CHAPTER IV
DETAIL DESIGN

SECTION 4-08 GRADING

4-08.1 REMOVAL OF EXISTING STRUCTURES, BUILDINGS, AND MISCELLANEOUS ITEMS. The plans show the disposition of all existing facilities and structures within right of way limits, including buildings, bridges, drainage structures, foundations, sidewalks and existing surfaces. The standard specifications provide that all materials removed under construction contracts, except guardrail, become the property of the contractor, unless otherwise specified in the contract.

4-08.1 (1) BRIDGES. The item for the removal of bridges is applicable to the removal of drainage structures with spans exceeding 20 ft. [6.1 m] and other major structures, such as large retaining walls. The plans include a complete description, with dimensions, of the items to be removed under this specification. If the material resulting from the removal of these large structures is to be hauled and stored on maintenance lots, the plans provide a lump sum item for hauling materials to storage (see Subsection 4-08.1 (3)).

4-08.1 (2) REMOVAL OF IMPROVEMENTS. This work consists of the removal and disposal of all existing improvements from the right of way and within the limits of any construction area outside the right of way, except for the following: existing improvements designated or permitted to be left in place; existing improvements included in Removal of Bridges; plugging or closure of wells, septic tanks, petroleum storage tanks or lagoons included as separate bid items; and existing improvements in excavation limits for Class 3 or 4 Excavation. (It should be noted, Class 3 or 4 excavation does not include removal of existing headwalls, culvert concrete or roadway culverts. These items should be handled as removal of improvements for roadway culverts or partial removal of culvert concrete for bridge culverts.) The tabulation of removal items is used by the designer to prepare an intelligent estimate of each item from which an estimated lump sum cost can be prepared. Plans may designate removals or salvaged materials from improvements. Salvaged materials may not be stored permanently on the right of way. The federal government will not participate in hauling removed improvements to stockpile sites.

4-08.1 (3) SALVAGE MATERIALS. It is not required to give salvage credits for minor items such as base, surfacing and culvert pipe on temporary bypasses. If it is determined that these minor items would be useful to the state, federal funds can participate in the cost of salvaging, if the cost does not exceed cost of new material and if work is limited to the setting aside (not stockpiling) of the materials on the right of way, beyond construction limits. The cost of salvaging materials by the contractor, stockpiling and/or delivery to a storage site cannot receive federal participation and requires identification by separate bid items to make costs non-participating.

The benefit of salvaged materials is generally questionable unless it is a major item. If any major materials are salvaged by the contractor, not used on the project, and retained for use by the state, it will be necessary to give salvage credit if federal funds are involved. Examples of major items are traffic signals, guardrail, and large culvert structures. Salvaged bridge materials may become the property of the contractor as specified in the standard specifications or may, by special provision, be retained by the commission without the necessity of giving salvage credit.

The special provisions should show what materials, except guardrail, are to be salvaged, if any, and should state the disposition to be made of the materials. The standard specifications state that guardrail materials remain the property of the Commission and shall be stored on the right of way as directed by the engineer. A salvage credit value should be established for all salvaged materials, if practicable, at the P.S.& E. stage. The value can be established by the Engineer upon removal of the item, if it is anticipated that such value will be dependent upon the condition of the item after its removal. Salvage credit should be shown on the engineer's estimate.

4-08.1 (4) PLANS. The plans include a description of all known existing items to be removed. The items to be removed are noted on the plans by the letter "R". A tabulation of all known removal items is also included on the Summary of Quantities 2B sheet. The removal items are listed in the order of occurrence insofar as practicable, designated by sheet number, station, location left or right with distance and a description. A total of the

individual items is not indicated, as this is a lump sum item. Items to be left in place are noted "UIP" if they are to be used, and "LIP" if they are left in place and not used. Examples are shown in Section 4-10. Plans for all projects should be prepared to reuse material where the construction sequence will permit and where the cost of salvaging does not exceed the cost of new material.

4-08.2 CLEARING AND GRUBBING. Clearing and grubbing is estimated during the design field check, and in conjunction with aerial photographs if available, consistent with the method of measurement given in the standard specifications. The standard specifications establish the size of trees and stumps that qualify for payment as clearing and grubbing.

Roadways designed with clear zones are cleared at least to the minimum clear zone width. Use other roadway exceptions to decrease the cost of roadside maintenance and to improve the appearance of the completed facility. Clearing is excepted at the top of deep cuts, the bottom of high fills, in areas not conveniently accessible to maintenance equipment, in areas where the natural growth of trees and shrubbery will blend with adjacent areas, and at all other locations where natural trees and shrubbery will improve the appearance without detracting from the service of the completed facility. Clearing exceptions can be used to control erosion at interception and roadway ditch outlets. Areas which are not to be cleared are outlined on the plans and noted as "No Clearing" or "N. C." in accordance with Section 4-10. This area should provide sufficient clearance for equipment to construct items such as interception ditches and levees at the top of backslopes or at the bottom of fillslopes. When the entire surface of the right of way is not to be cleared, the following general note is included on the first plan-profile sheet: "Areas noted 'No Clearing' or 'N. C.' on the plans are not to be cleared of trees, undergrowth, brush, grass, weeds or natural rock formations."

The clearing and grubbing quantity is estimated, and pay items in acres [hectares] are included. The quantity of acres [hectares] should be placed on the Summary of Quantities 2B sheet.

4-08.3 GRADING. Grading quantities are computed on the basis of either a volume or linear unit of measurement. Volume grading is classified in accordance with the various grading items defined in the standard specifications. Unclassified excavation is not specified, except in special cases and where prior approval from the district's Soil and Geology Technologist has been obtained. Class C excavation consists of the removal of stone, including sandstone and igneous rock, as described in Sec 203 of the standard specifications. The standard specifications classify linear grading as Linear Grading, Class 1 and Linear Grading, Class 2. Other items measured on a linear basis are Subgrading and Shouldering, Class 1 and Subgrading and Shouldering, Class 2; and Shaping Slopes, Class I and Shaping Slopes, Class II.

4-08.3 (1) VOLUME GRADING. Volume grading quantities are shown on the plans, divided into the various items. Volume grading quantities may be determined by the computer or manually. Methods for processing grading quantities are computed manually by plotting cross sections and templates and manually measuring and computing by the use of the double end area method. The computer is used to compute grading quantities whenever practicable, and depending upon the extent of the volume grading. Grading quantities computed by the computer are supplemented with incidental quantities which are usually computed manually. Volume grading is used for grading all roadways which are to be compacted.

4-08.3 (1) (a) UNDERGRADING CUTS. Where the standard grading template is in rock, partially in rock, or in unsuitable material, the grading template is undergraded below the bottom of the surface or base courses in accordance with the standard specifications and standard plans to provide a uniform foundation. The station limits for undergrading are shown on the profile portion of the plan profile sheets. The elevation shown on the cross sections should account for the necessary undergrading. The undergrading quantities are included in the classified excavation quantities shown on the plan profile sheets. Where unsuitable material is not to be used in the roadway balance, caution is exercised to insure that a sufficient quantity of material is included in the plans to complete backfill of undergraded areas and all other required fills. Details for undergrading are shown on standard plans. Other data for undergrading and subgrade are given in Chapter VI.

4-08.3 (1) (b) BORROW OR EXCESS MATERIAL. The plans shall designate commission furnished borrow areas for all projects where suitable borrow areas can be provided. The commission will acquire borrow area

easements for use by the contractor (in accordance with established procedures). The borrow material will be designated on the plans as Class A excavation (borrow) and included in the bid item for Class A excavation. For those projects where suitable borrow areas cannot be secured or for projects which involve small quantities of borrow material (i.e., less than 100,000 cubic yards [76,500 m^3], such as bridge replacements, intersection geometric revisions, 4R interstate projects, urban projects, and other similar projects, it is acceptable to use contractor furnished borrow material which will be designated on the plans, quantified and paid for as embankment in place. All requirements of Section 4 (f) of the Department of Transportation Act and Section 106 of the Natural Historic Presentation Act will apply to **all** borrow areas. A written request should be submitted for environmental services to General Headquarters Design to determine if commission furnished borrow areas are suitable for use. A form for this use (see Figure 2-02.2) can be found in the Environmental/Cultural Resources category of the Design forms on the computer system. If the contractor elects to use another site, rather than the site furnished by the commission, the contractor must provide written certification to the resident engineer that the proposed borrow site is cleared of environmental concerns under all applicable federal and state laws and regulations. These include but are not limited to the following: Clean Water Act; the Endangered Species Act; the National Historic Preservation Act; the Farmland Protection Act; Resource Conservation and Recovery Act; Comprehensive Environmental Response; Compensation and Liability Act; and RSMo Chapter 194, Section 194.400, Unmarked Human Burial Sites. Certification shall include clearance letters and other evidence of coordination with the appropriate regulatory agencies, as attachments. The contractor shall reimburse the Commission for any reduced or eliminated FHWA participation due to not meeting any of the regulations.

If the appropriate quantity of material is available from several sources on a project which specifies contractor furnished borrow materials, the contractor is required to designate the specific source from which the materials are to be obtained. The contractor is required to clear the borrow areas for environmental concerns, unless the source is a quarry or other locations where the necessary clearance has already been obtained. The contractor provides documentation that the borrow areas are clear of environmental concerns. Contractor furnished borrow material is designated on the plans as embankment in place. Roadway slopes and pavement design for a project specifying embankment in place will be based on the most probable soil in the area. The district is responsible for furnishing this information prior to slope and pavement design. In most cases it will be necessary to prepare a special provision establishing certain minimum soil characteristics to guarantee the quality of the material used.
Department furnished borrow areas will be located out of sight of the traveled way, if at all practical. If it is not practical to locate it out of sight, the borrow areas are to be graded and dressed so their appearance is aesthetically pleasing.

The following note is placed on the right of way plans for Commission furnished borrow areas. "The design grade established for this borrow area is approximate. During the construction phase of the project, it may be revised as necessary to provide the proper quantity of fill material to complete the roadway grading."

Cross sections are taken and a design grade established on all commission furnished borrow areas. The cross sections are made a part of the detail design plans.

The plans may indicate suggested disposal sites for excess material but do not specify mandatory disposal sites unless such mandatory sites are justified economically with respect to a particular federal-aid project or a combination of federal-aid projects. The FHWA may concur in and may approve the designation of a mandatory site based solely on environmental considerations, provided the environment would thereby be substantially enhanced without excessive cost. The specifying of a mandatory disposal site is rare, and in most instances, the contractor is given the option on the disposal site. This does not prohibit the specifying of disposal sites on state-financed projects. Borrow, embankment in place, and excess material quantities are clearly indicated in the grading quantities on the plans. Where the plans provide more than one borrow or excess area, the plans clearly indicate which areas are used in specific balances, and specify the approximate quantities involved. Costs of borrow easements obtained on right of way projects are not accountable as a right of way item. Such costs are charged to the construction of the project.

4-08.3 (1) (c) BALANCE POINTS AND EXCAVATION DIVISION POINTS. The plans show balance points, a zero point on the mass diagram, to the nearest 1 ft. [0.5 m]. The location is determined by accumulatively subtracting excavation from the adjusted (shrunk or swelled) fill until the point of zero quantity of fill or cut is reached. The length of a balance is not limited; however, where possible the profile grades are adjusted to minimize overhaul quantities. Excavation division points or balance points are shown at the ends of span type bridges to define the fill exception and to provide the contractor with the volume of material to be hauled across the bridged location.

4-08.3 (1) (c) 1 SHRINKAGE AND SWELL FACTORS. The ratio of the quantity of excavated material to the quantity of embankment that can be constructed from the same material is the shrinkage or swell factor of the material being excavated. The shrinkage factor given in the soil survey is generally not acceptable for use in balancing roadway excavation because of excess in scalping, grubbing, and material losses during grading and hauling operations, but is used as a guide. Shrinkage factors for earth excavation will vary from approximately 140 percent in light grading to approximately 105 percent in heavy grading. Shales and rock excavation are usually arbitrarily swelled approximately 10 to 25 percent, depending on the quantity and type of rock. The higher percentage is used where the percentage of rock to total excavation is high. The swell factor also partially accounts for overbreak. Shrinkage and swell factors are usually determined for each improvement on the basis of previous experience with grading operations in the same area, or in a similar area, and is largely a matter of good engineering judgment aided by the soil survey and all other available data. When selecting shrinkage and swell factors, the district soils and geology technologist should be consulted for input. These factors are not shown on the plans.

4-08.3 (1) (c) 2. OVERBREAK AND SWELL FACTOR. Overbreak resulting from blasting rock below the limits of undergrading shall be removed and backfilled with spalls or rock fragments at the contractor's expense. Therefore, do not include overbreak in the classified excavation quantities. The overbreak within the roadbed limits is backfilled and does not materially influence the swell factor for the classified excavation, unless backfilled with other than roadway excavation.

4-08.3 (1) (d) OVERHAUL. There is no direct payment for overhaul. For estimation purposes, consideration should be given to haul distances greater than 2,000 feet [600 m] and/or material that cannot be handled with off-road equipment. The existence of either one of these conditions may result in decreased production rates and increased costs.

4-08.3 (1) (e) STOCKPILED EXCAVATION. The preliminary geotechnical report may specify certain embankment to be constructed with rock or shale in the lower portion of a fill. In such cases, and when earth is to be used for backfilling undergraded cuts or for shouldering, it is sometimes necessary to stockpile earth excavation to accomplish this result. Sometimes material for these uses can be obtained from adjacent balances without stockpiling material. Stockpiling of excavation is provided for on the plans in those cases where the material necessary for these uses cannot be obtained elsewhere without undue inconvenience and expense. The payment for handling stockpiled excavation is at the rate for the applicable item of Class A excavation or unclassified excavation for each handling.

4-08.3 (1) (f) SURCHARGED FILLS. It is sometimes desirable to place additional loads on fills in areas with poor fill foundations to accelerate settlement. This loading is usually accomplished by constructing the fill to a specified height above grade, which is called surcharging the fill. The surcharging is placed to a depth required by an analysis of the fill foundation by the GHQ Construction and Materials Geotechnical Section, and is left in place for the time required for the fill to fully consolidate. The Geotechnical Section will also recommend number, location and type of pore pressure and embankment control measuring devices and necessary drains. Surcharging is usually left on fills for a period of at least 90 days. The portion of the fill surcharge, to the depth of anticipated settlement, is compacted in accordance with compaction requirements for other fills. The surcharge above this elevation is not compacted. The surcharge is usually sloped on 1:1 slopes above grade. Where anticipated settlements are significant, the grade slopes may be made steeper as required to obtain a finished roadway slope and roadbed width after settlement. If the surcharge is to be left on the fill for an extended period of time that will cause undue delay to the contractor, separate grading and paving projects may be considered. In such cases, GHQ is advised of the date that the surcharge was

placed at the time the paving plans are submitted. Removal of surcharge material is paid for as Class A excavation.

4-08.3 (1) (g) OBLITERATING ROADWAYS. Existing roadways beyond construction limits which are to be abandoned, and temporary roadways which do not become a part of the completed facility, are obliterated to at least the new right of way limits and to beyond the new right of way limits as required to improve appearance. Payment for removal of concrete pavement should be listed as "Removal of Improvements" on the plans for the obliteration. The removal of any bituminous pavement will be covered by the grading pay item used. Appropriate volume grading units are to be used for the obliteration. The quantities for the obliteration are noted and kept separate from the main roadway grading quantities or may be used in balancing the earthwork quantities in the job, provided the material is used within the shoulder embankment and is not greater than 24 inches [0.6 m] in size. All residual asphalt pavement must be covered from exposure and reinforced concrete rubble should not have protruding reinforcement. Linear grading should be used in special circumstances, such as median crossovers and connections to driveways for the obliteration where the grading quantities are within the limits of linear grading. A job special provision should be written to specify the contractor's responsibilities for the job.

4-08.3 (1) (h) ROCK FILL. See Subsection 4-09.5(1).

4-08.3 (1) (i) INCIDENTAL GRADING. Quantities for incidental grading for such items as entrances, ditch blocks, inlet and outlet ditches, levees, etc., are included in the grading quantities shown on the plans. An arbitrary quantity of Class A excavation amounting to 500 yd^3/mile [250 m^3/km] is added to the tabulation of volume grading quantities for rounding.

4-08.3 (1) (j) PLANS. The plans show complete quantities and other grading information as illustrated in Section 4-10. The plans show grading quantities by classification. The Class A excavation is further divided into roadway, borrow, channel change, roadway obliteration, etc. All Class A excavation is considered as one item in the estimate and in the contract. Care is exercised to insure that the grading quantities indicated on the plans are accurate and complete, since plan quantities are the basis of final payment, with certain exceptions.

4-08.3 (1) (k) GRADING PROJECTS SEPARATED FROM PAVING PROJECTS. On projects where the roadway grading and mainline paving are constructed with individual contracts, the subgrade elevation for the grading template should be designed to be built 0.1 ft. high. This provides the paving contractor the necessary thickness for fine grading operations prior to paving, and excess material for backfilling shoulders and dressing slopes. The appropriate use of Type B Berms and Slope Drains as described in Subsection 4-09.4(2) should be incorporated into the project.

4-08.3 (1) (l) TEMPORARY SHORING. Temporary shoring may be necessary where grade differences are encountered during construction and there is not adequate R/W to build a stable slope. These areas may include differing grades for bridge construction or MSE wall excavation, which will be indicated in the bridge memorandum, or raising the grade of a relocated roadway and other stage construction. The need for temporary shoring will be dependent upon the recommended slope found in the soil survey report. Temporary shoring pay item should only be used when temporary shoring is needed in a specific location and not as a precautionary measure. The District Soils and Geologist Technician and District Construction and Materials personnel should be involved in the decision to include temporary shoring in a contract. Contractors may opt to use different construction methods that may require more or less shoring than estimated by MoDOT. Temporary shoring is paid for as a lump sum item to avoid disputes over the exact quantity needed. Designers should estimate the surface area that will be needed in square feet [square meters] and indicate this area on the Summary of Quantities 2B sheet with a note "For Information Purposes Only".

4-08.3 (2) LINEAR GRADING. The linear unit for measuring roadway excavation quantities is used when grading is expected to be minimal. Linear grading can be used on plans for all systems, however linear grading should not be used for roadways built with a constructed base.

4-08.3 (2) (a) LINEAR GRADING CLASS 1. Class 1 consists of grading where the topography is such that the excavation necessary to bring the roadway to the designated cross section will approximately complete the nearby embankments with a minimum of drifting, and where it is not necessary to control the finished grade line for purposes other than to obtain minimum cover over culverts. Grades cannot be controlled except at culverts; therefore, profile grades are not shown on the plans. The estimated volume of the grading should be shown on the plans. If linear grading is used for construction of median crossovers or connections to driveways, a job special provision should be written to specify the contractor's responsibilities for the job.

4-08.3 (2) (b) LINEAR GRADING CLASS 2. Class 2 consists of grading where it is necessary to excavate and haul material approximately 200 feet [60 m] or greater to bring the roadway to the desired grade and may involve work on high banks and side hills. It is not the intent of this item to require the contractor to haul material across several hilltops or for unduly long distances. Grades can be controlled within 0.5 ft. [0.15m]. Profile grades are indicated on the plans by a dashed line in the vicinity of culverts, at sight distance controls, and at any other locations where it is necessary or desirable that this grading be performed to a controlled grade. Otherwise, profile grades are not shown.

When specifying Linear Grading, Class 2, the designer should show the estimated volume (yd^3 or m^3) of material to be placed or removed on the Summary of Quantities 2B sheet. Though this class of grading is paid for in units of stations or meters, the volumetric estimates allow the contractor to more accurately bid this work.

4-08.3 (2) (c) APPROACHES. Linear Grading, Class 1 can be used as a unit of measurement for grading approaches on plans for all systems within the limits of Class 1 and Class 2 Linear Grading. Measurement will be made to the nearest 10 feet [5 m] for each facility and totaled to the nearest 100 feet [25 m]. If grading quantities exceed Class 2 limits, Volume Grading is required and specified for approach construction. No attempt is made to adjust volume grading quantities where linear grading is used for grading approaches connecting to sections of the main roadway being graded by volume.

4-08.3 (2) (d) CLASSIFIED EXCAVATION. A limited quantity of excavation, such as Class C excavation, from the roadway can be paid for in addition to the linear grading in sections being graded by linear grading. In such cases, the plans indicate the quantity of classified excavation and a note is placed on the profile section of the plan-profile sheet to indicate the approximate location of the classified material. Undergrading cut is not usually specified where linear grading is used. Volume grading is used where it is necessary to undergrade cuts.

4-08.3 (2) (e) INLET AND OUTLET DITCHES. The construction of inlet and outlet ditches is included in the roadway linear grading if the excavation for the construction of the ditch does not exceed approximately 50 yd^3 [50 m^3] on either side. If the ditch excavation does exceed approximately 50 yd^3 [50 m^3], it is paid for by volume grading, and the quantities for the volume grading are indicated on the plans in addition to the linear grading quantities.

4-08.3 (2) (f) PLANS. Linear grading is shown on the plans by class and units consistent with the units specified in the standard specifications. Linear grading quantities for grading approaches are shown separately on the plans, but are combined with other linear grading quantities in the estimate and contract. Examples are shown in Section 4-10.

4-08.3 (3) SUBGRADE PREPARATION. This grading item is required for preparing a subgrade upon which a base course is to be constructed or a surfacing placed. No direct payment is made for this item and it is equally applicable for combination grading and paving projects, and for paving projects on a previously graded improvement.

4-08.3 (4) SUBGRADE SCARIFYING. This item is used to loosen the surface and to remove oversize rock from the roadbed. The plans show the locations to be scarified and the quantities are indicated on the plans in accordance with the units specified in the standard specifications. This item is intended for use primarily where an aggregate surfaced travel way is provided. Although this item is provided in the contract, it is performed

only by written order of the Engineer during construction.

4-08.3 (5) SUBGRADE COMPACTION. This grading item is used to insure an adequate subgrade for placement of a base or pavement and is used only in paving contracts on improvements which have been previously graded. Subgrade compaction 6 in. [150 mm] depth is provided in the paving contract for the full length of earth subgrade including cuts and fills. Although this item is provided in the contract, it is performed only by written order of the Engineer during construction.

4-08.3 (6) SUBGRADING AND SHOULDERING. This grading item, consisting of two classes, is used only for grading incidental to the construction of pavements on improvements which have been graded under a previous contract. This item is provided in addition to the required item of subgrade compaction. It provides for the fine grading and shaping necessary to complete the finished roadway. The quantity is measured along the centerline of pavement and includes both shoulders. Divided lane improvements require double quantities.

4-08.3 (6) (a) SUBGRADING AND SHOULDERING CLASS 1. This work consists of preparing the earth subgrade for the surfacing and shoulders by fine-grading, and shaping the existing roadbed of a previously graded roadway, and shaping fillslope, foreslope, and ditches as required to complete a finished roadway conforming to the typical section.

4-08.3 (6) (b) SUBGRADING AND SHOULDERING CLASS 2. This item includes all work included in Subgrading and Shouldering, Class 1 and also includes the construction and final shaping of earth shoulders.

4-08.3 (7) SHAPING SHOULDERS. This item is not described in the Standard Specifications. For grading and shaping existing shoulders for resurfacing and widening, and widening shoulders beyond the prevailing width of the roadbed, volume grading should be used. If the work is minor in scope, Linear Grading, Class 1 may be used or the grading may be considered incidental to the other pay items. The shoulder to be constructed is shown on the typical section. If ditch work is contemplated in connection with the work of shaping shoulders, the required ditch typical section must be shown on the plans. Shouldering by maintenance forces on resurfacing projects will not be permitted. Shaping shoulders generally involves relatively small quantities of excavation or fill, which results in an exceptionally high shrinkage factor. A shrinkage factor of 200 percent or more is not uncommon in estimating the volume of material required.

Linear Grading, Class 1 may be used for those work locations where an aggregate shoulder is to be provided and where only a very minimum of shoulder work is necessary. For those areas, the only work necessary would be that of mowing the existing shoulder, scalping existing vegetation, or such minimal grading to prepare for the placing and compacting of the aggregate. The method of measurement and payment of aggregate base specified for the shoulder will be made to the nearest square yard [m^3] of aggregate material placed on the shoulder.

4-08.3 (8) SHAPING SLOPES. This item is used for grading and shaping slopes on resurfacing projects where stabilized shoulders exist and the resurfacing includes the shoulder. This item is not intended to be used for major reconstruction of slopes, ditches, or shoulders. The shaping is to eliminate the abrupt drop-off at the shoulder edge resulting from the resurfacing, and to dress up the slopes from an appearance and safety view point. A separate measurement is made of each side measured along the centerline of the travel way. Shaping Slopes, Class I is specified on the plans where the material required to bring the roadway to the designated cross section can be obtained or disposed of within an approximate distance of 1000 feet [300 m] on the right of way. Shaping Slopes, Class II is specified where it may be necessary to haul outside the limits of Shaping Slopes, Class 1 or where it is necessary to go outside the limits of the right of way for additional material to construct the slopes to the designated cross section or to dispose of excess material outside the limits of the right of way. Contract quantities are used for payment thus requiring careful consideration of the specified type and accurate indicating of the respective type on the plans.

4-08.3 (9) PLANS. All quantities of linear grading and other grading items with linear measurements are indicated on the plans in units consistent with the units of measurement specified in the standard specifications. Examples are shown in Section 4-10.

4-08.4 COMPACTION. Compaction quantities are computed in accordance with the methods given in the standard specifications. Three types of compaction are provided:

- Compaction of embankments and treatment of cut areas with moisture and density control
- Compaction of embankments not constructed with density or moisture and density control
- Compaction of embankments without specified compaction results or equipment.

Backfill placed in undergrading areas is compacted while that placed in over-break areas is not compacted.

4-08.4 (1) COMPACTION WITH MOISTURE AND DENSITY CONTROL. Roadways built with a constructed base will require moisture and density control and the contract should provide for the pay items of compacting embankment and compacting in cut as required. Compaction should be measured and paid in accordance with Sec 203 of the Standard Specifications. Compacting in cut should not be specified for areas within the limits of Class C excavation. Under the moisture and density control specification, 90 percent compaction is required for all embankments, all backfilled undergraded cuts, and certain portions of the roadbed cuts, except the following:

- Surcharges above the specified compaction area
- Excess material placed on side slopes of fills
- Berms
- Filling old channels
- Excess material disposal areas or similar areas
- Embankments constructed of rocky embankment materials.

Ninety-five percent compaction is required for:

- The upper 18 in. [460 mm] of the embankment full width between roadbed slopes where a flexible type surface is proposed
- For roadway embankment within 100 ft. [30 m] of each end of a structure on which the top slab or deck is to be used as the riding surface
- For the spill fill under such a structure
- Any portion of an embankment below an elevation 50 ft. [15 m] beneaththe top of the finished subgrade.

All material placed in accordance with Section 203.3 of the standard specifications is included in the measurement of compacting embankment, including Class C excavation and unclassified excavation. Compacting embankment also includes the compacting of the backfill in undergraded cuts. Rock fill for embankment protection, Sec 214 of the standard specifications, is not included in the measurement of compacting embankment.

4-08.4 (2) COMPACTION NOT CONSTRUCTED WITH DENSITY OR MOISTURE AND DENSITY CONTROL. Roadways requiring a processing aggregate surface treatment shall be compacted not requiring moisture and density control and shall be specified in the contract to be compacted in accordance with Sec 203.4 of the standard specifications. No direct payment will be made for compaction under this specification.

4-08.4 (3) COMPACTION WITHOUT SPECIFIED COMPACTION RESULTS OR EQUIPMENT. When no compaction is designated by the contract, no compaction will be required other than that obtained by distributing equipment movements over the entire fill area. Compaction for berms, filling old channels outside roadway limits, excess or similar areas, and for any roadway or approach for which a granular type surface is proposed will require this method of obtaining compaction.

4-08.4 (4) PLANS. The plans do not separate compaction quantities by required densities. The plans do show separate quantities for compacting in cut and compacting embankment. The plans should include quantities for compaction of material used to replace undergrading and overbreak areas within the roadway limits. The contract must designate which roadways are to receive which type of compaction when more than one type is involved on a given project.