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206-1 - EARTH EXCAVATION (GRADING) - OPSS 206

206-1.1 GENERAL

This section deals with the excavation, haulage, placement and compaction, and disposal of earth material, as classified in OPSS 206. Earth excavation, usually, is the main component of highway construction, and includes grading for sideroads, entrances, ditches, detours, etc.

206-1.1.1 Classification of Earth Materials

The following materials, when encountered during grading operations, usually are treated the same as earth, and are included in the tender item "Earth Excavation (Grading)"

a) Earth Overburden

Stripping and Earth Cut quantities originating from earth overburden on rock formations are estimated and treated as earth excavation in accordance with the Regional Geotechnical Section's recommendation.

b) Boulders and Fragmented Rock in Earth Cuts

The treatment of boulders and fragmented rock smaller than 1.0 m$^3$ encountered in earth cuts is normally stipulated in the Geotechnical Report and, unless otherwise directed, they are dealt with as per Ontario Provincial Standard Drawings.

c) Fragmented Rock and Weathered Rock

Quantities of fragmented rock, smaller than 1.0 m$^3$, excavated from existing road embankments or cuts will be included in "Earth Excavation (Grading)" quantities.

Certain rock deposits such as shale may be designated as earth to the bottom of excavation or to a designated pay line, below which it would be classified as solid rock.

d) Granular Deposits

Any granular or select subgrade material deposits which meet the requirements of OPSS 1010, when obtained from within the right-of-way, is paid for as "Earth Excavation (Grading)". Relevant estimating procedures and rates such as those for compaction, water, etc. apply equally to granular material.
Tender Item

The tender item associated with highway grading in earth is:

Earth Excavation (Grading)

and includes material from the following operations:

Stripping in Cuts
Stripping under Fills
Earth Cut/Fill
- roadway
- side ditches
- transition points
- sidewalks
- widening
- entrances
- frost heaves
- excavation below subgrade

Ditching
- catch
- interceptor
- intake/offtake

Swamp Excavation
- roadway
- culverts

Watercourse Correction
Frost Heaves, isolated
Sidewalks, isolated
Commercial Entrances

The benching of existing sideslopes for roadbed widening in fills is a construction operation only; it is not to be computed for inclusion in this tender item.

Other Excavation Tender Items

Excavation for the following is not carried out under the item "Earth Excavation (Grading)", but under separate tender items and governing OPS Specifications:

Pavement Widening (linear measurement)
Pipe Culverts
Sewers, Manholes, Catchbasins, Ditch Inlets
Subdrains
Structures

These items are detailed elsewhere in this Chapter.
206-1.4 Specifications

Details of the work of Earth Excavation (Grading) are contained in the following OPS Specifications:

OPSS  206 Grading General
      209 Swamp Treatment
      316 Expanded Polystyrene
      351 Concrete Sidewalk

206-1.5 Special Provisions

The designer should investigate to determine whether Standard Special Provisions are required to be included in the contract.

206-1.6 Standard Drawings

To establish the physical limits on which to base quantities the designer should become familiar with the "Ontario Provincial Standard Drawings" - 200 Series.

The designer may be required to develop typical sections or modify existing standard drawings for specific situations, such as:

- Sideroad Intersections
- Commercial Entrances
- Private Entrances
- Design of Open Channels

and should consult the following manuals, where appropriate:

- Geometric Design Manual
- Commercial Access Manual
- Drainage Manual

206-1.2 COMPUTATION

This is a Plan Quantity Payment item.

In computing earth quantities - cut and fill - the designer will subtotal the figures every 350 m along the highway, and also on service roads, sideroads, detours, ramps and entrances where the length justifies such a breakdown. Each subtotal will constitute a single-line entry on the "Quantities - Grading" sheet.
Where stage construction is proposed, quantities must be considered on a stage basis, as material excavated in one stage may not be available for fill purposes in a later stage. Separation of quantities may also be required for left and right sides of a widening project.

206-1.2.1 Source of Information

A. Design Criteria

This document contains the approved parameters governing the alignment and cross-section of the main roadway in a project.

B. Survey Information

Field notes are produced by survey crews, and provide details of existing surface features on the main roadway, sideroads and entrances, as well as data for the new horizontal and vertical alignments.

Cross-sections are recorded by survey crews, using rod and level, for plotting either manually or by machine. Surveys and Plans Office also provide cross-sections obtained by means of aerial photography.

C. Soils Profile

The Soils Profile shows the existing groundline, the proposed vertical alignment and the existing drainage data. Also shown are the relevant soils data and grading and granular base recommendations specified by the Regional Geotechnical Section.

D. Reports

A number of reports contain data needed by the designer to establish cross-sections upon which cut and fill quantities will be based. These reports are:

- Geotechnical Report (Pavement Design Report)
- Preliminary Design Report
- Environmental Assessment Report
- Foundations Report

E. Field Review

206-1.2.2 Components of Earth Excavation (Grading)

A. Stripping
Stripping consists of the removal of the upper layer of soil, which is predominately organic and generally known as topsoil. It differs from the underlying material in that it is unsuitable for the construction of embankments - within the load supporting area of the 1:1 slope of the fill while, at the same time, it needs to be treated as a valuable commodity, to be stockpiled for later use in the contract as topsoil on graded areas, prior to seeding or sodding.

The depths of required stripping under fills and in cuts, also the percentage of stripping considered as suitable for use as topsoil, will be as recommended by the Regional Geotechnical Section, based on soils investigations and published in the Geotechnical Report.

(a) Stripping in Cuts

Cut stripping occurs when the subgrade is below the bottom of the stripping depth.

Topsoil is to be removed for the full width of the cut to the depth recommended in the Geotechnical Report. In the absence of any recommendation, a depth of 0.15 m is to be used.

It is not necessary to manually deduct the stripping areas beyond excavation backslopes from the computerized stripping areas.

(b) Stripping under Fills

(i) Stripping under Fills 1.2 m or less in height.

The height of fill is defined as the vertical distance between the top of granular base and the ground line.

Fill stripping occurs when the subgrade is above the bottom of the stripping depth.

The width of stripping under shallow embankments coincides with the width of the proposed embankment, i.e. toe to toe of slope. This does not include areas under embankments due to slope flattening.

Topsoil is to be removed to the depth recommended in the Geotechnical Report. In the absence of such recommendation, a depth of 0.3 m is to be used.

(ii) Stripping under Fills more than 1.2 m in height

Stripping is not required under fills higher than 1.2 m unless there is a shortage of topsoil, in which case the
height limitation may be waived and the stripping area extended, rather than resorting to the more expensive operation of importing topsoil.

(c) Stripping in Areas to be Grubbed

Stripping is calculated for all areas to be grubbed within the grading limits. Excavated material is considered lost and not available for further use.

The depth of stripping in grubbing areas is that recommended by the Regional Geotechnical Section or 0.3 m, whichever is the greater.

(d) Stripping in Swamps

Stripping is not calculated in areas where swamp excavation or displacement is required.

(e) Stripping in Areas of Embankment Widening

In areas of reconstruction requiring embankment widening, stripping of previously constructed slopes is estimated using a depth of 0.15 m, or as recommended in the Geotechnical Report.

(f) Stripping of Sideslopes Prior to Benching

Although benching of sideslopes is not a measured quantity, stripping is computed over the benched area to the depth recommended in the Geotechnical Report. If no depth is recommended, a depth of 0.15 m is to be used.

Note: On projects where all of the excavated earth is unsuitable for embankment construction, or where there are no embankments to be constructed, and there is no need to salvage stripping material for topsoiling, then stripping over cuts need not be computed.

B. Earth Cut for Roadways, Interchanges, Detours, Sideroads, Entrances and Sidewalks.

Earth Cut is material classified as earth as per OPSS 206, and which is excavated from below the stripping down to subgrade level (i.e. bottom of granular sub-base), as outlined in the theoretical section which applies to that particular project. The volume of earth cut is computed using the end area method, with the appropriate areas calculated geometrically, measured by planimeter or electronically computed.
In reconstruction projects where the existing pavement is removed, the cross-sectional area of the earth cut section is measured from the top of pavement, and the volume of pavement removed (including concrete base, lean concrete base and asphalt treated base) is included in the excavation quantity for "Earth Excavation (Grading)".

The removal of in place processed pavement material by means of fine grading to specified lines and grades, prior to paving is considered part of the work of the tender item - In-Place Processing of Bituminous Pavement, and must not be computed under the tender item - Earth Excavation-Grading.

Quantities are computed separately for roadways, interchanges, detours, etc., and subtotalled at 350 m intervals.

Excavated earth, usually, is suitable fill material, and the total volume computed is considered available for embankment construction and backfilling excavated areas. When some of the material is not acceptable, the percentage to be used for earth fill is normally shown on the Soils Profile or contained in the Geotechnical Report.

On projects where there is removal of pavement as part of earth excavation, the volume of pavement removed must be subtracted from the excavation quantity when calculating the amount of material available for fill.

The Soils Profile may be supplemented by other forms of presentation, such as the Geotechnical Report, which may indicate an average percentage waste for all cut material on the project or an expected percentage waste in each individual cut.

The percentage waste is based on the earth excavation quantity remaining after deducting stripping volumes, pavement volumes and material removed in grubbing operations.

(a) Earth Excavation for Transition Point Treatment

In order to overcome the variance in bearing and frost heave characteristics found at the transition between cuts and fills, excavation and backfilling is carried out in accordance with Ontario Provincial Standard Drawings for Transition Point Treatments, and the resulting excavation quantities included under "Earth Cut". Values for "t" (depth of transition point treatment) and "H" (depth of 'A' and 'B' horizons) as indicated in
the Ontario Provincial Standard Drawings are obtained from the Regional Geotechnical Section.

(b) Widening of Existing Roadbed

On projects which include the widening of an existing roadbed to increase lane width or add an entire lane (e.g. passing lane), the work is included as part of "Earth Excavation (Grading)". The excavation is computed in cubic metres and, generally, the material is available for fill purposes, unless otherwise decided by the Regional Geotechnical Section.

In some instances the work of widening may be included in the item "Rental of Grader" (see Section B299-1). Another alternative to cubic measurement (m³) for this item is linear measurement (m) as discussed elsewhere in this Chapter.

The designer should investigate cut sections that may require widening beyond the limits set in the standards in order to maintain traffic during stage construction. Where widening is necessary it should be considered as a detour and the appropriate quantities should be included in the tender.

(c) Excavation for Widening in Cuts

In order to effect a balance of earth requirements for a grading contract when grade adjustment is not feasible, widening of cut sections beyond the limits set in the standards, or excavating within interchange loops, medians or similar operations are acceptable alternatives.

These possibilities should always be investigated and, if no conflict with design or soils recommendations is apparent, should be implemented - provided that the total cost of excavating, including the stripping quantity not usable for fill, and the haul to the required fill area, is more economical than borrow from outside sources.

(d) Frost Treatment

Frost heaving is caused by freezing temperatures acting upon frost-susceptible soils and free water below the subgrade. The combination of these factors results in the formation of frost lenses, which, by expanding upward, cause substantial and costly damage to the pavement structure. Frost heave damage is particularly severe on roads in the northern part of the Province.
Frost heave treatment is applied in areas specified by the Regional Geotechnical Section in accordance with Ontario Provincial Standard Drawings.

All frost-susceptible material is excavated to the lengths, widths and depths recommended by the Regional Geotechnical Section. Such excavations are backfilled with acceptable material and compacted. Frost heave areas must be given drainage treatment by means of deepening ditches, if possible, or by installing subdrains or french drains. The treatment of frost heaves using expanded polystyrene is discussed in Section B316 of this Chapter.

(e) Earth Excavation Below Subgrade

In some cases the Regional Geotechnical Section will recommend excavating below subgrade where there are pockets of unsuitable soil. The depths to be excavated, usually not uniform, will be shown on the Soils Profile.
Fig.B206-1-1

Fig.B206-1-2

Fig.B206-1-3
The illustrations in Figs. B206-1-1 and B206-1-2 are examples of additional excavation required below subgrade. The upper hatched area indicates the granular base courses, while the lower hatched area indicates the additional excavation below subgrade, which may be backfilled with earth or granular material as stipulated in the Geotechnical Report.

C. Earth Excavation for Ditching and Watercourse Correction

(a) Ditching

Any excavation required to construct an open drainage course is defined as ditching, and is subject to the following conditions:

the excavation is outside the limits of the theoretical roadway cross-section, or

the excavation is within the limits of the theoretical section, but outside the point of intersection of the subgrade and the side slope; and the point of intersection is above original ground (see Fig. B206-1-3).

Generally 50% of the estimated quantity for ditching is considered available for fill when balancing quantities. This percentage is subject to change depending on the recommendations of the Regional Geotechnical Section.

Ditches of the following types are usually constructed:

- side ditches
- interceptor/catch ditches
- intake and offtake ditches
In order to compute quantities for ditches, other than side ditches, the end area method is used, provided that the necessary field information is available.

Note: The designer should review the design earth ditching cross-sections and, where the intersection of the theoretical earth ditch backslope intersects the original ground line at an elevation equal to or above the edge of subgrade elevation, then this excavation should be documented as earth cut, (see Figure B206-1-3A), for the following reasons:

i) earth ditching and earth cut require different excavation methods and equipment which will affect a contractors bid.

ii) to arrive at a realistic grading balance (i.e.) earth ditching is considered 50% available for fill compared to earth cut which can be up to 100% available for fill exclusive of stripping.

(b) Watercourse Correction

A watercourse correction is defined as an alteration to a natural watercourse, up to a culvert or apron face, if flowing through a culvert. Excavation within the limits of a culvert is considered part of the work of other tender items and is paid for accordingly.

The recommendations of the designer, based on the advice and findings of the Hydrology Report, are followed by the designer in the computation of quantities and the incorporation of the final design into the contract drawings. The use of excavated material depends on the decision of the designer, who may consider its use in the construction of embankments. Usually, the excavated material is used for filling-in the old streambed, and a note to that effect placed on the construction plan. The following illustrations Fig B206-1-4 & B206-1-4A show plan, profile and section of a proposed watercourse correction, as they appear on the contract drawings.

Generally, quantities are calculated using the end area method, on cross-sections when available, or otherwise from ditch profiles.
D. Swamp Excavation

Swamp, also referred to as muck, peat, marsh, muskeg is a deposit of organic matter resulting mainly from the decomposition of plants and roots which have grown and died in place. The material usually has a high moisture-content and a low bearing-capacity.

(a) Swamp Removal by Excavation or Gravity Displacement
Swamp is usually removed by excavation or gravity displacement, and this section deals only with these two methods.

The stages of swamp excavation and backfill are illustrated in Figures B206-1-5 to B206-1-9.

In highway reconstruction, other than specifying excavation on the widened portion of the embankment, the Geotechnical Report may recommend full-width excavation including the existing embankment and the underlying material. In such cases, the cross-sectional area of the embankment is measured separately from that of the swamp excavation and is considered available for fill purposes. The limit of embankment excavation is the line joining the toes of slopes (see A-B in Fig. B206-1-10). Both the adjacent and underlying swamp materials are excavated, either by equipment rental (separate tender item), or by cubic measurement (this item), with the material considered "not available for fill".

The Regional Geotechnical Section will prepare a detailed breakdown of swamp areas to be treated and provide the designer with a complete set of recommendations as a guide in the preparation of estimates. The bottom limits of swamp excavation must be shown on the contract profiles, as described elsewhere in this Section under "Documentation". Figures B206-1-11 and B206-1-12 illustrate examples of soils recommendations and are intended as a guide in computations.
SWAMP TREATMENT

Fig.B206–1–10

- Backfill
- Earth fill
- Excavation and Earth fill
- Excavation and Backfill
Formulae, as shown, may be used only when the value of "D" in a given section is constant.
Although swamp excavation is usually carried out as part of "Earth Excavation (Grading)", an alternative method of measurement, forming a separate tender item - "Rental of Swamp Excavation Equipment" - may be specified by the Regional Construction Engineer. Refer to Section B209 of this Chapter for details.

(b) Swamp Excavation for Culverts

Swamp excavation for placing culverts is considered part of the tender item - "Earth Excavation (Grading)", and is included in the main swamp excavation quantity.

If the culvert is being placed in a swamp displacement area, any excavation required to place the culvert is calculated as culvert excavation.

(c) Use of Geotextiles

In some situations, the swamp material is neither excavated nor displaced and the top mat is left undisturbed and close-cut cleared where required. Prior to placing embankment material on top of the swamp material, its bearing capacity may be improved by the use of geotextiles. The geotextiles may be specified to be placed longitudinally or laterally with successive sections overlapped.

206-1.2.3 Utilization of Excavated Materials

Based on the recommendations of the Regional Geotechnical Section, the designer will indicate in the calculations which cut materials are suitable and available for embankment construction and those which are marginal or unsuitable for embankment construction and, therefore, require to be either incorporated into the work within the right-of-way, other than in embankment, or disposed of outside the right-of-way.

Computed quantities need to be adjusted to compensate for shrinkage due to compaction, and the designer should refer to Appendix "A" to this Chapter for the applicable volume adjustment factor.

The compaction of earth is described fully in OPSS 501.

The work of compaction is paid for under the item "Earth Excavation (Grading)" and does not require any computation.

Excavated materials may be utilized of in the following ways:

Stripping - topsoil for graded areas to be sodded or seeded
- stockpile for future use
- designing flatter or contoured slopes

Earth Cut
(suitable)
- embankment construction
- backfilling of excavations
- designing flatter slopes
- berms
- stockpile for future use

Earth Cut
- embankment construction beyond the (Unsuitable) minimum specified earth and rock embankment slopes
- berms
- designing flatter slopes

Ditching
- as for Earth Cut, except that, because of staging, material may not be available when required.

Swamp-Excavation
- Flattening of embankment slopes beyond 2:1 slopes
- building berms
- top soil only when approved for use for graded areas to be sodded or seeded

Note: Excess bituminous pavement, concrete, and masonry surplus to the recycling requirements on a project may be incorporated into embankments, provided it is processed as specified elsewhere in the contract. Guide rail may also be eliminated by the use of slope flattening, as detailed in Roadside Safety Manual.

In Crown Lands additional R.O.W. should be taken to ensure excavated swamp material can be disposed of on the fill slopes adjacent to the swamp excavation.

Frost Heaves - as per Earth Cut (Unsuitable)

Watercourse Correction - disposal in old streambed
(a) Embankment Construction (Earth Fill)

Earth Fill is the placing of excavated earth material within the design section, from the original groundline up to the earth subgrade elevation.

(b) Stripping Backfill
Roadbeds excavated for frost heave treatment will be backfilled with granular material in accordance with Ontario Provincial Standard Drawings, as set out in Section B314 of this Chapter.

(f) Swamp Backfill (Earth)

Voids resulting from swamp excavation may be backfilled with earth (see Figs. B206-1-10 to B206-1-12). The end-area of swamp excavation plus the area contained by the In fill sections where stripping is required, an allowance equal to the depth of stripping, as recommended in the Geotechnical Report, must be made in order to fill the resultant voids (see Fig B206-1-14).

In sections where the profile grade is close to the original ground line, the designer should analyze carefully the extent of stripping backfill since the area of stripping may, in part or totally, correspond to the area of the granular base.

(c) Stripping Backfill in Grubbing Areas

Where grubbing is required within embankment grading limits, an allowance, equal to the depth of stripping, of additional fill material must be provided to compensate for stripping.

(d) Backfill below Subgrade

Where the Regional Geotechnical Section has recommended excavation of earth material from below the subgrade, the resultant voids must be backfilled with acceptable earth, rock or granular material.

(e) Frost Heave Backfill

1/2:1 slopes up to original ground will require backfill.

Where displacement of swamp is required, the fill in that area will consist of the actual embankment required for roadway construction plus material required to effect the swamp displacement. The additional fill material is designated as Swamp Backfill (Earth), and is equal in volume to the displaced swamp material. (See Fig. B206-1-12).

The volume adjustment factors for Swamp Backfill are detailed in Appendix "A" to this Chapter.

(g) Benching of Earth Slopes
Where benching of earth slopes is required (in widening existing embankments), no measurement or payment will be made in respect of quantities excavated during this operation. Stripping, however, if required as a separate operation, will be measured and included for payment under the item "Earth Excavation (Grading)". Additional earth quantities will be computed as Stripping Backfill, but no quantities, cut or backfill, will be computed for benching.

Existing embankment slopes should be benched as specified in the Ontario Provincial Standard Drawings.

(h) Use of Unsuitable Materials

Every effort should be made to incorporate all excavated material into the work.

Areas within the right-of-way where marginal, unsuitable or swamp material may be utilized are:

1) Designing flatter slopes, beyond the minimum design requirements. This improves the safety of the highway and may eliminate the need for guide rail. (Refer to the Roadside Safety Manual).

Note: Drainage gaps must be provided when slope flattening rock or granular embankments with more permeable materials, in accordance with the appropriate OPSD. The drainage gap locations must be identified on the plans. The slope flattening limits and the volumes involved must also be shown on the plans.

2) Designing berms - which may improve the aesthetics of the highway; improve landscaping; shield drivers from roadside distractions, and provide noise and dust control.

206-1.2.4 Disposal of Surplus Materials

In today's spirit of sustainable development and environmental consciousness it is imperative to incorporate a maximum of excavated materials into the design of a facility as detailed in 206-1.2.3(h), 1) and 2). Only after all possibilities of incorporation of materials are exhausted all disposal of surplus materials outside the ROW regardless of the type of materials, should be contemplated.

206-1.2.5 Methods of Calculation

The basic unit of measurement for the tender item "Earth Excavation (Grading)" is the cubic metre.

Electronic computation of grading quantities has largely replaced manual methods. The designer has access to the microcomputer based Highway Design
System and must prepare input forms to supply the necessary data, and must be capable of interpreting the output data produced by the computer.

The following manuals are available to assist the designer in using the computer:

**HDS Manuals**
Highway Design System Volume 1 (System 50)
Highway Design System Volume 2 (Interactive Update)
Highway Design System Volume 3 (Typical Examples)
Contract Preparation System (CPS)
CPS User's Guide

(a) Cross Sections

Working from field survey notebooks, cross-sections are plotted to cover the area of the work project. These original groundline sections usually are machine-plotted and drawn by computer.

The interval between sections is that used in the field survey and may vary according to the roughness of terrain, up to a specified maximum interval.

Usual intervals between sections are:

- 25 m (earth, rock fill, swamp, borrow pit)
- 10 m (rock cut)
- 20 m (possible rock)

Cross-Sections normally are plotted at a scale of 1:100 both horizontally and vertically.

The following details should be incorporated in a plotted cross-section either manually or by computer, from input data provided by the designer.

- Original Ground
- Rock Line
- Design Section including,
  - top of pavement
  - top of granular
  - subgrade and grading limits
  - ditching limits
- stripping limits
- frost treatments
- transition point treatment
- shatter
- swamp excavation limits
- any other excavation below subgrade.

- In addition the cross-section will include,

  - cross-section station
  - profile grade elevation
  - offset distances and elevations for original ground line.

Areas outlined on the cross-section are measured either by planimeter, calculated geometrically or computed electronically.

In reconstruction projects where the existing pavement is removed, the volume of the removed pavement must be subtracted from the total volume of earth cut to obtain the volume of material available for fill.

(b) Forms

Following the measurement of end areas, they are listed on Form PH-D-420 "Earth and Rock Quantities", and the computation of volumes for each type of work - stripping, earth cut, ditching, etc., is detailed separately in individual columns.

Where stage construction is proposed, excavation quantities must be considered on a stage, rather than a project basis, as, for example, quantities excavated in the first stage may not necessarily be available for fill at a later stage. In order to obtain accurate quantities for material available, required - borrow - disposal, both calculation and quantity sheets must be prepared for each stage of the contract.

(c) Mass Haul Diagram

Mass Haul diagrams are to be prepared for all major grading contracts.

A Mass Haul Diagram serves as a guide in the appraisal of moving materials and balancing quantities. The comparison of the availability and usage of the excavation quantities provides guidance as to the feasibility and economy of a grading project.

After analyzing the diagram, the designer may recommend revisions to the set grades, or seek other solutions. Should a grade revision be required, it would be necessary to amend the cross-sections accordingly, recalculate the pertinent grading quantities and revise the Mass Haul Diagram.
For the preparation of a Mass Haul Diagram refer to MTC publication "Introduction to Mass Haul Techniques in Highway Design", prepared by the former Systems Design Branch.

206-1.3 DOCUMENTATION

A. Contract Drawings

Where OPS Drawings do not exist, typical design cross-sections are to be included in the contract.

Typical cross sections are required for frost heave treatment areas and areas where excavation below subgrade is needed, showing the full extent of treatment necessary, including provision for drainage, where required.

When flared guiderail terminations are required, the designer should show the location of the widened embankment. This may mean that interpolated cross-sections have to be inserted at the termination points.

If a particular type of material (earth cut) is to be used at a specific location (earth fill), then these requirements must be indicated either on the Mass Haul Diagram or on the Contract Drawings by a special note.

When the design depends on the use of a specific material, that material must be identified on the drawings even when it is to be provided under the Earth Excavation or Earth Borrow item.

Swamp must be plotted on profile and treatment (by OPS Drawing No., or typical section) indicated. Any excavations below subgrade must be shown on the profile sheets.

B. Contract Documents

The earth excavation (Grading) quantities are to be recorded on the "Quantities - Grading" sheet.

The quantities of earth excavation (grading) for the following locations are shown separately for 350 m intervals.
- Highways
- Service Roads
- Ramps and Loops (when separate profiles are shown)
- Sideroads
- Detours

The quantities for earth excavation grading for the following locations are shown for the total contract.
- Commercial Entrances
- Sidewalk (isolated locations not part of grading section)

The quantities for the following type of earth excavation are shown for each location.

- Cut/Fill
- Stripping, (cut and fill stripping quantities need not be separated on Q-sheets. Only a single heading "Stripping" need be shown).
- Ditching/Sidewalk
- Swamp
- Frost Heaves (isolated locations not part of grading section)
- Watercourse Corrections
- Unusually large entrance quantities

Totals for each component are entered in columns designated for:

- Earth Excavation (Grading)
- Material Available
- Fill Required.

The Material Available and Fill Required may be separated into three uses.

- Suitable Material available for use as fill within the specified 2:1 minimum earth embankment slopes, or as recommended by Regional Geotechnical Section.

- Surplus, unsuitable, marginal or swamp material is available for use as fill beyond the specified minimum 2:1 earth or 1?:1 rock embankment slopes unless otherwise recommended by the Regional Geotechnical Section.

The totals of earth quantities resulting from the work of culverts, structures, etc. are transferred from their respective quantity sheets to the quantity grading sheets as materials available for fill when the quantities are significant.

Where stage construction is proposed, quantities must be considered on a stage basis, as material excavated in one stage may not be available for fill purposes in a later stage.

Where there is a shortage of material available for the fill required, the earth borrow entry must be completed on the quantity sheet (see Section B-212).

The total quantities of stripping available for the project is transferred to the stripping breakdown in the bottom left hand corner of the quantity sheet. The top soil required and the stripping balance are calculated and recorded.

The total volume of "Earth Excavation (Grading)" is transferred to the Tender documentation.
All other columns are totalled but tender item box is crossed out.