 m) below the bottom of the asphalt or concrete pavement.

Excavate for a width of 1 foot (0.3 m) beyond the shoulders. Replace with suitable material according to 204.08.

204.06 Proof Rolling. Perform the testing of the stability and uniformity of the subgrade compaction in locations shown on the plans by proof rolling.

Use a proof roller conforming to the following:

1. Four heavy pneumatic tire wheels mounted on a rigid steel frame.
2. Wheels evenly spaced in one line across the width of the roller.
3. Wheels arranged so that all wheels carry approximately equal loads when operated over an uneven surface.
4. A maximum center-to-center spacing between adjacent wheels not exceeding 32 inches (0.8 m).
5. A body for ballast loading capable of varying the gross load from 25 to 50 tons (23 to 45 metric tons).
6. Tires capable of operating at inflation pressures ranging from 90 to 150 square inch (620 to 1040 kPa). Provide a tire pressure gage for measurement before use.
7. Tires filled with liquid from 90 to 95 percent by volume.

Provide ballast that consist of ingots of known unit weight, sand bags with a unit weight of 100 pounds (45 kg), bags of other material of known unit weight, or other suitable material such that the total ballast weight is readily determinable at all times. Provide sufficient ballast to load equipment to a maximum gross weight of 50 tons (45 metric tons).

Furnish the Engineer with charts or tabulations verifying the contact areas and contact pressures over the full range of tire inflation pressures and over the full range of loading.

After compacting the subgrade according to 204.03 and before placing overlying course, proof roll designated subgrade areas. If proof rolling is performed after the underdrains are installed, do not use the proof roller within 1 1/2 feet (0.45 m) of the underdrains.

Ensure that the subgrade moisture content at the time of proof rolling is within 2 percent of the moisture used for acceptance in 204.03.

Adjust the load and tire inflation pressure according to the following:

1. For soils classified as A-4, A-6 or A-7-6, use a 35 ton (32 metric ton) roller with a tire pressure of 120 psi (830 kPa).

2. *For granular soils, and soil, rock, and granular mixtures, use a 50 ton (45 metric ton) roller with a tire pressure of 150 psi (1040 kPa).*
3. *Measure the tire pressure in the presence of the Engineer.*

Operate equipment at a speed between 2 1/2 miles per hour (4 km/hr) and 5 miles per hour (8 km/hr). Adjust the speed to allow the Engineer to measure the deflections, ruts, or elasticity.

Use one or more coverages of the proof roller. One coverage is two trips of the roller, with the second trip offset from the first by one tire width to completely cover the subgrade area. Operate the proof roller in a pattern to readily allow recording of the number of coverages.

Where proof rolling indicates areas of soft subgrade or areas of non-uniform subgrade stability, the Engineer will investigate for the source of the problem. The Engineer will check the subgrade materials, density, and moisture content according to 204.02 and 204.03. The Contractor is responsible for all problems found in the materials constructed under the contract documents. Correct all deficiencies found.

After proof rolling, check the subgrade for conformance to the plans, and correct all surface irregularities. Shape the subgrade within the tolerances specified in 203.08.

204.07 Test Rolling. *Test Rolling should be used when verifying the stability and uniformity of the subgrade in a private development, or in areas not specified for Item 204.06. This procedure shall be performed in the presence of the Project Engineer or its designee.*

1. *Use a test roller conforming to the following:*
 - A. *Tandem axle, dual wheel dump truck.*
 - B. *Tire pressure shall be no less than 90 percent of the manufacturer's recommended maximum inflation.*
 - C. *The minimum gross weight of the loaded truck shall be 60,000 pounds (37,000 kg). A weigh slip shall be provided.*
2. **Procedure.**
 - A. *Operate equipment at a rate not to exceed 3 to 5 mph (4.8 to 8.0 km/hr.) or a comfortable walking pace. Adjust the speed to allow the Inspector to measure any deflections and/or areas of rutting.*
 - B. *Operate the proof roller in a pattern so that all affected areas are loaded with at least one pass.*
 - C. *After proof rolling, check the subgrade for conformance to the plans, and correct all surface irregularities. Re-shape the subgrade within tolerances specified in 203.08.*

3. **Evaluation.**

- A. *Rutting up to 1 inch (25 mm) is acceptable, as long as the requirements of Item 203.08 are met. Rutting in excess of 1 inch (25 mm) but not more than 6 inches, (150 mm) shall be considered a failure and will require that the soil be reworked and compacted to the required density.*
- B. *Deflection (pumping) up to 1 inch (25 mm) is acceptable. Deflection in excess of 1 inch (25 mm) but not more than 2 inches (50 mm) shall be acceptable if there is not substantial cracking or lateral movement of the soil. Deflection in excess of 2 inches (50 mm) but not more than 6 inches (150 mm) shall be considered a failure, and will require that the soil be reworked and compacted to the required density.*
- C. *Rutting and/or deflection in excess of 6 inches (150 mm) will require review and recommendation for corrective action by an approved Geotechnical Engineer.*
- D. *When remedial work is performed under Item 3.C., a final test roll shall be performed upon completion of the work. If remedial work is performed as directed under 3.A. or 3.B., a second test roll may be required at the discretion of the Project Engineer or his designee.*

204.08 Spreading and Placing of Materials. *Place materials conforming to 204.02 in 8 inch (203 mm) loose lifts. The Engineer may increase the lift thickness depending on the stability of the bottom of the cut. The Engineer may increase the lift thickness up to 24 inches (609 mm) to obtain stability at the top of the lift. Doze, track, or manipulate the material to maximize the density and stability. Once stability is achieved, compact according to 204.03.*

When specified, place the geotextile fabric at the bottom of the cut or at locations designated in the contract documents. Place the geotextile fabric smooth and free of tension or wrinkles. Fold or cut the geotextile fabric to conform to curves. Overlap a minimum of 18 inches (450 mm) (or the manufacturers recommendation whichever is greater) at the ends and sides. Hold the fabric in place with pins or staples.

End dump the suitable material on the fabric. Do not operate the equipment directly on the fabric. Spread the end dumped material maintaining a minimum lift thickness of 12 inches (300 mm).

When using Granular Material Type E, use a geotextile fabric at the bottom of the cut and use a minimum of 6 inches (150 mm) of Granular Material Type B, C or D to choke off the surface before placing the next layer of material. The Engineer will use Granular Material Type E when excess water is at the bottom of the cut.

204.09 Method of Measurement. *The City will measure Subgrade Compaction by the number of square yards (square meters) actually compacted. The City will measure 18 inches (450 mm) beyond the edge of the pavement surface, paved shoulders, and paved*

medians. The City will measure the surface area of the paved driveways, paved mailbox turnouts, curb and gutter.

The City will measure Proof Rolling by the number of hours accepted. The City will not measure idle time for repairs, servicing, loading and unloading ballast, adjusting tire pressure, bad weather, wet subgrade, usage at times and at locations other than City directed, and stand-by time to be available when next needed or other cause for stand-by time.

The City will measure Excavation of Subgrade, Embankment, Granular Embankment, and Granular Material according to 203.09.A. All excavation is unclassified.

The City will measure Geotextile Fabric by the number square yards (square meters) of surface area of geotextile fabric placed. The City will not measure the specified lap length.

204.10 Basis of Payment. The City will pay according to 109.04 for added work that increases the haul distance more than an 1/2 mile (0.8 km) to the work detailed in the contract documents.

If soft subgrade results from inadequate surface drainage or lack of maintenance, as required by 203.04.A, the City will not pay for replacing the soft subgrade and disposing of the removed material.

For problems identified in 204.06 that are the result of soils or conditions at lower elevations than the contract work, the City will pay for the corrections.

The City will pay for the subgrade compaction in areas requiring undercut and replacement in 204.04, 204.05 and 204.08. The City will not pay for subgrade compaction in areas stabilized with lime or cement. The City will pay for accepted quantities at the contract prices as follows:

<i>Item</i>	<i>Unit</i>	<i>Description</i>
204	Square Yard (Square Meter)	Subgrade Compaction
204	Square Yard (Square Meter)	Subgrade Compaction ____” (____ mm) Deep
204	Hour	Proof Rolling
204	Cubic Yard (Cubic Meter)	Excavation of Subgrade
204	Cubic Yard (Cubic Meter)	Embankment
204	Cubic Yard (Cubic Meter)	Granular Embankment
204	Cubic Yard (Cubic Meter)	Granular Material
204	Square Yard (Square Meter)	Geotextile Fabric