CONSTRUCTION SPECIFICATION FOR GRADING

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206.01 SCOPE

This specification covers the requirements for grading, including earth and rock excavation and embankment construction, rock face, and the management of excavated materials.

206.02 REFERENCES

This specification refers to the following standards, specifications, or publications:

Ontario Provincial Standard Specifications, Construction

OPSS 209 Embankments Over Swamps and Compressible Soils
OPSS 212 Earth Borrow
OPSS 501 Compacting
OPSS 802 Topsoil
OPSS 804 Seed and Cover

Ontario Provincial Standard Specifications, Materials

OPSS 1010 Aggregates - Base, Subbase, Select Subgrade and Backfill Material

Ontario Ministry of Transportation Publications

MTO Form:
PH-CC-820 Certification of Grade Elevation - Crossfall

MTO Laboratory Testing Manual:
LS-706 Moisture-Density Relationship of Soils Using 2.5 kg Rammer and 305 mm Drop

206.03 DEFINITIONS

For the purpose of this specification, the following definitions apply:

Angle of Repose means the maximum angle measured from the horizontal at which fill remains stable.

Backslope means the slope in a cut between the invert of the roadside ditch and the point where the slope intersects original ground.

Benching means the keying into existing slopes by excavating horizontal planes. Benching also means the stepping of cut slopes at intermediate levels in deep cuts.

Berm means an extension of an embankment constructed to a lower height and designed to provide road embankment stability.

Bulking Factor means the ratio of the volume of rock material following excavation, placement, and compacting to the original in situ volume of the same material. The bulking factor for rock shall be 1.35. For rock excavation quantities identified as shatter, the bulking factor shall be 0.35.

Cushion Blasting means the placing of a single row of lightly-loaded closely-spaced holes along the excavation limits as specified in the Contract Documents and firing them coincident with the main excavation blast as the last delay sequence to remove rock inside the cut limits.

Ditching means the excavation in earth or rock for all water courses. The term shall include roadside ditches, all excavation lying beyond the end of drainage structures, and stream and watercourse diversions and corrections.

Earth means all soils, except those defined as rock, and excludes stone masonry, concrete, and other manufactured materials.

Embankment means the material placed within the sideslopes; below the top of subgrade; and above the original ground, excavated base, or theoretical bottom, as applicable, to the limits as specified in the Contract Documents. Widening, flattening, or other placement of material adjacent to or on top of sideslopes beyond that specified in the Contract Documents is excluded.

Existing Rock Surface means either the rock surface that is exposed at ground level prior to the beginning of the Contract or the rock surface that is exposed after the overburden above it has been removed during the Contract.

Frontslope means the slope in a cut section between the edge of shoulder and the invert of the roadside ditch.

Grubbing means the removal of all stumps, roots, embedded logs, debris, and secondary growth.

Line Drilling means the placing of a single row of very closely-spaced holes without explosives along the rock excavation limits as specified in the Contract Documents.

Mucking means the picking up of broken rock prior to haulage.

Overbreak means any broken, displaced, or loosened rock that originates outside the designated rock excavation limits as specified in the Contract Documents, regardless of whether that rock has been excavated, displaced, or loosened due to the inherent character of the rock formation itself or due to any other cause.

Pre-Shearing means the placing of a single row of closely-spaced lightly-loaded holes along the rock excavation limits as specified in the Contract Documents that are fired simultaneously before and independently of the main excavation blast. Pre-shearing is sometimes referred to as pre-splitting.

Reclaimed Asphalt Pavement (RAP) means the processed hot mix asphalt material that is recovered by partial or full depth removal.

Reclaimed Concrete Material (RCM) means removed or processed old Portland cement concrete.

Roadside Ditch means a ditch with one of its slopes coincident with the road frontslope.

Rock means natural beds or massive fragments of the hard, stable, cemented part of the earth's crust, either igneous, metamorphic, or sedimentary in origin, that may or may not be weathered and includes boulders having a volume of 1 m^3 or greater.

Rock Face means the uniform, relatively planar, maintenance-free, vertical or near vertical rock surface between the top of the existing rock surface and the designated rock or ditch grade line that is generally characterized by noticeable drill hole traces and a minimum of blast-induced fractures beyond the rock excavation limits.

Rock Surplus means the rock excavation original tender quantity multiplied by the bulking factor, plus the volume of rock material excavated from all other items as specified in the Contract Documents, minus the rock embankment original tender quantity. Rock overbreak and rock materials resulting from scaling are specifically excluded.

Scaling means the removal of loose, broken, or overhanging rock fragments from an existing rock surface or the removal of loose, broken, or overhanging rock fragments from a rock face that remain in place after the rock has been blasted and mucked.

Shale means a fine-grained, low strength, sedimentary rock that undergoes rapid deterioration on exposure.

Shatter means fractured rock broken by the use of explosives or mechanical means and left in place.

Sideslope means the slope in a fill between the edge of shoulder and the point where the slope intersects original ground.

Spall means a rock fragment, chip, or splinter from a rock surface created by weathering, stress relief, blasting, or a combination thereof.

Stripping means the excavation of the upper layer of soil, that is predominantly organic, too soft, or wet and otherwise unsuitable for the construction of embankments that is done prior to and usually independent of earth excavation or the placement of fill materials or both.

Tolerance means a construction working tolerance only that is considered to be:

a) Minus when it is:
   i. narrower than the Contract standard when pertaining to horizontal dimensions as measured from centreline, or
   ii. lower in elevation than the Contract standard when pertaining to vertical dimensions.

b) Plus when it is:
   i. wider than the Contract standard when pertaining to horizontal dimensions as measured from centreline, or
   ii. higher in elevation than the Contract standard when pertaining to vertical dimensions.

Wall Control Blasting means a blasting method using carefully-spaced and aligned drill holes intended to produce a relatively flat, maintenance-free, rock surface or rock face as specified in the Contract Documents. Wall control blasting techniques are cushion blasting, line drilling, and pre-shearing.

206.04 DESIGN AND SUBMISSION REQUIREMENTS

206.04.01 Submission Requirements

206.04.01.01 Rock Material Management Plan (RMMP)

For each construction stage, the following information shall be submitted to the Contract Administrator a minimum of 5 Business Days prior to undertaking the work of rock excavation or rock embankment:

a) A plan for rock excavation corresponding to the station intervals as specified in the Contract Documents. The plan shall identify the volume in cubic metres of the following:
   i. In-situ rock prior to blasting with shatter quantity shown separately.
   ii. Excavated rock available calculated by applying the bulking factor to the quantity of in-situ rock prior to blasting, less the quantity of shatter.
   iii. Excavated rock to be placed in rock embankment.
   iv. Excavated rock within the Contract limits to be processed into granular material or other aggregates as specified in the Contract Documents.
   v. Excavated rock to be used for other purposes in completing the Work, such as rock protection, rip rap, or river stone and the types and locations of that Work.
   vi. Excavated rock not incorporated into the Work and the locations and uses of that material.

b) A plan for the construction of rock embankments that identifies each location and volume in cubic metres where the material is going to be supplied to the corresponding station intervals as specified in the Contract Documents.

c) The locations and volume in cubic metres for the sources where rock materials are obtained for the rock supply item.

d) The location and volume in cubic metres for each source when additional rock or granular material or both are required to complete the Work.

e) The amount of rock surplus, if any, during the applicable construction stage.

The Contractor shall be solely responsible for the assumptions and the reasonableness of the RMMP.

In addition, for each construction stage, on a monthly basis, an updated RMMP shall be submitted to the Contract Administrator which shall include an ongoing tabulation of all rock materials that have been removed by the Contractor from the rock excavation or not incorporated in embankments, shown as a cumulative reduction in rock surplus.

The work of rock excavation or rock embankment shall not commence until the RMMP in accordance with the above requirements is submitted.

206.04.01.02 Trial Section for Modified Layer Compaction Method

If the Contractor wishes to request to use the modified layer compaction method as specified in the Modified Layer Compaction Method clause, a detailed plan shall then be submitted in writing to the Contract

Administrator a minimum of 48 hours prior to commencing any work on the required trial section. The plan shall include full details of the placing of material and its compaction, including layer thickness; number and type of compaction units and number of passes.

206.06 EQUIPMENT

206.06.01 Tractor Bulldozer - Crawler Type for Rock Embankment Construction

Tractor bulldozer, crawler type for rock embankment construction required in the General clause of the Rock Embankments clause shall have a minimum net flywheel power of 200 kW.

206.06.02 Rollers for Shale Embankment Construction

Sheepsfoot, packall, padfoot, or tamping foot rollers required for the construction of shale embankments shall weigh a minimum of 18 tonnes and vibratory steel drum or pneumatic-tired rollers shall weigh a minimum of 9 tonnes.

206.06.03 Nuclear Moisture and Density Gauge

Nuclear moisture and density gauges shall meet the requirements of the Nuclear Moisture and Density Gauge subsection of OPSS 501.

206.06.04 Hydraulic Excavator - Crawler Mounted for Rock Embankment Construction

Hydraulic excavator, crawler mounted for rock embankment construction required in the General clause of the Rock Embankments clause shall have a minimum operating weight of 32,000 kg.

206.07 CONSTRUCTION

206.07.01 General

206.07.01.01 Removal of Ice, Snow, and Frozen Ground

The Contractor shall remove and dispose of all ice, snow, and frozen material from all earth, rock, or granular surfaces prior to placing fill and from all earth, rock, or granular materials being used for backfill, embankments, or any other construction purposes.

206.07.01.02 Compaction

Earth and granular materials shall be compacted according to OPSS 501.

For compaction purposes, reclaimed asphalt pavement (RAP) or reclaimed concrete material (RCM) or both shall be treated as earth or rock when such material is respectively included in an earth embankment or a rock embankment.

206.07.01.03 Earth Borrow

When earth borrow is specified in the Contract Documents, it shall be according to OPSS 212.

206.07.01.04 Tolerances - General

In the event of a conflict between meeting horizontal grading tolerances and meeting vertical grading tolerances, the vertical grading tolerances shall take precedence.

206.07.01.04.01 Tolerances for Earth

Upon completion, all earth grade surfaces, excluding swamp excavations, shall be shaped to the grades and cross-sections as specified in the Contract Documents within the following tolerances:

a) Vertical grading tolerances for the finished earth subgrade within the limit of the roadway:

+ 30 mm and - 30 mm

b) Horizontal grading tolerances for the vertical faces of excavations to be backfilled:

+ 100 mm and - 0 mm

c) Horizontal grading tolerances for ditch slopes, excluding roadside ditches:

+ 300 mm and - 0 mm

Sideslopes beyond the plus tolerance may be accepted by the Contract Administrator when they are not detrimental to the work.

d) Vertical grading tolerances for all ditching in earth:

+ 30 mm and - 30 mm

e) Horizontal grading tolerances for the backslopes in earth cut sections:

+ 300 mm and - 300 mm

Backslopes beyond the plus tolerance may be accepted by the Contract Administrator when they are not detrimental to the work.

f) Horizontal grading tolerances for each sideslope in earth embankment construction:

+ 300 mm and - 0 mm

g) Horizontal grading tolerances for roadside ditch frontslopes in earth cut sections:

+ 30 mm and - 0 mm

Irrespective of compliance with the above tolerances, the completed slopes shall present a uniform appearance.

206.07.01.04.02 Tolerances for Rock

Completed rock grade surfaces shall be shaped to the grades and cross-sections as specified in the Contract Documents within the following tolerances:

a) Vertical grading tolerances for the finished rock subgrade within the limits of the roadway:

For cut sections: + 30 mm and - 100 mm
For fill sections: + 30 mm and - 75 mm

Excavation below the minus tolerances may be accepted by the Contract Administrator when it is not detrimental to the work and is brought up to grade as specified in the Rock Excavation, Grading clause.

b) Horizontal grading tolerances for vertical rock face cut limits:

+ 0 mm and - 300 mm

Final faces beyond the plus tolerance may be accepted by the Contract Administrator when they are not detrimental to the work.

c) Horizontal grading tolerances for sloped rock face cut limits:

+ 300 mm and - 300 mm

d) Horizontal grading tolerances for ditch slopes, excluding roadside ditches:

+ 300 mm and - 0 mm

Excavation beyond the plus tolerance may be accepted by the Contract Administrator when the Owner deems it is not detrimental to the work or contribute to additional rock surplus.

e) Vertical grading tolerances for all ditching in rock cuts:

+ 30 mm and - 30 mm

Excavation below the minus tolerance may be accepted by the Contract Administrator when it is not detrimental to the work.

f) Horizontal grading tolerances at the top of each sideslope of rock embankment construction:

+ 300 mm and - 0 mm

206.07.02 Drainage

Excavation operations shall be performed in a manner to avoid water saturation of embankment material and roadway foundation material and to avoid leaving undrained pockets in excavations by providing effective drainage during all stages of the work.

In excavations below subgrade and in stripping operations when provision for surface drainage is impractical, backfill materials shall be placed as soon as possible following the excavation work.

Ditching required to provide for drainage of an embankment shall be completed in advance of the embankment construction. Ditches in roadway cuts shall be constructed as soon as possible to provide drainage from the cuts. Ditches located above and beyond roadway cuts shall be constructed prior to excavating adjacent cuts. When pipe subdrains are required in the bases of roadway cuts, such work shall be carried out at the time that the roadside ditches are being constructed.

206.07.03 Excavation and Grading

206.07.03.01 Earth Excavation - Grading

206.07.03.01.01 General

The work shall include excavating, hauling, handling and placing, shaping, compacting, trimming of earth material, applying temporary cover, and the management of excavated and excess materials as specified in the Contract Documents.

The work shall also include the excavation and removal of pipes and culverts smaller than 200 mm in diameter and expanded polystyrene insulation when located within the limits of the earth excavation, grading work.

Suitable and non-excess earth material excavated from roadway cuts, ditching, and other associated sites shall be used in earth grading and embankment construction, unless otherwise specified in the Contract Documents.

206.07.03.01.02 Stripping

Except when swamp treatment is required, the original ground shall be stripped at the locations and to the depths specified elsewhere in the Contract Documents.

Material meeting the requirements of topsoil according to OPSS 802 that is required for re-use shall be stockpiled as specified in the Contract Documents. Other material obtained from stripping shall be managed as specified in the Management of Excavated Materials clause.

206.07.03.01.03 Excavation Below Subgrade

Unsuitable materials, other than material excavated from swamps, shall be removed below the subgrade to the lengths, widths, and depths as specified in the Contract Documents. The resulting excavation shall be backfilled with material acceptable to the Contract Administrator and compacted according to OPSS 501.

206.07.03.01.04 Swamp Excavation

Swamp excavation shall be according to OPSS 209.

206.07.03.01.05 Backfilling of Overexcavated Areas

When overexcavation occurs, the overexcavated area shall be backfilled with granular material according to OPSS 1010 and compacted according to OPSS 501 at no additional cost the Owner. With the exception of frontslopes and when boulders are encountered in the excavated slopes, backfilling shall not be permitted to obtain the required slopes for excavations.

When boulders are encountered in the excavated slopes, the boulders shall be removed at the direction of the Contract Administrator and the resulting cavity or cavities shall be backfilled with properly-compacted granular material according to OPSS 1010.

206.07.03.02 Rock Excavation - General

Except where shatter is required, drilling shall not be performed outside of or extend beyond the design excavation limits as specified in the Contract Documents.

The use of explosives for rock excavation shall be as specified in the Contract Documents.

All excavated rock, including rock materials resulting from overbreak and scaling, except the quantity of rock surplus, shall be placed in embankments.

Any excavated rock remaining after constructing the embankments shall be managed as specified in the Management of Excavated Materials clause.

206.07.03.02.01 Rock Excavation - Grading

The work shall include drilling and blasting to obtain the required rock excavation and shatter, mucking, and bringing to grade any overexcavation. Hauling shall only be part of the work when the excavated material is part of the rock surplus or is in excess of the rock embankment requirements.

When rock is to be excavated, all overlying stumps, roots, and vegetation shall be managed as excess material as specified in the Contract Documents. When earth overlies the rock to be excavated, the earth shall be removed. This work shall be performed sufficiently in advance of any blasting or rock excavation operations to allow rock cross-sections to be taken.

Scaling shall be carried out during mucking. All rock fragments or boulders either within or outside the excavated areas that are likely to slide or roll down rock cuts or are otherwise deemed to be unstable by the Contract Administrator shall be removed. Cut ditches shall be excavated at the same time as the main excavation.

Excavation below grade in rock cuts shall be brought to grade within the specified tolerances with rock shatter or other approved material at no additional cost to the Owner.

Rock in roadway cuts shall be shattered to a uniform minimum depth of 300 mm below the theoretical rock subgrade for the full width of the cut, including the ditch.

Rock scaling and the removing of all overbreak and scaled materials shall be included in the rock excavation, grading item, unless a rock face item is included in the Contract Documents.

206.07.03.02.01.01 Shale

Shale shall be excavated using methods appropriate for the site conditions. Side slopes in shale shall be as specified in the Contract Documents. Rock face and subgrade shatter are not required in shale.

206.07.03.02.02 Rock Face

The work shall include drilling and blasting using one or more wall control blasting techniques to produce the rock face required in the Contract Documents and all associated scaling, mucking, hauling and management of all overbreak and scaled rock as specified in the Management of Excavated Materials clause.

The Contractor shall decide the required spacing, diameter, and loading of all drill holes for wall control blasting in order to ensure a uniform shear face between the holes and to meet the tolerance requirements stated in the Tolerances for Rock clause for rock face. In no case shall the diameter and spacing of these holes be more than 100 mm and 0.75 m centre-to-centre, respectively,

The Contractor shall also decide the required spacing, diameter, and loading of the adjacent line of production drill holes located inside the controlled blasting limits in order to ensure that wall control blasting is able to produce the required rock face.

However, in no case shall any portion of a production drill hole be within 0.75 m of the line formed by the drill holes for wall control blasting.

206.07.03.03 Excavation for Widening

Excavation that is adjacent to the travelled portion of the roadway shall at no time be in advance of the backfilling operation by a distance greater than the limits as specified in the Contract Documents. Any such excavation shall be backfilled and compacted with material as specified in the Contract Documents, prior to closing down operations each day.

206.07.03.04 Excavation for Pavement Widening

The work shall include excavating a trench adjacent to the existing pavement to the widths and depths as specified in the Contract Documents. Excavated material shall be spread on the adjacent shoulders and slopes.

206.07.03.05 Management of Excavated Materials

Excavated materials shall be used within the Contract limits as specified in the Contract Documents.

When the Contract Administrator has deemed that the Contractor's sequence of operations, inadequate drainage measures, or handling processes or all have caused earth materials that were identified in the Contract Documents as being suitable for embankment or other construction purposes to become unsuitable for such purposes then, at no additional cost to the Owner, the Contractor shall either condition that material until it is suitable or manage it as excess material as specified in the Contract Documents and, if necessary, replace it with an equivalent volume of earth borrow. When the Contractor's operations have caused the material to become unsuitable due to excessive moisture content, conditioning may then involve re-working the material as necessary or spreading out the material in layers or both so that the material is thin enough to allow it to sufficiently dry out.

Quantities of unsuitable earth as specified in the Contract Documents and deemed suitable for use by the Contract Administrator at the time of excavation shall be used to offset borrow quantities.

Rock excavated from within the right-of-way (ROW) may be used for aggregate production up to the rock surplus quantity.

Earth or rock that is surplus to embankment requirements may be placed adjacent to the embankments by widening embankments, flattening side slopes, or constructing berms if optional cross sections or locations or both have been specified for such material in the Contract Documents or as requested by the Contractor and agreed to, in writing, by the Contract Administrator.

Surplus material may only be used within the Contract limits with the written consent of the Contract Administrator.

Surplus materials that cannot be accommodated as above and unsuitable materials shall be managed as excess material as specified in the Contract Documents.

206.07.03.06 Provision for Temporary Cover

Cover used in temporary applications shall be applied according to OPSS 804 to areas as specified in the Contract Documents.

206.07.04 Rock Supply

The work shall include any required clearing, grubbing, and stripping of the source; construction and maintenance of access roads; excavating and hauling of rock materials, regardless of whether the hauling is to the Contract limits or for rock surplus; and source rehabilitation.

The rock surplus quantity, if any, is an entitlement of the Contractor. Excavated rock may be removed for the Contractor's purposes or disposed of as the Contractor deems appropriate up to the rock surplus quantity as the staging of the work allows. All materials removed from rock excavation and not placed in rock embankment shall be deemed to be removed as part of the Contractor's rock surplus quantity.

All materials removed as part of the rock surplus quantity shall be accurately measured as specified in the Measurement of Rock Surplus clause and recorded by the Contractor at no additional cost to the Owner. Whenever such measurements are to be taken, the Contractor shall inform the Contract Administrator at least 1 Business Day in advance of such measurements.

All weighing of materials shall be as specified in the Contract Documents.

Within 7 Business Days of the Contractor taking a set of measurements, the Contractor shall:

a) Provide the Contract Administrator with a copy of those measurements and the calculations based on those measurements.

b) Advise the Contract Administrator, in writing, that the locations where the measurements were taken are ready for verification.

In the event that the Contract Administrator chooses to verify those measurements, such verification shall be undertaken within 3 Business Days of the Contract Administrator being advised that the locations are ready for verification and for those 3 Days, the Contractor shall not:

a) Place rock on or remove rock materials, as the case may be, from the measured locations; or

b) Impede the Contract Administrator in any way during the verification of those measurements.

206.07.04.01 Measurement of Rock Surplus

Rock removed as part of the rock surplus quantity shall be measured by the Contractor and verified by the Contract Administrator as specified in the Rock Supply subsection using one or more of the following 4 methods given below:

a) Weighed Aggregate Production Quantity

All locations to be used for stockpiling processed aggregates shall be identified in writing to the Contract Administrator no less than 3 Business Days prior to production.

At each stockpile location, the Contractor shall complete an accurate survey of the initial ground elevations subject to verification by the Contract Administrator prior to any materials, including materials used for a granular pad, are placed at that location.

All aggregate materials removed from each stockpile within the Contract limits shall be weighed by the Contractor for reconciliation with the rock surplus quantity by converting the mass to a bulked broken rock volume using a factor of 0.519 m3/tonne.

Once all of the aggregates have been removed, each stockpile shall be re-surveyed by the Contractor, the measurements verified by the Contract Administrator, and the volume of material remaining determined by the Contractor.

Quantities of rock used for aggregate production and quantities of materials remaining in aggregate stockpiles shall be deducted from the rock surplus quantity.

Any materials that are added to an aggregate production stockpile within the Contract limits that do not come from rock that was excavated on the Contract shall be weighed by the Contractor and subtracted from the weighed aggregate quantity provided. If such materials are not weighed or the Contract Administrator was not given sufficient notice or opportunity by the Contractor to verify the weight of those materials, then no deduction shall be made for those materials.

b) Stockpile Volume

Excavated rock forming part of the rock surplus may be measured in stockpiles constructed by the Contractor. The Contractor shall inform the Contract Administrator, in writing, of the location where each stockpile is to be established a minimum of 3 Business Days prior to commencing any work at that stockpile location. Disposal sites shall be treated as stockpiles.

At each stockpile location, the Contractor shall complete an accurate survey of the initial ground elevations and allow the Contract Administrator to verify those measurements prior to any rock materials are placed at that location.

Once the stockpile has been completed, the stockpile shall then be resurveyed by the Contractor, the measurements verified by the Contract Administrator, and the final volume determined by the Contractor. The Contractor shall not remove any rock material from any such stockpile prior to completion of its final survey and verification by the Contract Administrator.

With the exception of excavated rock placed in rock embankment, the quantity of all other excavated rock placed within the Contract limits (e.g., for widening of pre-existing embankments, construction of access roads, crane bases, etc.) shall be measured in the same manner as the stockpiles described above. Such quantities shall be deducted from the rock surplus quantity.

At the request of the Contract Administrator, the Contractor may be required to conduct backhoe or other subsurface investigations in the Contract Administrator’s presence to determine if compressible soils are

present at the Contractor's proposed stockpile locations. Backfilling of such investigated areas shall be carried out using properly-compacted material acceptable to the Contract Administrator.

If the Contractor Administrator deems that compressible soils are present, the Contractor shall then re-locate the proposed stockpile or the Contractor shall install monitoring devices at the affected location. Each monitoring device shall consist of a circular 1.0 m diameter 6 mm thick steel plate with a 3.0 m length of 50 mm diameter steel pipe securely welded vertically to the centre of the plate. Whenever the level of rock placement surrounding the monitoring device is vertically within 300 mm of the top of a monitoring device, successive 3.0 m lengths of 50 mm diameter steel pipe shall be welded to the top of that device. The length of each new section shall be added to the original elevation. The Contractor shall be paid to supply and place each monitoring device as specified in the Contract Documents. Any monitoring devices damaged during placement of materials shall be replaced at no additional cost to the Owner.

The Contractor shall survey the top of each monitoring device prior to rock material placement. The Contractor shall resurvey the top of each monitoring device when the placement of rock materials is complete. Both sets of measurements shall be verified by the Contract Administrator. If the difference in elevation between the two surveys is greater than 300 mm, the initial ground elevations for this location shall then be lowered universally by the difference in monitoring device elevation. When more than one monitoring device is placed at a given location, the differences in elevations shall be averaged together.

The Contractor shall ensure that the Contract Administrator has free and unencumbered access to any location where excavated rock is being placed.

c) Weighed Broken Rock

Excavated rock forming part of the rock surplus quantity shall be weighed by the Contractor prior to exiting the Contract limits. The Contract Administrator shall be informed, in writing, at least 2 Business Days in advance that such rock materials are to be weighed as rock surplus, the specific locations where the broken rock material is to be obtained, and the locations where it is to be placed.

Excavated rock weighed as part of the rock surplus shall be converted to a bulked broken rock volume using a factor of 0.519 m^3/tonne.

d) In-situ Measure of Distinct Rock Cut

Excavated rock from distinct rock cut locations may be removed as part of the rock surplus specified in the Contractor's RMMP. A distinct rock cut location shall be one that begins with and ends at points of zero rock excavation. The excavated rock shall be used in its entirety as rock surplus material from distinct rock cuts and shall not be split between Contract rock embankment requirements and the rock surplus quantity. This quantity shall be the quantity of the distinct rock cut in cubic meters, multiplied by the bulking factor.

206.07.05 Embankments

Only materials that are specified in the Contract Documents for use in embankments shall be used, unless approved by the Owner, in writing, prior to placement.

Materials shall not be placed over either frozen earth or ice surfaces. Ice, frozen earth, or other unsuitable materials shall not be incorporated into embankments.

RAP materials used in embankments shall be surplus to the recycling requirements of the Contract.

The Contractor shall notify the Contract Administrator, in writing, when an embankment has been completed to the dimensions that are as specified in the Contract Documents, at least 3 Business Days prior to the Contractor places any topsoil or any other material on the embankment slopes.

206.07.05.01 Earth Embankments

206.07.05.01.01 General

Material for earth embankments shall be deposited and spread in uniform layers for the full width of the embankment, except as otherwise permitted for berms. Each layer shall be compacted prior to the succeeding layer is placed. The lower portion of side hill or sloping sections shall be similarly constructed in layers and compacted until the full width surface of the specified cross-section is obtained. The embankment shall be completed thereafter with full width layers or as staged construction allows.

The construction of a core through the embankment and the subsequent completion of the embankment are prohibited, except when core construction is permitted in swamps according to OPSS 209.

Boulders, cobbles, and fragments of rock, RAP, and RCM over 150 mm in their maximum dimension shall not be placed within 300 mm of the surface of the earth grade.

Boulders, cobbles, and fragments of rock, RAP, and RCM up to 0.5 m^3 may be incorporated into an earth embankment provided:

a) They are placed only in the bottom layer of the embankment.

b) The maximum dimension of the largest particle shall not exceed 800 mm.

c) They are not located within 300 mm of the final embankment side slopes.

d) They are not located within 1.0 m of the surface of the earth grade.

Topsoil placed on earth embankments shall be according to OPSS 802.

Berms may be constructed separately, but shall be completed prior to the road embankment is built to a higher level than the berm.

Any excavation necessary for establishing compaction results throughout any embankment or any trial areas such as the one described in the Modified Layer Compaction Method clause shall be done by hand and the excavated areas shall be backfilled with the same material or material otherwise acceptable to the Contract Administrator and properly re-compacted by the Contractor.

206.07.05.01.02 Layer Compaction Method

Earth embankments shall be built using the layer compaction method, unless otherwise specified in the Contract Documents or the requirements specified in the Modified Layer Compaction Method clause have been met.

In the layer compaction method, the embankment material shall be spread out in uniform full width layers not more than 300 mm in depth prior to compaction. Each layer shall be shaped and compacted to the line and cross-section as specified in the Contract Documents prior to the succeeding layer is placed.

All boulders, cobbles, fragments of rock, RAP, and RCM shall have a maximum vertical dimension after placement, not greater than the fully compacted layer depth.

When the ground cannot support construction equipment using this method then, at the discretion of the Contract Administrator, the first layer may be increased in thickness as specified in the Modified Layer Compaction Method clause.

206.07.05.01.03 Modified Layer Compaction Method

The modified layer compaction method may be used if the Contract Administrator deems that it is practical to construct an earth embankment or a portion of an earth embankment in thicker lifts than that specified in the Layer Compaction Method clause.

In this case, the embankment material shall be spread out in uniform full width layers not more than 600 mm in depth prior to compaction. Each layer shall be shaped and compacted to the line and cross-section specified prior to the succeeding layer is placed.

All boulders, cobbles, and fragments of rock shall have a maximum vertical dimension when placed not exceeding the modified layer depth. All RAP and RCM shall have a maximum vertical dimension after placement not exceeding 300 mm.

Prior to placing any material, the Contractor shall provide proof to the Contract Administrator of the ability of the proposed method to achieve the specified density by means of a trial section consisting of a single uniform lift covering a minimum area of 400 m2 as specified in the Trial Section for Modified Layer Compaction Method clause. The location and extent of the trial section shall be acceptable to the Contract Administrator.

Prior to the construction of the trial section, the maximum dry density (MDD) of the material to be compacted shall be determined according to LS-706 from a minimum of 3 independent samples of the material.

Acceptance of the trial section shall be based on compaction testing within the trial section lift. For testing within the lift, the trial section shall be a single lot with 4 sublots of equal area. At a random location within each sublot, a level surface shall be prepared at a depth that permits the probe of a nuclear moisture and density gauge to extend to the bottom of the lift. Field wet density and moisture content shall be determined at each random location using the gauge and the dry density value calculated for each sublot.

If the quality index for the lot, calculated according to the Quality Index clause of OPSS 501, is equal to or greater than 1.47, the trial section shall be accepted. If the quality index for the lot is less than 1.47, the method of construction of the trial section shall not be accepted. The target density for the purpose of the quality index calculation shall be the average of the 3 MDD values determined according to LS-706.

If the trial section has been accepted, field wet density and moisture content testing shall be carried out at 10 random locations on the trial section surface using a nuclear moisture and density gauge. The average dry density from the 10 locations shall be calculated and used as the target density for acceptance, according to OPSS 501, for further placement of the material by the modified layer compaction method.

The same procedure used for the construction of the accepted trial section, including compaction equipment, vibration characteristics, and number of passes, shall be used for the further placement and compaction of the same material by the modified layer compaction method.

A new trial section shall be required for the material when one or more of the following apply:

a) A new target density is required according to the Target Density clause of OPSS 501.

b) The Contractor wants to change the accepted modified layer compaction method procedure.

c) An accepted modified layer compaction method procedure is no longer producing the required degree of compaction.

When requested by the Contract Administrator, compacted material shall be removed to verify the thickness and/or complete compaction testing on a levelled surface within any compacted lift.

All excavation, backfilling, and re-compaction necessary for thickness verification and compaction testing within the trial section lift and as requested by the Contract Administrator at other locations shall be completed to the satisfaction of the Contract Administrator at no additional cost to the Owner.

206.07.05.02 Rock Embankments

206.07.05.02.01 General

The work shall include hauling, placement, and compaction of excavated rock.

Excavated rock used to construct rock embankments shall be obtained from within the Contract limits. If there is insufficient material to complete the rock embankments, the additional material shall then be provided and paid for under the rock supply item.

All rock from other items as specified in Contract Documents shall be used to construct rock embankments. Rock embankments shall be constructed by placing embankment materials full width in successive uniform layers.

For rock embankments, other than shale, the layers shall not exceed 1.5 m thickness prior to compaction. The material in each layer shall be fully compacted before the succeeding layer is placed. Each rock fill layer shall be compacted with a tractor bulldozer, crawler type, as specified in the Tractor Bulldozer - Crawler Type for Rock Embankment Construction subsection. In confined areas or in any other areas where the Contract Administrator agrees that a tractor bulldozer, crawler type, cannot be reasonably used, then each rock fill layer may be compacted using a hydraulic excavator, crawler mounted, as specified in the Hydraulic Excavator - Crawler Mounted for Rock Embankment Construction subsection. The minimum number of complete passes shall be six and the maximum number of passes shall be eight for either type of equipment. A complete pass shall be defined as 100% coverage of the layer surface. The maximum speed of the equipment during each pass shall be 3.2 km/h.

For all rock embankments, materials shall be placed in their final position by blading when using a tractor bulldozer, crawler type for or by raking and chinking when using a hydraulic excavator, crawler mounted or a combination of both types of equipment, providing that the total number of complete passes over the same area specified in the paragraph given above is achieved. End dumping or depositing of rock over the end of any layer by hauling equipment is not permitted, except as otherwise noted below. Each layer shall be levelled in place and compacted to minimize voids and bridging of large rock fragments within the embankment.

Rock fragments exceeding a maximum of 1.0 m in any dimension shall be well distributed throughout the embankment. Rock fragments up to a maximum of 3.0 m in any dimension may be incorporated into the embankment, provided that the rock fragments are less than two-thirds the remaining embankment height when measured from the bottom of the oversized rock fragment at the point of placement to the top of the rock embankment, and shall be sufficiently spaced to allow free access of the specified equipment to compact the intervening fill.

Placement and compaction in layers is not required when rock is placed under water. In this case, end dumping may be used. However, end dumping shall only be used to an elevation of 1.0 m above the water level that is present at the time of placement. After that, the rock embankment shall be constructed using the equipment and method specified in the paragraphs above. The materials shall be well distributed to form a solid embankment constructed to full width as the work progresses or as staged construction allows.

When a rock embankment is constructed in a wet area such as swamps with full, partial, or no excavation, the direction of the rock placement shall be so that mud waves generated by the rock placement are able to move away from the embankment. Mud waves shall be displaced or removed to prevent their entrapment below or within the embankment.

End dumping from the top of the embankments may also be carried out at locations as specified in the Contract Documents when narrow and relatively shallow widening of an existing embankment is required for the shoulder portion of the highway.

The top surface of the embankment shall be chinked with rock fragments and spalls to form the subgrade prior to the placement of the roadway subbase in order to minimize voids and prevent migration of the subbase material into the rock fill.

Care shall be taken to avoid large boulders and rock fragments protruding above the average embankment surface within a distance of 3 m beyond the edge of shoulder.

With the written approval of the Contract Administrator, dumping of surplus rock over the sides of rock embankments by the Contractor is permitted as follows:

a) After the rock embankments have been completed to the grades and tolerances specified in the Contract Documents and all such measurements have been verified by the Contract Administrator.

b) Only in areas that do not affect features that are located within the right-of-way (e.g., ditches, culverts, and signs) or the right-of-way limits and shall not detrimentally affect stability or drainage or cause other potentially negative impacts.

c) At the direction of the Owner.

206.07.05.02.02 Shale Embankments

Shale embankment materials shall be deposited and spread in uniform layers for the full width of the embankment. Layers shall not exceed 450 mm in thickness prior to compaction. When a harder, more durable rock (e.g., limestone) is present as an integral part of a shale formation, no pieces shall be placed in the embankment that after placement are greater than 150 mm measured vertically or greater than 600 mm measured parallel to the embankment layers, respectively.

Compaction of each layer shall be in two stages using equipment specified in the Rollers for Shale Embankment Construction subsection. In the first stage, a minimum of 2 passes shall be made with a static sheepsfoot, packall, padfoot, or tamping foot type roller. In the second stage, a minimum of 2 passes shall be made with a vibratory steel drum or pneumatic-tired roller. The maximum speed of rollers shall not exceed 5 km/hr.

206.07.06 Rock Backfill to Structure

When rock backfill to structures is specified, the rock backfill shall only be comprised of rock fragments no larger than 250 mm in their greatest dimension and free of all debris, earth, topsoil, wood, chemical, or other contamination.

Rock backfill shall be placed in a manner that the structure is not damaged. Dumping of rock backfill against a structure shall not be permitted.

206.07.07 Quality Control

206.07.07.01 Grade Checks

The Contractor shall be responsible for carrying out all quality control (QC) grade checks to ensure that horizontal and vertical grading tolerances are met.

A competent survey crew shall carry out grade checks on all finished earth and rock grade surfaces. QC of earth and rock grade surfaces shall be based on horizontal and vertical grading tolerances as specified in the Tolerances for Earth and Tolerances for Rock clauses, respectively. The grade shall be certified at the stations and offsets shown in the grading templates or where grading templates are not available, at the frequency requirements specified for the layout elsewhere in the Contract Documents.

206.07.07.01.01 Submission of Grade Checks

The Contractor shall submit all grade checks relating to horizontal and vertical grading tolerances, including all non-compliances, to the Contract Administrator within 2 Business Days following completion of the grade.

When grading templates are available, the Contractor shall sign and certify on the grading template that the components of the work indicated on that template have been correctly constructed to the specified line and grade tolerances. If a template is not available, then the Contractor shall complete, sign, and submit MTO form PH-CC-820 to the Contract Administrator.

206.07.07.02 Compaction Quality Control

The Contractor shall use Method B according to OPSS 501 for quality control of compaction.

206.07.08 Management of Excess Material

Management of excess material shall be according to the Contract Documents.

206.08 QUALITY ASSURANCE

206.08.01 Grade Checks

The Owner may conduct random QA grade checks to verify horizontal and vertical grading tolerances.

Provided that the Owner's grade checks conform to those determined by the Contractor, no action shall be taken. If discrepancies between QA and QC grade checks occur, the Owner may then conduct additional QA grade checks at the Owner’s discretion.

If the finished grade or cross-section is found to be outside the specification limits specified in the Tolerances - General clause, then:

a) The Contract Administrator shall notify the Contractor.

b) The Contractor shall be charged for each station where the finished grade is outside of the specification limits, at the rate specified in the Finished Grade Checks Outside Specification Limits subsection.

c) The Contractor shall then bring the earth or rock grade surface to within the specified tolerances for grade, at no additional cost to the Owner.

206.09 MEASUREMENT FOR PAYMENT

206.09.01 Actual Measurement

206.09.01.01 Earth Excavation, Grading

Measurement for earth excavation, grading shall be the in-place volume of earth in cubic metres computed from field measurements of cross-sections taken both prior to grubbing and upon completion of the work.

When benching is required to key-in new fills into existing slopes, the quantity of materials that are excavated as part of that operation shall not be included in the measurement for payment.

206.09.01.01.01 Overbuilding, Earth

When the Contract requires earth borrow, the quantity of material placed beyond the earth grading tolerances shall be deducted from the measured quantity of earth borrow on a cubic metre for cubic metre basis, with no correction for changes in the density of the material.

206.09.01.02 Excavation for Pavement Widening

Measurement of excavation for pavement widening shall be the horizontal length in metres along each edge of the existing pavement when widening is specified in the Contract Documents.

206.09.01.03 Rock Excavation, Grading

206.09.01.03.01 General

Measurement of rock excavation, grading shall be the in-place volume in cubic metres computed from field measurements of cross-sections bounded by the original rock line after the earth overburden has been removed and the theoretical rock face and the bottom excavation limits designated in the Contract Documents. Where shatter is specified, the bottom of the cut shall be 300 mm below the designated rock grade.

The quantity of rock excavation shall also include:

a) All shatter that is specified in the Contract Documents.

b) Any rock that is excavated beyond the limits that are as specified in the Contract Documents at the Contract Administrator's written instructions.

206.09.01.03.02 Overbuilding, Rock

When the Contract has a rock supply item, the quantity of excavated rock placed beyond the rock grading tolerance at the top of subgrade and beyond the angle of repose for rock fills shall be deducted from the rock surplus quantity on a cubic metre for cubic metre basis with no correction for changes in density of the material.

206.09.01.03.03 Boulders

Measurement of each boulder classified as rock shall be by volume in cubic metres computed on the basis of the product of the actual rock measurement of the 3 maximum rectilinear dimensions in metres of the boulder.

206.09.01.04 Rock Face

Measurement of rock face shall be by area of the rock face in square metres.

206.09.01.05 Rock Supply

The quantity of rock supply shall be determined in cubic metres either at the end of a distinct stage or at the end of the Contract.

The quantity shall be determined as one of the following:

a) The rock surplus quantity less the quantities of rock materials removed as part of the rock surplus and measured as specified in the Measurement of Rock Surplus clause.

b) The quantity of rock materials determined by the Contract Administrator required to complete the embankments.

c) The total of both a) and b).

At the discretion of the Contract Administrator, earlier access to the rock supply item may be granted; however, the quantities shall be reconciled at the end of the stage or Contract.

The rock supply quantity shall be measured in-situ by the Contractor in neat lines at the source. The in-situ volume shall be the rock supply quantity divided by the bulking factor.

For rock materials supplied under the rock supply item for the completion of rock embankments, any rock materials remaining at the rock supply source after rock embankment construction has been completed or otherwise used on the Contract as specified in the Management of Excavated Materials clause, shall be paid for as specified in the Rock Supply subsection under the Basis of Payment section.

The Contract Administrator shall be informed in writing 2 Business Days prior to commencing drilling operations at the rock supply source or 2 Business Days prior to removing rock from the rock pile or both. The Contract Administrator reserves the right to verify any measurements at any source. The Contractor shall give the Contract Administrator complete access to all such sources.

206.09.01.06 Rock Embankment

Measurement of rock embankment shall be by volume in cubic metres of rock embankments. Adjustments to the Plan Quantity shall be limited to those supported with topographic survey information.

206.09.02 Plan Quantity Measurement

When measurement is by Plan Quantity, such measurement shall be based on the units shown in the clauses under Actual Measurement.

206.10 BASIS OF PAYMENT

206.10.01 Earth Excavation, Grading - Item

Payment at the Contract price for the above tender item shall be full compensation for all labour, Equipment, and Material to do the work.

Payment for earth grade checks, including provision of all labour, Equipment, and Material to conduct quality control testing shall be included in the Contract price as part of the work of earth excavation, grading.

206.10.02 Excavation for Pavement Widening - Item

Payment at the Contract price for the above tender item shall be full compensation for all labour, Equipment, and Material to do the work.

When the Contract Administrator directs that material excavated under this item is to be handled other than as specified in the Excavation for Pavement Widening clause, then such material shall be managed in accordance with the Contract Documents and treated as a Change in the Work.

Material used to backfill the excavation shall be paid for at the Contract price for the tender item of the type of material used.

206.10.03 Rock Excavation, Grading - Item

Payment at the Contract price for the above tender item shall be full compensation for all labour, Equipment, and Material to do the work.

When a rock face item is not included in the Contract, rock scaling and the removing of all overbreak and scaled materials shall be included in the rock excavation, grading item.

When a rock embankment item is not included in the Contract, the work of rock embankment shall be included in the rock excavation, grading item.

When excavated rock is to be used for any other Contract item work (e.g., rock embankment, granular materials, or rip-rap), the hauling costs are deemed to be included in payment for the work associated with the appropriate tender item. However, when excavated rock is not to be used for any other Contract item work, the hauling costs are then deemed to be included in payment for the work under the rock excavation, grading item.

Payment for rock grade checks, including provision of all labour, Equipment, and Material to conduct quality control testing, shall be included in the Contract price as part of the work of rock excavation, grading.

When drilling, blasting, and mucking are required as a part of the work for this tender item, the following progress payments shall be made:

a) 33% of the progress volume for drilling.

b) 33% of the progress volume for blasting.

206.10.04 Rock Face - Item

Payment at the Contract price for the above tender item shall be full compensation for all labour, Equipment, and Material to do the work.

On completion of drilling and blasting, a progress payment of 50% of this tender item shall be made.

On completion of mucking, a progress payment of an additional 25% of this tender item shall be made.

When the Contract does not contain a separate tender item for rock face, the Contract price for rock excavation, grading, shall include full compensation for all labour, Equipment, and Material to do the work of rock face.

206.10.05 Rock Supply - Item

Payment at the Contract price for the above tender item shall be full compensation for all labour, Equipment, and Material to do the work, and all costs for fees and royalties.

When drilling, blasting, and mucking are required as a part of the work for this tender item, the following progress payments shall be made:

a) 33% of the progress volume for drilling.

b) 33% of the progress volume for blasting.

The unit price tendered for this item is excluded from the provisions specified in the Contract Documents for renegotiation of unit prices.

For rock materials supplied under the rock supply item for completion of rock embankments as specified in the Contract Documents, any rock materials remaining at the rock supply source after completion of all rock excavation and rock embankment construction shall be paid at 50% of the tender unit rate for rock supply.

As specified in part b) of the Measurement of Rock Surplus clause, the Contractor shall be paid $400.00 for each monitoring device used to monitor compressible soils, regardless of the number of additional pipe sections that are required.

206.10.06 Rock Embankment - Item

Payment at the Contract price for the above tender item shall be full compensation for all labour, Equipment, and Material to do the work.

When the Contract does not contain a separate tender item for rock embankment, the Contract price for rock excavation, grading shall include full compensation for all labour, Equipment, and Material to do the work of rock embankment.

206.10.07 Backfill for Overexcavation

Payment shall not be made for backfill of any overexcavation in excess of the specified tolerances.

206.10.08 Backfill for Subexcavation

Material used to backfill subexcavations and transition or grade point treatments shall be paid for at the Contract price for the tender item of material used.

206.10.09 Finished Grade Checks Outside Specification Limits

As specified in the Grade Checks subsection of the Quality Assurance section, for each station where the QA grade check of the finished grade is outside of specification limits, the Contractor shall be charged $250.00.