DIVISION II
CONSTRUCTION DETAILS

20 CLEARING

20-1.1 Description. This item shall consist of clearing the areas designated by the engineer including outlook points and clear vision areas, which work shall include clearing the ground of all trees, brush, shrubs and other vegetation, down timber, rotten wood, rubbish and other objectionable material, removing fences and old or incidental structures, salvaging such of these materials as hereinafter required or designated by the engineer, and burning or otherwise disposing of the spoils as directed by the engineer; excepting, however, such living trees, within the area designated for clearing but outside the roadbed, which the engineer may order to be left standing. All work under this item shall be done in accordance with these specifications and in conformity with the plans.

-3.1 Construction Methods. The highway must be cleared on each side of the center line of the road to the full width indicated on the plans, or staked by the engineer. No trees, unless specifically designated, shall be cut down outside the limits of the roadway, except: (1) in clearing for borrow pits and selected outlook points; or (2) when the designed sight distance for motor vehicle drivers cannot be secured by cutting off the lower branches of such trees, and then only as directed by the engineer. Upon written order in connection with specific stretches of road where the engineer desires that the forest cover be cut or thinned to let in sunlight, the contractor shall cut such trees outside the limits of the roadway as directed in accordance with such written order. All trees left on the highway shall be properly trimmed as necessary to avoid interfering with the required sight distance. Branches of trees overhanging the area to be occupied by the surfacing and shoulders, shall be cut and properly trimmed to maintain a clearance height of 14 feet above the entire road bed surface.

-3.2 The contractor as required under Article 8.3 shall protect from injury or defacement any trees or other vegetation which the engineer may indicate for preservation. Such trees will be clearly marked by the engineer.

-3.3 All standing material that is to be removed shall be cut off at a height not more than 3 feet above the ground, provided, however, that in any areas where clearing is required but grubbing is not required, all such standing material shall be cut off as close to the ground as is practicable but not to exceed 12 inches above the ground.

-3.4 Timber cut from the highway when through Government land may be utilized for constructing drainage or other structures and for camp purposes, provided authorization in writing is obtained from the Federal service responsible for the area within which the road is being constructed. In the event that timber for these purposes is not available on the highway the contractor may secure the necessary timber free of cost, if available, under proper authorization from the appropriate Federal service. Conditions covering the cutting and removal of timber and the disposal of brush and refuse will be contained in such authorization. The contractor shall request such authorization in due season and, if it be granted, shall be governed by the terms thereof.

-3.5 All timber which is to be cut shall be felled in the highway, toward the center of the area to be cleared where feasible, or as ordered in writing by the engineer. Where trees cannot be felled without danger to traffic or injury to other trees, structures or property, they shall be cut down in sections from the top down, in an approved manner.

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-3.6 (a) When required by the National Forest supervisor or by the appropriate National Park officer, merchantable portions of the trees to be cut shall be cleared of limbs and tops and sawed into suitable log lengths and neatly piled along the highway, separately from the piles to be burned, as directed. All timber from which saw-logs, pulpwood, piles, posts, poles, ties or cordwood can be made shall be considered as merchantable timber. The contractor will not be required to cut merchantable timber into less than 10-foot lengths.

(b) Locust or cedar trees, if encountered in the clearing, shall be trimmed, and barked in the case of locust, and cut into 18 or 10-foot lengths and stored off the ground where directed by the engineer, provided the individual lengths have a minimum dimension of 6 inches under the bark. As many lengths shall be cut from each tree as possible,

(c) Excepting said merchantable timber and large logs or stumps which in the opinion of the National Forest supervisor or the appropriate National Park officer cannot be burned or advantageously piled, all timber after felling, and all other down timber, dead trees and stumps, together with all brush, roots, duff, rotten wood and other debris, which protrudes into the cleared highway, shall be placed in piles in such manner as to be consumed completely when fired. In case the burning is to precede the construction operations the piles may be placed in the center of the highway, otherwise, the piles shall be located in the most convenient place at the side of the highway and beyond the fill slopes, where the burning will not cause damage to the surrounding forest cover. The piles shall not be higher than approximately 5 feet nor wider than approximately 9 feet.

(d) All the above clearing and piling operations shall be done before excavation is started. All the piles resulting from the clearing except those intended for merchantable lumber, unless otherwise ordered by the engineer, shall be burned by the contractor. All burning shall be done at such times and in such manner as not to scorch or injure live trees or other surrounding vegetation and to prevent the fires from spreading. The contractor shall either burn debris in small piles so as to eliminate the hazard to surrounding vegetation or remove it before burning to locations which eliminate the hazard.

-3.7 (a) The contractor shall furnish sufficient men in the judgment of the engineer properly to patrol all burning, day and night, both during actual burning and for at least two days after the fires are extinguished. Burning at any one time shall be restricted to a distance of 800 feet front. Pumping equipment and hose, if required by the engineer, shall be available at the site during all burning operations and the contractor shall be responsible that an adequate supply of water is secured.

(b) The contractor shall notify the engineer a sufficient time in advance of all burning in order that the National Forest supervisor or the appropriate National Park officer may advise the engineer what precautions need be taken to safeguard the burning and prevent forest fires.

(c) All burning shall be done under the provisions hereinbefore given in Article 8.3 as amplified by any existing regulations of the Federal service in which the work is located; all such regulations, duly promulgated, shall govern the same as though contained herein. In case burning is discontinued either for fire prevention or for other reasons, the contractor shall make such temporary disposal of the material on the ground as the engineer may indicate; any subsequent moving of the material by order of the engineer to complete the burning will be paid for as extra work.

-3.8 (a) At the discretion of the engineer a "preliminary" clearing may be required in order to prevent premature destruction of trees or other vegetation which might be found unnecessary when the nature of the underground materials is disclosed during the excavation operations or where, because of other contingencies, the final boundary of clearing is in doubt until the slope angle of repose of the materials encountered in cuts or used in fills is finally determined by the engineer. In such cases the engineer shall designate the boundary of such "preliminary" clearing so as to effect the above purpose and the contractor shall not clear beyond such boundary until the precise limits of final clearing are determined and fixed by the engineer.

(b) Where such "preliminary" clearing is ordered by the engineer, and after the due completion of excavation and embankment operations the contractor shall complete the clearing to the final boundary designated by the engineer, in appropriate sequence with other operations as directed.

(c) Specimen trees and shrubs of value to the appearance of the road, and coming within the fill slopes up to such height as would cover the trunks to a depth of 5 feet, shall be left when directed by the engineer. These trees shall be protected by tree wells or otherwise as directed by the engineer and any special protection work shall be paid for under the proper item within the specifications or as "extra work" if no such item is specifically provided for in the contract.

(d) Where directed by the engineer as required in Article 8.3, all trees remaining within an area designated to be cleared shall be left as a protective screen for surrounding vegetation during blasting operations and shall not be removed until blasting has been completed.

-4.1 Method of Measurement. (a) The area of "clearing" to be paid for shall be the number of "clearing units" of area laid out as hereinbelow required which have been cleared and accepted as meeting these specifications. Each "clearing unit" shall be a rectangle of ground 50 feet in length in direction parallel to the center line of the road and 20 feet in width, measured horizontally; these units shall be laid out contiguously with corners at even stations or half stations, beginning at the center line of the road and proceeding outward to the boundary of "clearing" fixed by the engineer.

Where equations of center line stationing occur the tier of clearing units necessarily affected shall be counted as complete 1,000 foot units except when they are of less than 200 square foot area. In the case of center line curvature the layout and the units shall be conformed thereto, but shall not otherwise be changed save that the lines at stations and half stations normal to the center line shall be used as bounding lines between successive units, and units of greater or less than 1,000 square foot area thus created shall be treated and considered as normal units each payable at the contract unit price bid, provided however that any unit of less than 200 square foot actual area shall be disregarded so far as inclusion in payment quantity is concerned. The engineer will determine the boundary or boundaries of the area or areas to be cleared, and he will determine, station by station, the number of "clearing units" for which payment is to be made and total the number of units.

(b) No "clearing unit" will be included in the pay summation, if such unit involves only removal of light brush, shrubs, heavy grass, and other vegetation that can be cut with a brush scythe or mowing machine, but such removal shall be done by the contractor at his expense, and compensation therefor will be considered as work subsidiary to, and in effect paid for under, "Roadway and Drainage Excavation" or "Borrow."

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(c)e If any clearing, for which payment is to be made exists withine any "clearing unit," the entire area of that unit shall be allowed as the basis for payment. Should the boundary line of any unit intersect a single tree, it shall not be counted as another unit if there is any clearing to be paid for in the adjacent unit.

-5.1 Basis of Payment. The number of "clearing units," determined ase provided above, shall be paid for at the contract unit price per clearing unit bid for "Clearing," which price and payment shall constitute full compensation for all labor, equipment, tools and incidentals necessary to complete the item.

21 GRUBBING

21-1.1 Description. This item shall consist of grubbing the areas designated by the engineer including outlook points and clear vision areas, which work shall include removing from the ground all stumps, roots and pole stubs more than three inches in diameter and all brush, matted roots and debris, removal of which is not prescribed in the item "Clearing," and burning or otherwise disposing of the spoils as directed by the engineer, all in accordance with these specifications and in conformity with the plans.

-3.1 Construction Methods. (a) Where, within any "unit" designated fore "grubbing," excavation will be less than 3 feet in depth, all stumps, roots and other objectionable material as described above, shall be removed and heavy grass and heavy vegetation shall be cleared from the surface of the ground before excavation is started. Any grubbed holes occurring in shallow excavation areas shall be backfilled with suitable material and thoroughly compacted. All stumps and roots shall be removed and disposed of without damage to adjacent property.

(b) Within the areas where embankments are to be made, all stumps, roots, embedded wood or vegetable matter, including duff and other objectionable material, shall be grubbed or blasted from the ground and completely removed, excepting that where the embankment is to be three feet or more in height trees and stumps shall be cut off as close to the ground as is practicable, but not to exceed 12 inches from the ground surface; providing further, that no portion of any stump or tree shall be left extending nearer than two feet to any subgrade or slope surface.

(c)e No perishable material such as leaves, stumps, roots, trunkse or limbs of trees or brush, shall remain within the clearing or grubbing limits or be incorporated or embedded within the embankments. All depressions made below the surface of the ground for or by the removal of stumps and roots shall be refilled with suitable material to ground elevation and compacted before the construction of an embankment is started over such depressions.

-3.2 All the products resulting from grubbing shall be burned or otherwise disposed of as directed by the engineer. All burning shall be done under the direction of the engineer at such times and at such locations as will not cause injury to live trees or other vegetation adjacent to the grubbed area, and to prevent fires from spreading. All the requirements as to burning and fire prevention prescribed and inferred in the item "Clearing" shall prevail equally for this item insofar as they apply. In case burning is discontinued either for fire prevention or for other reasons the contractor shall make such temporary disposal of the material on the ground as the engineer may indicate;

any subsequent moving of the material by order of the engineer to complete the burning will be paid for as extra work.

-4.1 Method of Measurement. (a) The area of "grubbing" to be paid for shall be the number of "grubbing units" of area laid out as hereinbelow required which have been grubbed and accepted as meeting these specifications. Each "grubbing unit" shall be a rectangle of ground 50 feet in length in direction parallel to the center line of the road and 20 feet in width, measured horizontally; these units shall be laid out contiguously with corners at even stations or half stations, beginning at the center line of the road and proceeding outward to the boundary of "grubbing" fixed by the engineer. Where equations of center line stationing occur the tier of clearing units necessarily affected shall be counted as complete 1,000 foot units except where they are of less than 200 square foot area. In the case of center line curvature the layout and the units shall be conformed thereto, but shall not otherwise be changed save that the lines at stations and half stations normal to the center line shall be used as bounding lines between successive units, and units of greater or less than 1,000 square foot area thus created shall be treated and considered as normal units each payable at the contract unit price bid, provided however that any unit of less than 200 square foot actual area shall be disregarded so far as inclusion in payment quantity is concerned. The engineer will determine the boundary or boundaries of the area or areas to be grubbed, and he will determine, station by station, the number of "grubbing units" for which payment is to be made and total the number of units.

(b) No "grubbing unit" will be included in the pay summation if such unit involves only removal of stumps or other material less than 3 inches in diameter, measured 6 inches above the ground, nor where the entire ground surface constituting the particular "unit" is to be excavated 3 feet deep or more, but any grubbing in cases so excluded shall be done by the contractor at his expense and compensation therefor will be considered as work subsidiary to and in effect paid for under "Roadway and Drainage Excavation" or "Borrow."

(c) Grubbing work including stumps or material of less than 3 inches in diameter is not to be included in any payment except as such work may occur in units otherwise included for payment. Stumps, regardless of height as encountered, which are to be cut off near the ground line shall not be included in grubbing but shall be paid for as "Clearing," as provided in the item for "Clearing."

(d) If any grubbing, within the definition for payment, exists within any "grubbing unit," the entire area of that unit shall be allowed as the basis for payment. Should the boundary line of any unit intersect a single stump, it shall not be counted as another unit if there is any grubbing to be paid for in the adjacent unit. Should part of a unit contain grubbing and the remainder contain clearing, the entire area of such unit shall be allowed for both clearing and grubbing payments. Hence "clearing units" and "grubbing units" shall be counted independently.

-5.1 Basis of Payment. The number of "grubbing units," determined as provided above, shall be paid for at the contract unit price per grubbing unit bid for "Grubbing," which price and payment shall constitute full compensation for all labor, equipment, tools and incidentals necessary to complete the item.

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22 SELECTIVE REMOVAL OF TREES

22-1.1 Description. This item shall consist of removing certain trees where called for on plans, or marked by the engineer, outside of areas designated for clearing and grubbing, and shall include cutting such trees, removing their stumps and roots from the ground, and properly burning or otherwise disposing of the material in the manner required under "Clearing." This item may include leaning and dangerous trees and "snags" which in the opinion of the engineer are a hazard to traffic.

-3.1 Construction Methods. The trees shall be cut and disposed of as specified under the item for "Clearing" in these specifications.

The stumps, roots and debris shall be removed and disposed of as specified under the item for "Grubbing" in these specifications.

-4.1 Method of Measurement. The number of trees to be paid for shall be the actual number of trees, removed as ordered, of the several sizes as called for in the Bid Schedule.

The size of trees will be determined by the average diameter of the tree trunk measured at a point 4 feet above the ground line at the base of the tree.

-5.1 Basis of Payment. The number of trees of the several sizes, determined as provided above, shall be paid for at the contract unit price each bid for "Selective Removal of Trees" of the several sizes, as the case may be, which price and payment shall constitute full compensation for removing the selected trees, for removing all trees and vegetation less than 4 inches in diameter ordered removed by the engineer in connection therewith and for all labor, equipment, tools and incidentals necessary to complete the item.

The size designation under which each tree will be paid for will be determined in accordance with the following schedule of sizes:

Size of trees	Pay name
Diameter	Trees of
4-inch to 8-inch	"6-inch size"
8-inch to 12-inch	"10-inch size"
12-inch to 24-inch	"18-inch size"
24-inch to 36-inch	"30-inch size"
36-inch and over	"36-inch size"

23 STRIPPING AND STORING TOPSOIL

23-1.1 Description. This item shall consist of removing topsoil from selected portions of the areas indicated on the plans or directed by the engineer, transporting and depositing it in storage piles at locations designated by the engineer in accordance with these specifications.

-3.1 Construction Methods. The plans indicate the survey stations and the stripping limits from which topsoil may be required to be removed. Between these survey stations and within these limits the contractor shall remove topsoil over such areas and to such depths as the engineer may direct. No stripping of topsoil over any designated area shall be less than 6 inches in depth. Where

topsoil is to be removed from areas which have to be cleared and grubbed, the clearing and grubbing shall be done before the topsoil is removed. The topsoil so removed shall be transported and deposited in storage piles at locations designated by the engineer beyond the slope stakes.

The topsoil shall be kept separate from other excavated materials and shall be completely removed to the required depth from any designated area prior to the beginning of regular excavation or embankment work in the area. If topsoil is removed to a greater depth than directed by the engineer, payment will be made only for the amount of topsoil directed to be removed.

-4.1 Method of Measurement. The yardage to be paid for shall be the number of cubic yards of topsoil stripped, stored and accepted, computed from the actual stripped area from which the soil has been completely removed to such depths as designated, except that no payment will be made for topsoil removed to a greater depth than designated.

-5.1 Basis of Payment. The yardage, determined as provided above, shall be paid for at the contract unit price per cubic yard bid for "Stripping and Storing Topsoil" which price and payment shall constitute full compensation for removing the soil to such depths as ordered, transporting and depositing it to the designated storage piles and for all labor, equipment, tools and incidentals necessary to complete the item, except "Overhaul."

24 ROADWAY AND DRAINAGE EXCAVATION

24-1.1 Description. This item shall consist of excavating and grading the roadway including the gutters, removing and suitably disposing of all structures that obtrude, encroach upon or otherwise obstruct the roadway or the work and the final disposal of all materials taken from within the limits of the roadway not disposed of under the items "Clearing" or "Grubbing" or under other items as specifically provided therein; this disposal work shall include, but not be limited to, all work involved under "Embankments," "Foundation Fill," "Bedding and Backfill for Pipe Culverts," "Subgrade," "Shoulders" and "Rounded and Transition Slopes," all as prescribed in the detail specifications therefor, and this item shall be performed in accordance with these specifications and in conformity with lines, grades and dimensions shown on the plans. This item shall also include all excavation, as above prescribed, in connection with extra width and parking areas, ditches, intersections, approaches and private entrances.

-1.2 This item shall include the performance of any clearing and grubbing work not covered under "Clearing" or "Grubbing" and shall include the backfilling of all stump holes and the correction of all surface irregularities, as directed, in the area between the roadway slope lines and the designated outside boundary of "Clearing."

-1.3 Classification. (a) All material excavated shall be paid for as "Unclassified Excavation" unless in the Bid Schedule prices are asked and bid for "Solid Rock Excavation" and "Common Excavation."

(b) Unclassified excavation shall include all excavation performed under this item regardless of the material encountered, provided, however, that in projects where deemed more practical the plans will arbitrarily divide the project into appropriate sections or units; the excavation yardage in each section will then be identified as "Unclassified Excavation, Unit A," or

"Unclassified Excavation, Unit B," etc., all as set forth on the project plans and Bid Schedule, and will be paid for at the price or prices bid specifically for the several units.

(c) Solid rock excavation, when this classification is provided for in the contract, shall consist of the removal and disposal of boulders, one-half cubic yard in volume or greater, and of all hard rock found in place which, in the opinion of the engineer, can only be removed by blasting.

(d) Common excavation, when this classification is provided for in the contract, shall consist of all excavation under this item not included in solid rock excavation.

-3.1 Construction Methods. All suitable materials removed from the excavation shall be used as far as practicable in the formation of the embankment, subgrade, shoulders, slopes, bedding and backfill for culverts and at such other places as directed. No excavated material shall be wasted without written permission, and when such material is to be wasted it shall be disposed of under the direction of the engineer as prescribed under "Disposal of Surplus Material." No payment will be made for the excavation of any material which is used for purposes other than those designated. During the construction of the roadway the roadbed shall be maintained in such condition that it will be well drained at all times. Side ditches or gutters emptying from cuts to embankments or otherwise shall be so constructed as to avoid damage to embankments by erosion.

-3.2 Any boulders or excavated rock too large to be placed in the embankment shall be hauled elsewhere and disposed of as directed by the engineer. Any rock or ledge encountered in the roadbed excavation shall be removed to a depth of nine inches below the proposed subgrade surface and backfilled as hereinafter required under "Subgrade," or under "Finishing Earth Graded Roads."

-3.3 For all embankments which are adjacent or parallel to streams, it shall be required that coarse rock from the excavation shall be conserved and used for constructing the embankments on the stream side. No additional compensation will be allowed because of this requirement, save the payment of any "Overhaul" involved.

-3.4 (a) During the progress of the excavation, material taken from the cuts and suitable for subgrade "Cushion" or for road finishing shall be saved and utilized for those purposes as directed by the engineer. Where directed, suitable topsoil material shall be conserved in the normal operation and used in covering embankments for the purpose of facilitating regrowth of vegetation. No extra payment will be made or allowed for conserving such "Cushion" material or for such "Topsoil" material or for the utilization thereof save the payment of any "Overhaul" involved, provided however, that if the contract contains the pay item for topsoil, any such topsoil conserved as above required shall be included in the pay yardage of such topsoil pay item.

(b) The yardage of material from any cuts used for any of the purposes permitted under Article 4.8 will be deducted from the yardage of excavation to be used in determining the "Overhaul" to be paid for, where "Overhaul" is or would be required for the material from such cuts used in roadway embankment. For computation of such deductions for "Overhaul" purposes only it will be assumed that one cubic yard of excavation will be required for each two tons of crushed stone or gravel surfacing.

(c) Where the general appearance of the surrounding landscape will not be marred or adversely affected, the engineer may authorize the widening of roadway section through cuts where suitable rock is found beyond the lines called

for on the typical cross sections in order to permit the contractor to obtain suitable material for stone or other surfacing to be used in the contract. Where such widening is authorized, no payment will be made for excavation beyond the lines shown on the typical cross section. When such widening is authorized, it shall be done on neat regular lines, and after quarrying is completed, the area shall be neatly trimmed up to lines that will conform to the surrounding landscape and so left that it will drain at all places.

-3.5 Stream Obstruction. Material deposited in any stream channel which in any way whatsoever obstructs or impairs the flow of the stream, thus endangering the roadway or stream bank, shall be removed as directed by the engineer and at the contractor's expense.

-3.6 Ditches. Ditches shall be interpreted to mean roadway ditches and gutters, changes in channels of streams, inlet and outlet ditches to culverts and other structures, and ditches parallel to or in connection with the roadway, but beyond the limits of the roadway section as constructed, whether the excavation is dry or wet. Roadway gutters shall be cut accurately to cross section and grade as governed by the plans. Care shall be taken not to excavate gutters below the grade contemplated and the engineer may order any such places brought to grade with suitable stone or cobble to form an adequate gutter paving. The material excavated from all ditches and channel changes within 50 feet of the center line shall be used in the embankments if the engineer so directs. No excavation or spoil from a ditch shall be deposited or left within 3 feet of the edge of the ditch unless otherwise shown on the plans or ordered in writing by the engineer. All roots, stumps, and other foreign matter in the sides and bottom of the ditch shall be cut to conform to the slope, grade and shape of the section shown. The contractor shall maintain and keep open and free from leaves, sticks, and other debris all ditches dug by him until final acceptance of the work.

-3.7 All earth slopes not otherwise specifically provided for under "Rounded and Transition Slopes" shall be finished on neat regular lines that will conform naturally to the surrounding terrain. The work shall be done in proper sequence with the other operations involved. The degree of smoothness of finish shall be that normally obtainable from hand shovel labor operations. A hand-raked sandpaper finish is not intended.

-4.1 Method of Measurement. The yardage to be paid for shall be the yardage, measured in original position by the method of average end areas, of material acceptably excavated as hereinabove prescribed. The cross sectional area measured shall not include water or other liquid but shall include mud, muck or similar semisolid material which has not been disturbed by the contractor and which cannot be drained away. The measurement shall include overbreakage or slides in common or unclassified excavation, not attributable to carelessness of the contractor and authorized excavation of solid rock below grade, and also of soft and spongy spots below grade. The measurement shall include overbreakage of unclassified excavation, unavoidable in the opinion of the engineer, to be paid for at the unclassified price. The measurement shall also include unavoidable overbreakage occurring in solid rock whether the contract calls for classified or unclassified excavation to an amount not to exceed in any half-station of 50 feet, 10 percent of the actual quantity required for the same half-station within the lines shown on the plans. The measurement shall also include the volume of loose scattered rocks or boulders collected from the ground within the limits of the highway as directed.

-5.1 Basis of Payment. The yardage, measured as provided above, shall be paid for at the contract unit prices per cubic yard bid for "Unclassified Excavation," "Solid Rock Excavation," or "Common Excavation," as the case may be, which prices and payments shall constitute full compensation for the excavation and

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hauling, and also for the formation and the compaction of embankments, bedding and backfill for culverts, any "imperfect trench" backfilling required by the plans, any incidental clearing and grubbing work involved but not intended to be paid for under "Clearing" or "Grubbing," disposing of surplus structures and materials, preparation and completion of subgrade, shoulders, and rounded and transition slopes, and for all labor, equipment, tools and incidentals necessary to complete the item, except "Overhaul."

25 EXCAVATION FOR STRUCTURES

25-1.1 Description. This item shall consist of excavating foundations for culverts, bridges, and all other structures where not otherwise prescribed, and shall include the final disposal of all material obtained from such excavation in Backfill for Structures other than pipe culvert or as provided in the items "Embankment" or "Bedding and Backfill for Pipe Culverts" or otherwise and all work necessary or incidental thereto. It shall include all necessary bailing, draining, sheeting, bracing, and the construction of cribs or cofferdams if found necessary. The material shall be disposed of in such manner as not to obstruct the stream or otherwise impair the efficiency or appearance of the structure or other parts of the work.

No allowances will be made for classification, regardless of the material encountered, unless required by the Special Provisions.

-3.1 Construction Methods. The contractor shall notify the engineer a sufficient time in advance of the beginning of excavation for structures, so that the cross-sectional elevations and measurements may be taken of the undisturbed ground. Any materials removed or excavated before these measurements have been taken will not be paid for. The natural ground adjacent to the structure shall not be disturbed without permission of the engineer.

-3.2 Trenches or foundation pits for structures or structure footings shall be excavated to the lines and grades or elevations shown on the plans or as staked by the engineer. They shall be of sufficient size to permit the placing of the full width and length of structure or structure footings shown. The elevations of the bottoms of footings, as shown on the plans, shall be considered as approximate only and the engineer may order, in writing, such changes in dimensions or elevations of footings as may be deemed necessary to secure a satisfactory foundation.

-3.3 All excavated material, so far as suitable, shall be utilized as backfill or embankment. The surplus material, whether or not temporarily allowed to be placed within the stream area, shall be disposed of finally in such manner as not to obstruct the stream or otherwise impair the efficiency or appearance of the structure. No excavated material shall be deposited at any time so as to endanger the partly finished structure, either by direct pressure or indirectly by overloading banks contiguous to the operation, or other manner.

-3.4 Boulders, logs, or any other unforeseen obstacles encountered in excavation shall be removed. All rock or other hard foundation material shall be cleaned of all loose material and cut to a firm surface, either level, stepped, or serrated, as directed by the engineer. All seams or crevices shall be cleaned out and grouted. All loose and disintegrated rock and thin strata shall be removed. When masonry is to rest on an excavated surface other than rock, special care shall be taken not to disturb the bottom of the excavation and the final removal of the foundation material to grade shall not be made until just before the masonry is to be placed, except as hereinafter provided under "Foundation Fill." Where foundation piles are used the excavation of each pit shall be completed before the piles

are driven. After the driving is completed all loose and displaced material shall be removed, leaving a smooth solid bed to receive the masonry.

-3.5 Cofferdams. (a) Suitable and practically water-tight cofferdams shall be used wherever water-bearing strata are encountered above the elevation of the bottom of the excavation. Upon request the contractor shall submit drawings showing his proposed method of cofferdam construction and other pertinent features not shown in detail on the plans. Such drawings shall be approved by the engineer before construction is started, but such approval shall not operate to relieve the contractor of any of his responsibility under the contract for the successful completion of the improvement.

(b) Cofferdams or cribs for foundation construction shall, in general, be carried well below the bottom of the footings and shall be well braced and as water-tight as practicable. In general, the interior dimensions of cofferdams shall be such as to give sufficient clearance for the construction of forms and the inspection of their exteriors, and to permit pumping outside of the forms. Cofferdams or cribs which are tilted or moved laterally during the process of sinking shall be righted or enlarged so as to provide the necessary clearance and this shall be at the expense of the contractor.

(c) When conditions are encountered which, in the opinion of the engineer, render it impracticable to unwater the foundation before placing masonry, he may require the construction of a concrete foundation seal of such dimensions as may be necessary, and of such thickness as to resist any possible uplift; concrete for such seal shall conform to all the special requirements for "Depositing Concrete under Water." The foundation shall then be pumped out and the balance of the masonry placed in the dry. When weighted cribs are employed and the weight utilized to overcome partially the hydrostatic pressure acting against the bottom of the foundation seal, special anchorage such as dowels or keys shall be provided to transfer the entire weight of the crib into the foundation seal. When a foundation seal is placed under water, the cofferdam shall be vented or ported at low-water level as directed.

(d) Cofferdams shall be constructed as to protect green concrete against damage from sudden rising of the stream and to prevent damage to the foundation by erosion. No timber or bracing shall be left in cofferdams or cribs in such a way as to extend into the substructure masonry, without written permission from the engineer.

(e) Any pumping from the interior of any foundation enclosure that may be permitted shall be done in such a manner as to preclude the possibility of any portion of the concrete materials being carried away. No pumping will be permitted during the placing of concrete, or for a period of at least 24 hours thereafter, unless it is done from a suitable pump separated from the concrete work by a water-tight wall. Pumping to unwater a sealed cofferdam shall not commence until the seal has set sufficiently to withstand the hydrostatic pressure.

(f) Unless otherwise provided, cofferdams or cribs with all sheeting and bracing involved therewith shall be removed by the contractor after the completion of the substructure. The removal shall be effected in such manner as not to disturb or mar the finished masonry.

-3.6 Approval. After each excavation is completed, the contractor shall notify the engineer, and no masonry shall be placed until after the engineer has approved the depth of the excavation and the character of the foundation material.

-3.7 Backfilling. After the structure has been completed, the backfilling shall be performed as required under "Backfill for Structures other than Pipe

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Culverts" or under"Bedding and Backfill for Pipe Culverts" as the case may be.

No backfilling shall be placed against any abutment, wing wall or culvert until permission shall have been given by the engineer. In the case of concrete or other masonry such permission will preferably not be given until the masonry has been in place 21 days, or until tests made by the laboratory under the supervision of the engineer establish that the concrete has attained sufficient strength to withstand any pressures created by the methods used and materials placed without damage or strain beyond a safe factor. Adequate provision shall be made for thorough drainage and drains shall be placed at weep holes.

-4.1 Method of Measurement. The yardage to be paid for shall be the number of cubic yards, measured in original position, of the material acceptably excavated as hereinbefore prescribed, except that, unless such excavation is ordered in writing, no yardage shall be included of excavation outside of a volume bounded by vertical surfaces, 18 inches outside the neat footings and parallel thereto. The cross sectional area measured shall not include water or other liquid but shall include mud, muck or similar semisolid material which has not been disturbed by the contractor and which cannot be drained away.

Yardage of rehandling shall not be included, provided however that in cases of culverts where the fill is required by the engineer to be made prior to the installation, thus involving the re-excavation of a trench in such fill, the yardage of such trench, measured in the compacted fill, shall be included in the pay yardage and paid for under this item. No other compensation shall be due for the "Bedding and Backfill for Pipe Culverts" including any "imperfect trench" backfilling required. No specific compensation shall be due for any backfill except for "Foundation Fill" ordered as such in writing.

-5.1 Basis of Payment. The yardage, measured as provided above, shall bee paid for at the contract unit price per cubic yard bid for "Unclassified Excavation for Structures" which price and payment shall constitute full compensation for all excavation, for furnishing, placing, moistening and compacting backfill material, as required, for disposing of surplus structures and surplus material, for any clearing and grubbing work involved but not intended to be covered under "Clearing" or "Grubbing," for all bailing, draining and sheeting for the construction of cribs or cofferdams, unless otherwise provided, for furnishing all materials, and for all labor, equipment, tools and incidentals necessary to complete the item; provided, however, that in the case of bridges when it is found necessary to carry footings more than 5 feet below the lowest elevation shown on the plans, such excavation shall be paid for under a "Change Order" or under an "Extra Work Order."

The payment as provided above shall be considered to cover all work described under the item "Special Disposal of Designated Material," except where the Bid Schedule and contract contain a quantity and unit price for "Special Disposal of Designated Material."

26 BORROW

26-1.1 Description. This item shall consist of excavating and disposinge in embankments and backfills as directed, of approved material obtained from borrow pits designated, staked and measured by the engineer, and the final disposing of over-burden or other spoil material not disposed of under the items "Clearing" or "Grubbing" or under other items as specifically provided therein, and, when sufficient quantities of suitable material are not available from other excavations, shall include all work involved in completing backfills for

structures and all work prescribed under "Embankment," "Bedding and Backfill for Culverts," "Subgrade," "Shoulders," and "Rounded and Transition Slopes," all as prescribed in the detail specifications therefor, in accordance with these specifications and in conformity with the lines, grades and dimensions shown on the plans.

-1.2 The location of borrow pits will, as far as possible, be indicatede on the plans. Borrowing may be designated by the engineer at points in cuts where conditions are favorable to the flattening of earth slopes or to "day-lighting" or widening the inside of curves.

-1.3 Selected material for adjusting the roadbed grade, completing embankments, backfilling undergraded rock cuts and placing cushion material on rock embankments, if not obtainable from roadway cuts, shall be obtained from sources designated by the engineer, but his authorization must be obtained before any borrow pit is opened.

-1.4 Classification. No allowance will be made for classification, regardless of the material encountered unless otherwise provided on the plans or in the Special Provisions.

-3.1 Construction Methods. The contractor shall notify the engineer sufficiently in advance of the opening of any borrow pit so that elevations and measurements of the undisturbed ground surface may be taken. All borrow pits shall be neatly trimmed, and left in such shape as to admit of accurate measurement after the excavation is completed. Where practicable they shall be so excavated that no water will collect or stand therein. Borrow pits shall be designed as an integral part of the work as far as possible and, unless specifically permitted to the contrary, must not be visible from the completed road unless they are contiguous to, and in effect a part of, the roadway prism. Overburden and other spoil material shall be disposed of or used for special purpose as directed. Slopes of borrow pits shall be flattened and rounded into the natural ground surface as far as such transition grading may be permitted by local conditions.

-4.1 Method of Measurement. The yardage to be paid for shall be thee yardage, measured in its original position by the method of average end areas, of material (including overburden or stripping) acceptably excavated as hereinabove prescribed.

-5.1 Basis of Payment. The yardage, measured as provided above, shall bee paid for at the contract unit price per cubic yard bid for "Unclassified Excavation for Borrow," which price and payment shall constitute full compensation for the excavation and hauling, the sloping, draining and cleaning up of pits, and also for formation and compaction of embankments, backfills for structures, and bedding and backfill for culverts, including any extra expense resulting from any "imperfect trench" backfilling, any clearing and grubbing involved but not intended to be covered under "Clearing" or "Grubbing," disposing of all spoil material, preparation and completion of subgrade and shoulders, and for all labor, equipment, tools, and incidentals necessary to complete the item except "Overhaul."

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27 OVERHAUL

27-1.1 Description. This item shall consist of such hauling in excess of 500 feet as may be ordered, of any material paid for under "Roadway and Drainage Excavation," "Borrow," or "Stripping and Storing Topsoil," hauled more than 500 feet and placed in "Embankment," "Foundation Fill," "Bedding and Backfill for Pipe Culverts," "Shoulders," "Subgrade," "Rounded and Transition Slopes," or in storage piles in the case of "Stripping and Storing Topsoil."

This item is void as to the particular contract unless an estimated quantity therefor appears in the Bid Schedule as prepared by the engineer and furnished bidders and in any case is void where "Special Overhaul" is involved in the contract.

The hauling shall be performed along the route determined by the engineer as feasible and satisfactory, or if hauled over some other route consuming a greater distance, then the distance for purposes of payment shall be computed over the route determined by the engineer. In all other cases the distance shall be computed over the route as actually hauled.

-4.1 Method of Measurement. The number of station-yards of overhaul to be paid for shall be the product of the volume of the overhauled material, measured in its original position, in cubic yards, by the overhaul distance in feet, divided by 100. The "Overhauled Material" shall be the material comprehended within the terms of article 1.1 above and hauled as ordered more than 500 feet. The "Overhaul Distance" shall be the distance between the centers of volume of the "Overhauled Material" in its original position and after placing, less 500 feet.

-5.1 Basis of Payment. The station-yards, calculated as provided above, shall be paid for at the contract unit price per station-yard bid for "Overhaul" which price and payment shall constitute full compensation for all labor, equipment, tools and incidentals necessary to complete the item.

28 SPECIAL OVERHAUL

28-1.1 Description. This item shall consist of such hauling in excess of 1,000 feet as may be ordered, of any material paid for under "Roadway and Drainage Excavation," "Borrow," or "Stripping and Storing Topsoil" hauled more than 1,000 feet and placed in the work as specifically ordered in writing under "Special Overhaul."

This item is void as to the particular contract unless an estimated quantity therefor appears in the Bid Schedule as prepared by the engineer and furnished bidders.

The hauling shall be performed along the route determined by the engineer as feasible and satisfactory, or if hauled over some other route consuming a greater distance, then the distance for purposes of payment shall be computed over the route determined by the engineer.

-4.1 Method of Measurement. The "Overhauled Material" shall be the material comprehended within the terms of article 1.1 above and hauled as ordered more than 1,000 feet. For material hauled 2,000 feet or less, the "Overhaul Distance" shall be the distance in feet between the centers of volume of the overhauled material in its original position and after placing, less 1,000 feet. For material hauled more than 2,000 feet the "Overhaul Distance" for computation of station yard overhaul shall be 1,000 feet and the "cubic yard mile overhaul distance" for computation

of the cubic yard mile overhaul of the same material, shall be the distance expressed in miles between the centers of volume of the material hauled in excess of 0.38 of a mile in its original position and after placing less 0.38 of a mile. The number of station yards to be paid for shall be the product of the volume of all the "Overhauled Material" by the "Overhaul Distance," as defined above, in feet divided by 100, and the number of cubic yard miles to be paid for shall be the product of that portion of the "Overhauled Material" hauled more than 0.38 of a mile by the "cubic yard mile overhaul distance." The volume of the material shall be determined by measurement in original position.

-5.1 Basis of Payment. The station yard overhaul and the cubic yard mile overhaul, defined and determined as provided above shall be paid for respectively at the contract unit price bid for "Station Yard Special Overhaul" or "Cubic Yard Mile Special Overhaul" which price and payment shall be full compensation for overhauling, and for all labor, equipment, tools and incidentals necessary to complete the item.

29 EMBANKMENT

29-1.1 Description. This item shall consist of placing in embankments material excavated under the items "Roadway and Drainage Excavation," "Excavation for Structures," and "Borrow," all in accordance with these specifications and in conformity with the lines, grades, cross sections and dimensions shown on the plans.

-3.1 Construction Methods. Embankments shall be formed of suitable material, placed in successive layers for the full width of the cross section of the road. Each layer shall be thoroughly compacted before placing the next layer. Where rock is being used in the embankment, it shall be carefully distributed, and the interstices filled with the finer material to form a dense, compact mass. No rocks or hard lumps, which cannot readily be broken up into pieces not over six inches in diameter shall be placed in the upper 12-inch layer of embankments. Written permission from the engineer must be secured before trestles may be used in the construction of embankments, and when trestles are so used and left in place they must be cut 2 feet or more below subgrade.

-3.2 Embankments shall be built up by placing the material in successive layers of not more than 12 inches in depth for the full width of the cross section except that the 12-inch maximum limit will be considered as waived where the engineer has specifically authorized a method of construction which as determined by him will not permit placing in layers limited to the 12-inch depth.

-3.3 Where embankment is to be constructed across low swampy ground which will not support the weight of trucks or other hauling equipment, the lower part of the fill shall be constructed by dumping successive truck loads in a uniformly distributed layer of a thickness not greater than that necessary to support the trucks while placing subsequent layers. The upper portions of such fills shall be constructed in layers as above specified.

-3.4 When embankment is to be superimposed upon any type of existing roads, the existing surface shall, regardless of depth of embankment to be placed thereon, be scarified to such degree as will provide ample bond between old and new material.

-3.5 The contractor shall construct embankments so that, after shrinkage and settlement are complete, all embankments shall have the required grade, width and cross section at all points.

-3.6 The contractor shall be responsible for the stability of all embankments made under the contract and shall bear the expense of replacing any portions which have become misplaced due to carelessness or negligent work on the part of the contractor or to damage resulting from natural causes, such as storms, cloudbursts, etc., and not attributable, in the opinion of the engineer, to unavoidable movements of the ground upon which the embankment is made. Embankments over and around culverts, arches and bridges shall be of selected materials placed and thoroughly tamped and compacted so as to avoid undue strain on the structure and as prescribed by the specifications for the several types of structures and as prescribed under "Backfill for Structures other than Pipe Culverts." Bedding of pipes and backfill shall be as required in specifications therefor. Traffic over the work during construction shall be distributed so as to cover the entire surface.

-3.7 In all cases proper precautions shall be taken to assure that thee method of operation does not cause movement or undue strain on any structure.

-3.8 Extra Compacting. Where indicated on the plans embankments shall bee constructed in layers not exceeding 8 inches in thickness instead of 12 inches. The sides of the fill shall be placed first and the center shall be carried up lower than the shoulders. Each layer shall be thoroughly compacted by rolling with a 12-ton 3-wheeled power roller or with a tamping or sheep's foot roller, the outer surface of which shall be studded with teeth not less than 7 inches long and having an end surface area of approximately 4 square inches each; the roller shall be of such a weight that the load upon each tooth when any one row of teeth is supporting the whole weight of the roller will not be less than 300 pounds. Unless the material when placed in the fill is moist enough to be compacted properly, each layer shall be watered sufficiently to dampen the material before being rolled. Successive layers shall not be placed until the layer under construction has been thoroughly compacted.

-3.9 (a) At points where the plans state that the material available fore embankment must be sampled and tested before use in embankment, and at other points, or in connection with specific borrow pits, where it is deemed necessary, materials for embankment shall meet the following requirements for Class 1 or Class 2, and Class 1 or Class 2 material shall be used where and as ordered in writing.

(b)e Class 1 material shall be that which has more than 55 percent of material retained on the No. 200 sieve or, if less than 55 percent of material is retained on the No. 200 sieve, the liquid limit shall not exceed 35.

(c)e Class 2 material shall be that which has less than 55 percent retained on the No. 200 sieve and which has a liquid limit between 35 and 75. The minimum plasticity index shall be determined by the equation:

$$PI = .6LL-9$$

where PI = plasticity index

LL = liquid limit

(d)e When Class 2 material is used it shall be thoroughly compactede by rolling with the tamping or sheep's foot roller hereinabove described.

(e)e The density of each layer of Class 2 material composing thee embankment shall be not less than 90 percent of the maximum density as determined by the compaction test.

-4.1 Compensation. Embankment will not be measured or paid for directly. It shall be considered necessary work covered under the contract unit prices per

cubic yard bid for "Unclassified Excavation," "Solid Rock Excavation," "Common Excavation," "Unclassified Excavation for Structures," or "Unclassified Excavation for Borrow," as the case may be.

30 FOUNDATION FILL

30-1.1 Description. This item shall consist of furnishing and placing special approved rock or gravel backfill required to replace material encountered and found unsuitable below the foundation elevation of culverts, bridges and other structures, and shall be constructed in accordance with these specifications and only where specifically directed.

-2.1 Materials. Foundation fill shall consist of suitably graded gravel ore rock as required by the engineer.

-3.1 Construction Methods. After the unsuitable material has been excavatede and removed as required by the engineer and piles driven if called for, the foundation fill shall be placed and built up in uniform layers as directed to the foundation elevation and thoroughly compacted.

-4.1 Method of Measurement. The yardage to be paid for will be the yardage, measured in final position, of the special material actually placed as "Foundation Fill" except that no yardage will be included outside of the vertical planes limiting this payment for "Excavation for Structures" that is to be included in the measurement and paid for under the item therefor. Material measured and paid for as foundation fill will not be measured or paid for as excavation, nor borrow.

-5.1 Basis of Payment. The yardage, measured as provided above, shall bee paid for at the contract unit price per cubic yard bid for "Foundation Fill," which price and payment shall constitute full compensation for furnishing, excavating, hauling, depositing, and compacting the materials placed and for all labor, equipment, tools and incidentals necessary to complete the item, except "Overhaul."

31 STONE OR GRAVEL SHEATHING

31-1.1 Description. This item shall consist of a layer of gravel ore crushed stone placed against the inside faces of retaining walls, wing walls, back faces of abutments, and over the extrados of arches as shown on the plans or directed by the engineer.

-2.1 Material. The gravel or stone used shall conform to the requirements for coarse aggregate given in the specifications for "Concrete," except that a maximum size of 3 inches will be permitted.

-3.1 Construction Methods. When used against a mortar protection course ofe membrane waterproofing, sheathing shall not be placed until the mortar has aged for at least three days. The inlet ends of all weep holes and drains shall first be covered with large selected stones over which there shall be placed the finer material in such manner as to provide free access for the drainage but prevent the leaching out of the filling material. The sheathing shall form a continuous covering over the entire designated surface, extending from the elevation of the bottom of weep holes and drains to the top of the wall. In placing it shall be prevented from mingling with the fill. Planks and other suitable separators that can be withdrawn as the work progresses shall be kept between the sheathing and the fill when working against vertical faces or slopes steeper than the angle of repose of

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the material. Where waterproofing is protected by roofing felt, a 4-inch layer of sand shall be placed between the sheathing and the wall. Unless specific thicknesses are shown or ordered, the layer of sheathing shall be one foot in thickness.

-4.1 Method of Measurement. The yardage to be paid for under this item shall be the number of cubic yards of stone or gravel, measured in final position, between the limits shown on the plans or ordered by the engineer, complete in place and accepted.

-5.1 Basis of Payment. The number of cubic yards, determined as provided above, shall be paid for at the contract unit price per cubic yard bid for "Stone or Gravel Sheathing," which price and payment shall be full compensation for furnishing all materials, and for all labor, equipment, tools and incidentals necessary to complete the item.

32 BACKFILL FOR STRUCTURES OTHER THAN PIPE CULVERTS

32-1.1 Description. This item shall consist of backfilling in connection with all bridges except those specifically designed for hydraulic fill methods and in connection with all retaining walls unless specifically designed to withstand fluid pressure and in connection with all masonry culverts and with all concrete other than sectional precast structures and with all sheet metal culverts of other than self-closed circular or elliptic cross sectional outline larger than 60-inch span. This item does not embrace minor miscellaneous structures accessory to culverts or conduits or miscellaneous protective incidentals. All work under this item shall be performed and completed in accordance with these specifications and in conformity with the design shown on the plans.

-2.1 Material. The material used shall be selected from material obtained as excavation or borrow. When the plans stipulate sampling and testing of the backfill material, the material used shall meet the requirements of Class 1 or Class 2 as required by the plans and as defined under item 29, article -3.9, except that for areas and elevations where "Foundation Fill" is ordered in writing the material used shall be as prescribed thereunder.

-3.1 Construction Methods. After the structure has been completed, the areas around the foundations shall be filled with approved material, in horizontal layers not over 12 inches in depth, and compacted satisfactorily to the level of original surrounding surfaces.

-3.2 No backfilling shall be placed against any abutment, wing wall or culvert until permission shall have been given by the engineer. In the case of concrete or other masonry, such permission will preferably not be given until the masonry has been in place 21 days, or until tests made by the laboratory under the supervision of the engineer establish that the concrete has attained sufficient strength to withstand any pressures created by the methods used and materials placed without damage or strain beyond a safe factor. Adequate provision shall be made for thorough drainage and drains shall be placed at weep holes.

-3.3 Fill placed around culverts and piers shall be deposited on both sides to approximately the same elevation at the same time. All filling adjacent to structures shall be deposited in borizontal layers and compacted as prescribed. Especial care shall be taken to prevent any wedging action against the structure and all slopes bounding or within the areas to be backfilled shall be stepped or serrated to prevent such wedge action.

-3.4 In backfilling abutments, retaining walls or other structures, the bed for the backfill shall be so prepared and serrated and the backfill shall be so built up in horizontal layers that at all times there shall be a horizontal berm of thoroughly compacted material behind the structure for a distance at least equal to the height of the abutment or wall to be backfilled except insofar as undisturbed material obtrudes into this area. Each layer of this berm, if dry, shall be moistened and then compacted by tamping with mechanical rammers or by hand tamping with heavy iron tampers having a tamping face not exceeding 25 square inches in area.

By mechanical rammer is meant equipment designed to tamp the relatively thin layers herein prescribed. The use of drop pile hammers, loaded or unloaded clam shell or other similar unsuitable equipment for this purpose is prohibited within the berm area mentioned above as well as the dropping of any heavy weight for the purpose more than 10 feet. Jetting of fills, or other hydraulic methods involving or likely to involve liquid or semiliquid pressure within this berm area, is prohibited within the area contiguous to the abutment or wall to be backfilled and for a distance therefrom equal to 2-1/2 times the height thereof above low water.

-4.1 Compensation. The work prescribed under this item shall not be measured or paid for directly. This work shall be considered a necessary and subsidiary part of the work paid for under the contract unit prices per cubic yard bid for "Unclassified Excavation for Structures," "Unclassified Excavation," "Solid Rock Excavation," "Common Excavation," or "Unclassified Excavation for Borrow" as the case may be.

33 BEDDING AND BACKFILL FOR PIPE CULVERTS

33-1.1 Description. This item shall consist of preparing the bedding for culvert pipe and backfilling after the pipe is installed. This item shall include the preparation of the ground for the reception of the pipe so that after installation as prescribed in the detail specifications for the particular type of pipe, the flow line of the pipe will conform to the line required by the plan as staked by the engineer. This item shall include the backfilling around and over the pipe to an elevation 8 inches above the top or crown of the pipe and as much higher as may be involved in connection with the detail requirements herein below, and, in addition when required on the plans, in accordance with one of the "imperfect trench" methods hereinafter described. All work under this item shall be performed and completed in accordance with these specifications and in conformity with the lines, grades, dimensions and design shown on the plans.

-2.1 Material. The material used shall be selected from material meeting the requirements for class 1 or 2 as indicated or required by the plans, prepared as required under "Embankment."

-3.1 Construction Methods. When pipe is placed in a trench the width of the trench shall not be greater than necessary to permit satisfactory jointing and thorough tamping of the bedding material under and around the pipe, unless authorized as made necessary by field conditions and because of unsuitable material encountered. The bedding surface shall provide a firm but slightly yielding foundation of uniform density through the entire length of the culvert and shall in general be slightly cambered to correct for expected settlement and insure tight joints in the lower half of the pipe. Recesses shall be excavated for any bells involved.

-3.2 Bedding. (a) The pipe shall be bedded in an earth foundation of uniform density carefully shaped, by means of a template supported at the desired grade, to fit the lower part of the pipe exterior for at least 10 percent of its over-all height. Where rock, in either ledge or boulder formation, is encountered,

it shall be removed below grade and replaced with suitable materials in such a manner as to provide a compacted earth cushion having a thickness under the pipe of not less than one-half inch per foot height of fill over the top of the pipe, with a minimum allowable thickness of 8 inches. Where a firm foundation is not encountered, at the grade established, due to soft, spongy or other unstable soil, unless other special construction methods are called for on the plans or in special provisions, all of such unstable soil, under the pipe and for a width of at least one diameter on each side of the pipe, shall be removed and replaced with gravel or other suitable material properly compacted to provide adequate support for the pipe line.

(b) The installation of the pipe shall be as required in the detail specifications for the particular type of pipe and any special requirements therein given for bedding or backfilling shall be observed.

(c) After the bedding has been prepared and the pipe installed as required above, selected material from excavation or borrow shall be placed alongside the pipe in layers not exceeding 6 inches in depth and thoroughly compacted so that on each side of the pipe there shall be a berm of thoroughly compacted material at least as wide as the external diameter of the pipe, except insofar as undisturbed material obtrudes into this area. Each layer, if dry, shall be moistened and then compacted by rolling or by tamping with mechanical rammers, or by hand tamping with heavy iron tampers having a tamping face not exceeding 25 square inches in area, special care being taken to compact thoroughly the fill under the haunches of the pipe. This method of filling and compacting shall be continued until the embankment is level with the top of the pipe. Except as required below the remainder of the backfill shall be of the material prescribed in article 33-2.1.

-3.3 When the "imperfect trench" method is required on the plans, one of the following detailed requirements shall be followed in completing the backfill above the level of the top of the pipe.

-3.4 Imperfect Trench Methods. After the pipe line has been bedded and the embankment placed and compacted to the level of the top of the pipe in the manner previously described, the imperfect trench method of construction may be obtained by one of the following described methods. Upon written permission hand tamping may be substituted for mechanical rammers. Hand tamping shall be performed with heavy iron tampers having a tamping face not exceeding 25 square inches in area.

Method A.
The embankment shall be constructed in six-inch layers to a height above the top of the pipe equal to the external diameter of the pipe. Each layer shall be thoroughly compacted over the pipe and for a width on each side equal to the external diameter of the pipe by rolling or by tamping with mechanical rammers. The earth material in the prism directly over the pipe shall then be excavated and the trench backfilled with earth material deposited in the loosest possible condition.

Method B.
The embankment shall be placed in six-inch layers, that portion of each layer which is directly above the pipe being left loose, but that portion of each layer which is not directly over the pipe but which is within one diameter of same shall be thoroughly compacted by rolling or by tamping with mechanical rammers. After the fill has been completed to a height above the top of the pipe equal to the external diameter of the pipe any compacted earth in the prism directly over the pipe shall be removed and replaced in the loosest possible condition.

Method C.
Rigid side forms shall be placed on the fill in a vertical plane tangent to the sides of the pipe. The fill shall then be placed behind the forms to a height equal to the external diameter of the pipe in layers not exceeding 6 inches in depth. Each layer shall be thoroughly compacted by rolling or by tamping with mechanical rammers. The open space directly over the pipe line between the forms shall then be filled with earth material deposited in the loosest possible condition and the forms withdrawn.

In all cases when the imperfect trench method is used, the subgrade before any pavement surface course or base course is placed shall be consolidated, refilled to subgrade level, reconsolidated, if necessary, and brought to a condition of supporting capacity of uniform value equal to that of the contiguous subgrade areas.

-4.1 Compensation. The work prescribed under this item shall not be measured or paid for directly. This work shall be considered a necessary and subsidiary part of the work paid for under the contract unit prices per cubic yard bid for "Unclassified Excavation for Structures," "Unclassified Excavation," "Solid Rock Excavation," "Common Excavation," or "Unclassified Excavation for Borrow" as the case may be.

34 DISPOSAL OF SURPLUS MATERIAL

34-1.1 Description. This item shall consist of the disposal of all surplus excavation and waste material of any kind by widening embankments or flattening slopes or by depositing in such other places and for such other purposes as the engineer may direct, all in accordance with these specifications and in conformity with the lines, grades and dimensions shown on the plans or directed by the engineer.

-3.1 Construction Methods. Large rocks brought to the surface by scarifying or otherwise shall be disposed of in such manner that they will be unnoticed from the completed roadway and in places approved by the engineer. In no case shall material be deposited above the grade of the adjacent roadway unless directed in writing by the engineer. The contractor shall not borrow and waste without written application to and written consent from the engineer. Under no circumstances shall the contractor be paid for excavation beyond the established line of the roadway prism, or for borrow, when such excavation or borrow results from the method of borrow and waste, nor for overhaul not actually required by the design.

-4.1 Compensation. The work described under this item shall not be measured or paid for directly. It shall be considered necessary work covered under the contract unit prices per cubic yard bid for "Unclassified Excavation," "Solid Rock Excavation," "Common Excavation" or "Unclassified Excavation for Structures," as the case may be.

35 SPECIAL DISPOSAL OF DESIGNATED MATERIAL

35-1.1 Description. This item shall consist of the disposal of specific spoil material, resulting from the operations of "Excavation for Structures" at points specifically indicated on the plans as involving "Special Disposal," identified and required by a written order to be disposed of in a particular

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location and manner, also specifically shown on the plan. The material shall be disposed of as required by the order.

-1.2 This item shall apply only when the Bid Schedule and contract contains a quantity and unit price for "Special Disposal of Designated Material."

-4.1 Method of Measurement. The yardage to be paid for shall be the number of cubic yards of material measured in the original position of material designated and disposed of under this item in accordance with the written order.

-5.1 Basis of Payment. The yardage, measured as provided above, shall be paid for at the contract unit price per cubic yard bid for "Special Disposal of Designated Material," which price and payment shall constitute full compensation for all labor, equipment, tools and incidentals necessary to complete the item.

This price and payment shall be in addition to the price and payment for the same material provided for under "Unclassified Excavation for Structures" for that yardage of excavation for which "Special Disposal" is directed.

36 ROUNDED AND TRANSITION SLOPES

36-1.1 Description. This item shall consist of shaping and finishing graded slopes in accordance with these specifications and in conformity with the typical grading sections approximately as shown on the landscape grading sheet of the plans and shall include: (a) Rounding off by excavating the tops of cuts to blend more uniformly the cut slope with the slope of the adjacent natural terrain; (b) Rounding out by filling the bottoms of embankments to blend more uniformly the fill slopes with the natural ground surface; (c) Warping the slopes where cuts and fills intersect by flattening the ends of cuts and fills to blend more naturally the adjacent portions of the cut and fill respectively. Rounded and transition sloping shall be done after the earthwork has been substantially completed and all adjacent drains and structures completed and backfilled.

-3.1 Construction Methods. All slopes will be staked for flattening and rounding in places where the material is other than solid rock, except that rock such as decomposed sandstone and granite that decomposes to such an extent that it will have the same appearance as earth, shall have the slopes flattened and rounded the same as earth slopes. A layer of earth overlying a rock cut shall be rounded above the rock the same as in earth slopes.

Cut slopes shall be flattened and rounded in accordance with the typical sections shown on the plans.

Fill slopes shall be flattened and rounded in accordance with the typical sections shown on the plans.

Slope rounding and warping shall also apply to all drainage ditches. Where such ditches are not sufficient in depth to utilize the full typical rounding, the distance for beginning rounding back from the slope stake shall be adjusted proportionately.

The contractor shall adjust and warp the cut and fill slopes to flow into the natural ground surface with as little break in grade as possible.

-3.2 Wherever the treatment of the slopes may destroy or injure standing timber, trees or other vegetation which in the opinion of the engineer should be preserved, adjustments in slope grading shall be made by the contractor as

directed by the engineer. Gradual transition from the theoretical grading section shall be required. Whenever feasible and practicable to save trees, these adjustments in grading may include upon order: (1) the steepening of the backslope in cuts; (2) the steepening of the slope in fills; (3) the reduction or omission of the rounding at the top of cuts or at the base of fills; (4) the diversion of side ditches to miss trees or to follow the curve of the natural contour; (5) the omission of the open ditch by alternate provision for drainage.

-3.3 Wherever special treatment or construction other than grading operations is required to save trees or other vegetation indicated on the plans or marked by the engineer for preservation, such special treatment shall be measured and paid for separately in accordance with the particular and respective item of work involved. Special treatment or supplemental construction to preserve selected trees may include but is not limited to: (1) retaining walls in cut or fill slopes; (2) dry tree wells in fill slopes; (3) porous or loose material around trees in shallow fills; (4) underground drainage pipe.

-3.4 All earth slopes shall be finished on neat regular lines that will conform naturally to the surrounding terrain. This work shall be done in proper sequence with other operations involved. The degree of smoothness of finish shall be that normally obtainable from hand shovel operations. A hand-raked sandpaper finish is not intended.

-4.1 Compensation. Slope grading shall not be measured or paid for directly. It shall be considered necessary work covered under the contract unit prices per cubic yard bid for "Unclassified Excavation," "Solid Rock Excavation," "Common Excavation," "Unclassified Excavation for Structures," or "Unclassified Excavation for Borrow," as the case may be.

In measuring excavation for payment under "Roadway and Drainage Excavation" excavation cross sections will be measured to the slope as rounded and treated as required herein.

37 FURROW DITCHES

37-1.1 Description. This item shall consist of the construction of furrow ditches in accordance with these specifications and where shown on the plans or directed by the engineer.

-3.1 Construction Methods. Furrow ditches shall be formed by plowing one or two furrows according to the natural slope of the ground. They shall be finished either by hand shovel work or ditcher, or some other suitable method, throwing all loose material on the downhill side so that the bottom of the finished ditches shall be approximately 18 inches below the crest of the loose material piled on the downhill side. Absolutely smooth ditches will not be required, but the flow lines shall be in satisfactory shape to provide drainage without overflow.

-4.1 Method of Measurement. The footage of furrow ditches to be paid for shall be the number of linear feet of furrow ditch measured along the center line of the ditch as completed and accepted.

-5.1 Basis of Payment. The footage, measured as provided above, shall be paid for at the contract unit price per linear foot bid for "Furrow Ditches," which price and payment shall constitute full compensation for all labor, equipment, tools, and incidentals necessary to complete this item.

(Item 38)
(Item 39)

38 OBLITERATION OF OLD ROADS

38-1.1 Description. This item shall consist of the obliteration, ine accordance with these specifications and as directed by the engineer, of such portions of the discontinued road, or roads, as are indicated on the plans or ordered by the engineer. The obliteration of old roads shall consist of appropriate grading of portions of the old road that are to be abandoned, and shall include scarifying, plowing and harrowing all the areas of the old roadway as directed.

-3.1 Construction Methods. (a) After the old road is no longer needed fore traffic, the old ditches shall be filled and the roadway graded, either to restore approximately the original contour of the ground, or to produce a pleasing appearrance by forming natural, rounded slopes. Where feasible, borrow earth required for the new roadway shall be taken from fills on the old road, and surplus or waste material from the new roadway shall be placed in cuts on the old road. Old structures shall be broken down and buried or removed. All material with salvage value shall be carefully removed to avoid damage and used in the construction of the new road where provided. After the rough grading is completed, the area of the old road surfacing shall be scarified or plowed to mix effectively the remaining metal with earth and the entire area of the old roadway shall be harrowed and smoothed.

(b) Any gravel, macadam and other materials salvaged from the old road meeting the specifications for any items of the new road may be used in the construction thereof as provided in Article 48.

(c) Where directed, suitable topsoil or humus material shall be conserved and used in covering necessary areas for the purpose of facilitating regrowth of vegetation. No extra payment will be made or allowed for conserving such "Topsoil" material or for such humus material or for the utilization thereof save the payment of any "Overhaul" involved.

-4.1 Method of Measurement. The area of obliteration of old road to be paid for shall be the number of units of 1,000 square foot area of old roadway obliterated. The area will be measured horizontally. The measurement shall apply only to those areas of the old roadway outside of the limits of the new roadway.

-5.1 Basis of Payment. The number of units of 1,000 square foot area, measured as provided above, shall be paid for at the contract unit price per unit of 1,000 square foot area, bid for "Obliteration of Old Roads" which price and payment shall constitute full compensation for all work specified herein, and for all labor, equipment, tools and incidentals necessary to complete the item, except any excavation involved, which will be measured and paid for under "Roadway and Drainage Excavation," or under "Borrow," and except "Overhaul."

39 ROADSIDE CLEANUP

39-1.1 Description and Construction Methods. This item shall consist ofe clearing the ground of all down timber, dead brush, logs and timbers, the felling and destroying of all snags, and such dangerous trees as are designated by the engineer, in areas ordered outside of the roadway and outside any area covered by "Clearing" or "Grubbing," but within the limits of the "highway." The material obtained from the cleanup area shall be moved into the cleared right of way and burned as hereinbefore prescribed and inferred under "Clearing" and under "Grubbing."

-1.2 It is the intent of this item that neatness of cleanup is to bee relative, so as to be in character with the surroundings and does not imply handraking or any similar exaggerated degree of treatment.

-1.3 Intensity of cleanup shall be graduated so as to effect a natural transition in cleanup treatment from the edge of the roadway construction outward to the limits or boundary of cleanup designated by the engineer so as to avoid sharp demarcation between the artificial and the natural.

-1.4 As a general guide the first tier of units to be cleaned nearer the road centerline shall have small sticks and other loose particles practically all removed down to a size of approximately one inch thickness or smaller diameter, the second outward tier shall be substantially cleaned down to a size of approximately two inches, and the third outward tier substantially down to a size of approximately three inches.

-4.1 Method of Measurement. The area of "roadside cleanup" to be paid for shall be the number of "roadside cleanup units" of area outside the excavated and filled areas, laid out as hereinbelow required, which have been cleaned up and accepted as meeting these roadside cleanup specifications. Each "roadside cleanup unit" shall be a rectangle of ground 50 feet in length and 20 feet in width and the units shall be laid out as described under the item "Grubbing" to the boundary of "roadside cleanup" fixed by the engineer. The engineer will determine the number of "roadside cleanup units" for which payment is to be made, station by station, and total the number of units. If any roadside cleanup is ordered or designated on a portion of a given unit of area, the entire area of that unit shall be allowed as the basis for measurement and payment.

-5.1 Basis of Payment. The number of "roadside cleanup units," determined as provided above, shall be paid for at the contract unit price per roadside cleanup unit bid for "Roadside Cleanup," which price and payment shall constitute full compensation for all labor, equipment, tools and incidentals necessary to complete the item.

40 FINISHING EARTH GRADED ROADS

40-1.1 Description. This item shall consist of the final finish, ready for traffic, of the roadbed of an earth graded road where no surfacing other than earth or selected material is proposed; the work shall consist of shaping and dressing the roadbed to conform to the "Finish" lines, grades and typical cross section shown on the plans.

-1.2 Except where the plans specifically provide for this item and the Bid Schedule and contract contain a bid price for "Finishing Earth Graded Roads" any work required under this item will not be paid for directly but shall be considered an incidental part of the work paid for under excavation or borrow.

-3.1 Construction Methods. After all earthwork has been substantially completed, all structures are complete, and all drains laid, the entire surface of the roadbed shall be scarified by a scarifying machine to a depth of 6 inches and shall then receive a finish shaping with a grading machine, supplemented by hand work where necessary to secure a smooth surface and a uniform cross section. All rock sections and all other sections where the natural material is not deemed suitable by the engineer shall be brought to grade by a satisfactory cushion of selected material. This material shall be obtained in excavation or borrow and paid for as such, not to exceed the amount ordered in writing by the engineer. The yardage to be paid for shall not include any yardage made necessary by unauthorized excavation below grade. The selected fine graded material found in the excavation and meeting the approval of the engineer shall be used for the finishing so far as available. The entire roadbed shall be brought to the final elevation and shape indicated on the plans and dressed as directed by the engineer.

At intersections with other earth roads or trails a commodious smooth riding roadway shall be similarly constructed and dressed as directed. No roots, sod, or other deleterious matter or stones that would fail to pass a 1-1/4-inch square opening shall be left within the top 4 inches of the finished road surface.

-4.1 Method of Measurement. The mileage to be paid for under this item shall be the number of miles of roadbed finished to the full width and accepted for payment under this item. Only the mileage for which the plans specify earth finish shall be measured for payment.

-5.1 Basis of Payment. The number of miles of finishing, limited as provided above, shall be paid for at the contract unit price per mile bid for "Finishing Earth Graded Roads," which price and payment shall constitute full compensation for all scarifying, shaping, removing of coarse material and for all labor, equipment, tools and incidentals necessary to complete the item.

41 FINE GRADING SUBGRADE AND SHOULDERS

41-1.1 Description. This item shall consist of preparing a previously graded roadway for immediate placement of surface courses or pavements, in conformity with the appropriate lines, grades and cross section shown on the plans.

-1.2 Except where the plans expressly provide for this item and the Bid Schedule and contract contain a bid price for "Fine Grading Subgrade and Shoulders," any work required under this item will not be paid for directly but shall be considered as necessary and subsidiary work covered under the contract price for the proposed surface course or pavement.

-3.1 Construction Methods. All slides shall be removed and those portions of the existing roadway so directed by the engineer, shall be scarified, bladed and shaped to conform accurately to the line, grade and cross section shown on the plans. Should there develop any depressions or narrow embankments, sufficient approved earth material shall be obtained and placed, as common excavation, unclassified excavation, or borrow, to bring the surface of the roadway to the exact lines, grades and cross section shown on the plans. The roadbed shall then be rebladed and reshaped. At intersections the roadbed of the sideroad shall be similarly treated to the distance ordered as governed by the grading performed and so as to provide for proper joining of the proposed and existing riding surfaces. The work shall be compacted and all work done necessary to produce a completed and acceptable foundation for the placement of the surface course or pavement.

-4.1 Method of Measurement. The mileage to be paid for under this item shall be the number of miles of roadway measured along the center line thereof, fine graded to the full width and accepted for payment under this item.

-5.1 Basis of Payment. The mileage, limited as provided above, shall be paid for at the contract unit price per mile bid for "Fine Grading of Subgrade and Shoulders," which price and payment shall constitute full compensation for shaping, dressing and compacting the subgrade and shoulders all as prescribed in the specifications therefor, and for all labor, equipment, tools and incidentals necessary to complete the item, provided, however, that the removal of all slides in excess of 5 cubic yards per station and additional borrow material required to bring the roadway to the finished section shall be paid for at the contract unit prices per cubic yard bid for "Unclassified Excavation," "Common Excavation" or "Unclassified Excavation for Borrow" and "Overhaul," as the cases may be.

42 SHOULDERS

42-1.1 Description. This item shall consist of constructing the shoulders of approved materials, including the final shaping of the shoulders as directed, to the full width of the roadbed, after any base or surface course involved in the contract has been constructed, all in accordance with these specifications and in conformity with the lines, grades and cross section shown on the plans. The shoulders shall be constructed after earthwork has been substantially completed, all adjacent drains and structures completed and backfilled. The engineer may require construction or completion of shoulders by designated sections of road as may best advantage the work and public traffic.

-3.1 Construction Methods. Before any subgrade shall be approved the adjacent shoulders shall be constructed to the full width and at least to the level of the finished subgrade, but not necessarily to the final height and shape. In all cases where subgrade rolling is required, it shall be extended onto the shoulders for a distance of at least one foot outside the pavement or surface course. At all times construction shall be so carried on that the subgrade, shoulders and adjacent slopes and ditches will be effectively and completely drained. This work shall be done in proper sequence with any base or surface course construction, as directed. In the case of surface courses or pavements of a design or condition so requiring, the shoulders shall be sufficiently built up against the edges of such work as may be necessary to sustain it immediately after the laying.

-4.1 Compensation. Shoulder work shall not be measured or paid for directly. It shall be considered necessary work covered under the contract unit prices per cubic yard bid for "Unclassified Excavation," "Solid Rock Excavation," "Common Excavation," "Unclassified Excavation for Structures," or "Unclassified Excavation for Borrow," or under other pay items involved in the contract.

43 SUBGRADE

43-1.1 Description. This item shall consist of constructing the subgrade in accordance with these specifications and in conformity with the lines, grades and cross sections shown on the plans. The subgrade shall be constructed after the earth work has been substantially completed and all adjacent drains and structures completed and backfilled. Where the plans indicate that a base or surface course is to be placed, any requirements as to subgrade contained in the specifications for such base or surface course shall be performed accordingly. Subgrade rolling shall be as required for the class of "Embankment" involved under the contract, and as may be further required under the specifications for any base or surface course involved in the contract.

-3.1 Construction Methods. All soft and unstable material and other portions of the subgrade which will not compact readily or serve the intended purpose shall be removed as directed. The resulting areas and all other low sections, holes or depressions shall be brought to profile grade with satisfactory selected material and the entire subgrade shaped to line, grade and cross section. Satisfactory selected material reserved and paid for under "Roadway and Drainage Excavation" shall be used so far as deemed suitable by the engineer, supplemented as necessary by additional material obtained and paid for as borrow. In areas where satisfactory material is not available and the contract carries the item "Local Subgrade Reinforcement" material of the quality and characteristics necessary may be ordered in writing under such item, and shall then be furnished and paid for at the contract unit price for such item.

-3.2 All boulders or ledge appearing in the earth excavation shall be removed or broken off to a depth of not less than 9 inches below the subgrade. The resulting areas shall be brought to profile grade with satisfactory selected fine or "cushion" granular material obtained and paid for under "Roadway and Drainage Excavation" or as borrow.

-3.3 Railway Intersections. Where detail plans including the riding surface of pavement between the rails are not provided at grade crossings of intersecting railroad tracks the contractor shall construct the roadway so that a commodious, smooth riding and satisfactory intersection is obtained, meeting the requirements of the railway company.

-3.4 Protection of Subgrade. At all times ditches and drains along the subgrade shall be so maintained as to drain it effectively. Whenever ruts of 2 inches or more in depth are formed, the subgrade shall be brought to grade, and if necessary be reshaped and rerolled. In no case shall any surface course or pavement be placed on a frozen or muddy subgrade. Storage or stock piling of materials on the subgrade will not be permitted. Until the subgrade has been checked and approved, no base or surface course shall be laid thereon.

-4.1 Compensation. Subgrade work shall not be measured and paid for directly. It shall be considered necessary work covered under the contract prices bid for pay items carried in the contract.

44 LOCAL SUBGRADE REINFORCEMENT

44-1.1 Description. This item shall consist of special approved foundation material placed, as directed by the engineer, in excavation made by the removal of soft, unstable, or other unsuitable subgrade materials or to form the subgrade on fills and shall be constructed in accordance with these specifications and only in contracts carrying this item and only within the bounds of definite areas as specifically ordered in writing.

-2.1 Materials. The material to be used shall consist of one of the following types with necessary filler; sound, tough, durable telford stone, knapped field or quarry stone, crushed rock, slag, or gravel. The telford stone shall be approximately 8 inches in depth; the field or quarry stones shall be not more than 5 inches in their largest dimensions after knapping; and the crushed rock, slag, or gravel shall consist of pieces varying from 1 inch to 3-1/2 inches in diameter. When a finer material is necessary for the filler, quarry chips, gravel, or sand may be used to an amount not over 15 percent of the total. All material shall be approved before being used.

-3.1 Construction Methods. Any unsuitable subgrade materials shall be removed as directed and the bottom of the excavation shaped uniformly and compacted firmly and provision made for drainage. The material shall then be placed in the prepared excavations. If telford stones are used, they shall be laid at right angles to the center line of the roadway and rammed in layers of not more than 8 inches in depth; or if knapped field or quarry stone, crushed rock, slag, or gravel is used, it shall be spread and rammed in layers of not more than 5 inches. After the material has been placed in layers until level with the surrounding subgrade surface the voids shall be filled with the finer material and the work rolled or tamped if inaccessible to the roller; and the filling and rolling shall be continued until the entire mass is compacted thoroughly and satisfactorily. The surface shall be finished to conform accurately to the grade and cross section of the surrounding subgrade.

-3.2 Where the case involves placing a stabilized cap or layer on a fill, such fill, on order, shall be constructed only to the appropriately lowered level and the stabilizing material placed thereon. In cases where in accordance with instructions a fill has been constructed to the full height and re-excavation is therefore necessary the yardage of such re-excavation shall be measured and paid for as common or unclassified excavation whichever appears in the contract.

-4.1 Method of Measurement. The cubic yardage to be paid for shall be the number of cubic yards, measured in the vehicle, of reinforcement material furnished, hauled and placed to the satisfaction of the engineer.

-5.1 Basis of Payment. The yardage, measured as provided above, shall be paid for at the contract unit price per cubic yard bid for "Local Subgrade Reinforcement," which price and payment shall constitute full compensation for furnishing, hauling and placing the material required and for all labor, equipment, tools and incidentals necessary to complete the item, provided however that any unsuitable material encountered in the excavation or fill, through no fault of the contractor and removed as ordered, shall be measured and paid for under the item "Roadway and Drainage Excavation."

BASE COURSES

50 HEAVY GRAVEL BASE COURSE

50-1.1 Description. This item shall consist of a foundation course of gravel to be covered, under other specification item or items, by a wearing course or pavement or by a supplementary base course; this item shall be constructed in accordance with these specifications on the prepared subgrade and in conformity with the lines, grades, thickness and typical section shown on the plans.

-2.1 Materials. The gravel shall consist of hard durable pebbles, rock fragments or particles with a binder, either present naturally or blended artificially, meeting one of the following sets of grading requirements when tested by laboratory methods using sieves with square openings.

	3-inch Gravel	2-inch Gravel
Passing 3"	100	
Passing 2"		100
Passing 1"	35-65	50-80
Passing No. 4	10-25	15-35

-3.1 Construction Methods. The gravel shall be spread on the subgrade prepared as hereinbefore specified under "Subgrade" in a uniform layer to such loose depth that when compacted the course shall have the thickness shown on the plans. Blocks or other devices shall be used to secure the proper depth and alignment. Crown templets shall be used to assure that the cross section of the course is of the shape required by the plans. The spreading of the gravel shall be accomplished from dumpboards or from the vehicles. In no case shall the gravel be dumped or unloaded on the subgrade in piles.

-3.2 If it is necessary to add more binder after the material is spread the additional material shall be uniformly spread over the loosely spread gravel in layers as determined by the engineer and thoroughly mixed with the gravel by appropriate means. Additions of binder shall be such that the blend of added and original material shall at all points meet the grading requirements of the table above. The mixing shall be done to secure the best results from the material, as directed by the engineer.

-3.3 Rolling. The gravel, spread and prepared as above required, shall be rolled with a power roller weighing at least 10 tons until a satisfactory bond is secured. Any irregularities or depressions that develop under the initial or any subsequent rolling shall be corrected by loosening the material and adding or removing material meeting specifications until the surface presents a smooth, regular and uniform appearance.

-3.4 Rolling shall begin at the side and progress gradually to the center parallel with the center line of the roadway uniformly lapping each preceding track by one-half the width of the rear wheel. The rolling shall continue until the surface has been rolled by the rear wheels and until the maximum amount of compaction has been secured. After initial rolling has been completed on each course of the gravel base, it shall be machined with a road machine the blade of which is at least 8 feet long and which machine shall weigh not less than 1-1/2 tons. Machining and rolling shall be done as required or directed thereby maintaining a smooth, even, uniformly compacted base until the surface is placed thereon, unless otherwise specified or directed. Along curbs, headers, and other structures, and all places not accessible to the roller, the course shall be thoroughly tamped

with hand tampers. Such tampers shall weigh not less than 50 pounds and shall have a face area of not more than 100 square inches.

-3.5 Testing Finished Surface. The finished surface of the Gravel Base Course shall conform so nearly to that required by the plans that it will nowhere vary more than one-half inch when tested with a 10-foot straightedge applied to the surface parallel to the center line of the pavement or from a templet conforming with the cross section shown on the plans. Such portions of the completed base as are defective in finish, compression, or composition or that do not comply in all respects with the requirements of these specifications shall be taken up, removed and replaced with suitable material properly laid in accordance with these specifications.

-4.1 Method of Measurement. The yardage to be paid for shall be the number of cubic yards of gravel and binder, measured in the vehicle, placed, bonded and accepted in the completed base course.

-5.1 Basis of Payment. The yardage, measured as provided above, shall be paid for at the contract unit price per cubic yard bid for "3-inch Heavy Gravel Base Course" or for "2-inch Heavy Gravel Base Course" as the case may be, which price and payment shall constitute full compensation for the preparation of subgrade, furnishing, hauling, and laying all the material, and for rolling and binding the course, including all labor, equipment, tools and incidentals necessary to complete the item.

51 GRAVEL BASE COURSE

51-1.1 Description. This item shall consist of a foundation course of gravel for a surface course or pavement or for another base course, constructed in accordance with these specifications on a prepared subgrade, and in conformity with the lines, grades, and typical cross sections shown on the plans.

-2.1 Materials. The gravel shall be composed of stone, sand and a clay or similar material. The material over No. 4 in size shall be clean, hard, tough and durable, well graded from coarse to fine. The material passing the No. 4 sieve shall be known as "binder" and shall be a good grade of sand and clay or other material of satisfactory cementing value.

The gravel including the binder naturally present or added when tested by laboratory methods using sieves with square openings shall meet the following requirements:

	Percent
Passing 1 inch sieve	100
Passing 3/4 inch sieve	85 - 100
Passing No. 4 sieve	55 - 85
Passing No. 10 sieve	40 - 65
Passing No. 40 sieve	25 - 50
Passing No. 200 sieve less than	25

Material of greater maximum size may be used, provided however that the largest aggregate shall not exceed 1/3 the thickness of the stabilized layer and not more than 10 percent of the material should exceed 1 inch.

The fraction passing the No. 200 sieve shall be less than 1/2 the fraction passing the No. 40 sieve. The material passing the No. 40 sieve shall have a

plasticity index not to exceed 6 and have a liquid limit of not more than 25 when tested in accordance with the methods of the Bureau of Public Roads.

-3.1 Construction Methods. The base material shall be spread on the subgrade prepared as hereinbefore specified under the section "Subgrade" in a uniform layer to such loose depth that when compacted the base will have the thickness shown on the plans. Blocks or other devices shall be used to secure the proper depth and alignment. The spreading of the gravel shall be accomplished from dump boards, or by means of vehicles and approved spreading devices. In no case shall the material be dumped or unloaded on the subgrade in piles. Unless otherwise directed, the depth of the gravel shall be gaged by means of wooden blocks about 6 inches square and of a height equal to the required depth of the loose material. After the gaging of the loose material for any one section has been completed, the blocks shall be transferred forward and the space occupied by them filled with gravel.

-3.2 If it should become necessary to add more binder, the additional material shall be uniformly spread over the loose gravel in layers as determined by the engineer and thoroughly mixed with the gravel by means of plowing or harrowing. Addition of binder shall be such that the blend of added and original material at all points shall meet the grading and quality requirements given above. The mixing shall be done to secure the best results from the material, as directed by the engineer. Mixing shall be done only when the gravel contains enough moisture to cause the binder to adhere to the sand or stone particles in the gravel. Each layer of binder shall be mixed to the satisfaction of the engineer before the application of another layer. Wherever the plans call for multiple courses, they shall be placed and rolled independently, each as a complete course.

-3.4 Rolling. After each course of the gravel base has been spread and prepared in the manner specified it shall be compacted by rolling with a power roller weighing at least 10 tons. Any irregularities or depressions that develop in each course under the initial or any subsequent rolling shall be corrected by loosening the surface and adding or removing materials until the surface presents a smooth regular appearance.

Rolling shall begin at the side and progress gradually to the center parallel with the center line of the roadway uniformly lapping each preceding track by one-half the width of the rear wheel. The rolling shall continue until the surface has been rolled by the rear wheels and until the maximum amount of compaction has been secured. After initial rolling has been completed on each course of the gravel base, it shall be machined with a road machine the blade of which is at least 8 feet long and which machine shall weigh not less than 1-1/2 tons. Machining and rolling shall be done as required or directed thereby maintaining a smooth, even, uniformly compacted base until the surface is placed thereon, unless otherwise specified or directed. Along curbs, headers, and other structures, and all places not accessible to the roller, the course shall be thoroughly tamped with hand tampers. Such tampers shall weigh not less than 50 pounds and shall have a face area of not more than 100 square inches.

-3.5 Testing Finished Surface. The finished surface of the Gravel Base Course shall conform so nearly to that required by the plans that it will nowhere vary more than one-half inch when tested with a 10-foot straightedge applied to the surface parallel to the center line of the pavement or from a templet conforming with the cross section shown on the plans. Such portions of the completed base as are defective in finish, compression, or composition or that do not comply in all respects with the requirements of these specifications shall be taken up, removed and replaced with suitable material properly laid in accordance with these specifications.

-4.1 Method of Measurement. The tonnage to be paid for shall be the number of tons, of 2,000 pounds, of gravel base course in place completed and accepted. The binder added shall be weighed and included in the tonnage.

-5.1 Basis of Payment. The tonnage, determined as provided above, shall be paid for at the contract unit price per ton bid for "Gravel Base Course," which price and payment shall be full compensation for furnishing material, including binder, for hauling, placing, rolling and finishing and for all labor, equipment, tools and incidentals necessary to complete the item.

52 GRAVEL BASE COURSE (Cubic Yard Basis)

52-1.1 Description. This item shall consist of a foundation course of gravel for a surface course or pavement or for another base course, constructed accordance with these specifications on a prepared subgrade, and in conformity the lines, grades, and typical cross sections shown on the plans.

-2.1 Materials. Material shall meet all the requirements prescribed for "Materials" in Item 51.

-3.1 Construction Methods. The Construction Methods shall be as required under "Construction Methods" in Item 51.

-4.1 Method of Measurement. The yardage to be paid for shall be the number of cubic yards of material furnished, and placed in accepted base course, measured in the vehicle.

-5.1 Basis of Payment. The yardage, measured as provided above, shall be paid for at the contract unit price per cubic yard bid for "Gravel Base Course (Cubic Yard Basis)" which price and payment shall constitute full compensation for furnishing and hauling all material and preparing, placing and rolling same, including all labor, equipment, tools and incidentals necessary to complete the item.

53 CHERT BASE COURSE

53-1.1 Description. This item shall consist of a foundation course of chert for a surface course or pavement or for another base course, constructed in accordance with these specifications on the prepared subgrade and in conformity with the lines, grades, thickness, and typical section shown on the plans.

-2.1 Materials. The materials for this item shall be composed of chert. Before any chert or binder material is used in the construction of the base course, it shall first have been approved by the engineer and shall be from chert pits indicated to the contractor in the Plans or Special Provisions attached to the proposal form.

The chert base course material shall be composed of hard, durable rock of high resistance to abrasion, with sand and clay or other satisfactory binding material, and shall be free from elongated pieces.

The chert when tested by means of square opening laboratory sieves shall meet the following requirements:

	Percent
Passing 1 inch sieve	100
Passing 3/4 inch sieve	85 - 100
Passing No. 4 sieve	55 - 85
Passing No. 10 sieve	40 - 65
Passing No. 40 sieve	25 - 50
Passing No. 200 sieve less than	25

Material of greater maximum size may be used but the largest aggregate should never exceed 1/3 the thickness of the stabilized layer and not more than 10 percent of the material should exceed 1 inch.

The fraction passing the No. 200 sieve shall be less than 1/2 the fraction passing the No. 40 sieve. The material passing the No. 40 sieve shall have a plasticity index not to exceed 6 and have a liquid limit of not more than 25 when tested in accordance with the methods of the Bureau of Public Roads.

-3.1 Construction Methods. The chert base course material shall be placed on the prepared subgrade. Blocks or other devices shall be used to secure the proper depth and alignment. The material shall be spread from dump boards or dumped directly on the prepared subgrade and distributed uniformly over the subgrade during the process of dumping. Care must be used in spreading the material so that no irregularities in contour shall develop. To insure the proper thickness, the contractor shall either set wooden blocks or pins of a height equal to the required depth of loose material and shall spread the material flush with the tops of the blocks or pins, and spread the material flush with the tops of the forms and use a strike-off templet cut to the crown of the roadway section.

The base material shall then be shaped and thoroughly mixed to secure a homogeneous surface and true to crown and grade.

-3.2 Roller Compaction. When the materials have been properly spread and mixed, the side boards shall be removed, and the spaces occupied by them filled with shoulder material. The shoulders shall be completed to the full width and height shown on the plans before compaction is begun. Then the base shall be rolled with a power roller weighing not less than 10 tons, until it is firmly keyed together into an even compacted surface. Any depressions or irregularities that develop under the first rolling shall be corrected by loosening the surface and adding or removing materials until the surface presents a smooth regular appearance.

Rolling shall begin at one edge of the roadway with wheel overlapping the shoulders about 1/2 the width of the rear wheel and progressing gradually to the center of the road, overlapping by 1/2 the width of the rear wheel each preceding track in such a manner as to insure uniform compaction of the chert material. Rolling shall begin then at the opposite edge and proceed as above until the whole surface has been rolled with the rear wheels. The roller shall be run in lines as nearly parallel to the center line of the roadway as possible and be a continuous operation. The rolling shall continue until the maximum amount of compaction has been secured. After rolling has been completed, the base shall be machined with a road machine, the blade of which is at least 10 feet long and which machine shall weigh not less than 3 tons. Machining shall be continuous and rolling done as directed, thereby maintaining a smooth, even, uniformly compacted base until the surface is placed thereon.

Unless the materials contain sufficient moisture to insure proper compaction and bending, the surfacing material shall be sprinkled with sufficient water at no extra cost to secure proper compaction and bond by rolling.

-3.3 Where so ordered in writing, the base course completed shall be continuously maintained under traffic by repeated machining with a blade grader and dragging with an approved long base maintainer or drag and by adding material where necessary, until thoroughly compacted. Such machining and dragging shall be continued at least twice daily or as may be directed by the engineer. Machining and dragging shall be done at such time as to take advantage of weather conditions and to secure maximum advantage of rainfall. When the surface on any section of the road is in a condition acceptable to the engineer further maintenance will be required only as conditions demand until just prior to priming, when upon order the road shall be machined and dragged twice daily for a period of three days, or oftener if required to place the surface in acceptable shape.

The contractor shall keep the traffic distributed over the entire width so that uniform compaction is secured by effectively blocking off parts of the traveled width as designated by the engineer.

-3.4 Testing Finished Surface. The finished surface shall be checked with a templet cut true to the required cross section and shall be parallel to the grade line shown on the profile. Also a 10-foot straightedge placed parallel to the center of the roadway so as to bridge any depressions and ordinates measured from the bottom of the straightedge to the surface of the roadway, shall not exceed 1/2 inch at any point.

Any variation in excess of above requirements shall be immediately corrected by readjusting the defective surface, or if deemed necessary, by complete removal and replacement of all unsatisfactory areas as may be directed by the engineer.

-4.1 Method of Measurement. The tonnage to be paid for shall be the number of tons (2,000 pounds) of Chert Base Course in place completed and accepted.

-5.1 Basis of Payment. The tonnage, determined as provided above, shall be paid for at the contract unit price per ton bid for "Chert Base Course," which price and payment shall be full compensation for furnishing material, for hauling, placing, rolling and finishing and for all labor, equipment, tools and incidentals necessary to complete the item.

54 CHERT BASE COURSE
(Cubic Yard Basis)

54-1.1 Description. This item shall consist of a foundation course of chert for a surface course or pavement or for another base course, constructed in accordance with these specifications on a prepared subgrade, and in conformity with the lines, grades and typical cross sections shown on the plans.

-2.1 Materials. Material shall meet all the requirements prescribed for "Material" in Item 53.

-3.1 Construction Methods. The Construction Methods shall be as required under "Construction Methods" in Item 53.

-4.1 Method of Measurement. The yardage to be paid for shall be the number of cubic yards of material furnished, and placed in accepted base course, measured in the vehicle.

(Item 54)
(Item 55)

-5.1 Basis of Payment. The yardage, measured as provided above, shall be paid for at the contract unit price per cubic yard bid for "Chert Base Course (Cubic Yard Basis)" which price and payment shall constitute full compensation for furnishing and hauling all material and preparing, placing and rolling same, including all labor, equipment, tools and incidentals necessary to complete the item.

55 DRY CHOKED STONE OR SLAG BASE COURSE

55-1.1 Description. This item shall consist of a foundation course for a surface course or pavement or for another base course and shall be constructed on a prepared subgrade in accordance with the specifications and in conformity with the lines, grades and typical cross sections indicated on the plans.

-2.1 Materials. The material shall be either crushed stone or crushed slag.

Crushed stone shall consist of clean, tough, durable fragments, free from an excess of flat, elongated, soft or disintegrated pieces, dirt or other objectionable matter and shall have a percent of wear of not more than 8.

Crushed slag shall be air cooled, blast furnace slag, and shall consist of angular fragments, reasonably uniform in density and quality, and reasonably free from thin, elongated or glassy pieces, dirt or other objectionable matter, and shall weigh not less than 65 pounds per cubic foot.

Crushed stone and crushed slag for coarse and fine aggregates when tested by means of laboratory sieves shall meet the following requirements.

STONE AND SLAG

Proportionate Amount (Square Mesh Sieves)	Coarse Aggregate	Fine Aggregate
Passing 2-1/2 inch	100	
Passing 2 inch	90-100	
Passing 1-1/2 inch	35- 70	
Passing 1 inch	0- 15	
Passing 3/4 inch		100
Passing 1/2 inch		90-100
Passing No. 100		0- 30

-3.1 Construction Methods. The coarse aggregate shall be spread on the prepared subgrade to such depth that after compaction and completion of the Dry Choked Stone Base Course, the finished base course shall conform to the grade and cross section required on the plans. The coarse aggregate shall be spread from piles along the side of the roadway, or from dumping boards, or by means of approved spreading machines or devices, or directly from trucks when such work is handled satisfactorily so as to spread the aggregate to the required depth in such manner that segregation of materials is prevented and uniform compaction may be secured. Unless otherwise directed the depth of the coarse aggregate shall be gaged by means of wooden blocks about 6 inches square and of a height equal to the required loose depth of the aggregate. After the gaging of the loose material for any one section has been completed, the blocks shall be transferred forward and the space occupied by them filled with aggregate. The coarse aggregate shall not be laid in excess

of 500 lineal feet without being rolled and covered with fine aggregate.

Any ruts, holes or defects which occur in the subgrade by reason of improper drainage conditions, traffic or hauling over the same, or from any other cause shall be corrected and rolled until firm before coarse aggregate is placed thereon.

-3.2 Rolling. The coarse aggregate shall then be rolled with a power driven roller weighing not less than ten tons until the aggregate is thoroughly compacted and keyed together.

Rolling shall start at the side and progress toward the center parallel with the center line of this roadway, uniformly lapping each preceding track by at least one-half of the width of the rear wheel and continuing until the material does not creep or wave ahead of the roller. The compacted coarse aggregate shall present a firm, even surface, true to the cross section shown on the plans and parallel to the finished grade. If any irregularities appear during or after rolling they shall be removed by loosening the surface and removing or adding coarse aggregate as may be required, after which the area disturbed, including the surrounding surface, shall be rerolled. Any coarse aggregate which becomes coated or mixed with dirt or clay shall be removed, replaced with clean coarse aggregate and rerolled. Along curbs, headers and other structures, and all places not accessible to the roller, the course shall be thoroughly tamped with hand tamper. Such tamper shall weigh not less than 50 pounds and shall have a tamping face area of not more than 100 square inches.

-3.3 Application of Fine Aggregate. After the coarse aggregate has been spread and rolled as required above, the fine aggregate shall be applied. The fine aggregate shall not be dumped on the surface of the coarse aggregate, but shall be spread in uniformly thin layers from piles along the side of the roadway, or from dumping boards. The rolling shall continue while the fine aggregate is being spread to aid in settling it to the bottom. The fine aggregate shall not be allowed to cake or bridge on the surface of the coarse aggregate in such manner as to prevent the perfect filling of voids, but shall be swept in with hand brooms. The spreading, sweeping and rolling shall continue until no more fine aggregate can be forced into the voids. No excess of fine aggregate shall be used, and irregularities which appear during the spreading and rolling of the fine aggregate shall be corrected by the use of coarse aggregate as heretofore outlined.

-3.4 Testing Surface. The finished surface of the Dry Choked Stone Base Course shall conform so nearly to that required by the plans that it will nowhere vary more than 1/2 inch when tested with a 10-foot straightedge applied to the surface parallel to the center line of the pavement or from a templet conforming with the cross section shown on the plans. Such portions of the completed base course as are defective in finish, compression or compaction, or that do not comply in all respects with the requirements of these specifications shall be taken up, removed and replaced with suitable material properly laid in accordance with these specifications.

-4.1 Method of Measurement. The tonnage to be paid for shall be the number of tons of 2,000 pounds each of dry choked stone base course in place completed and accepted.

-5.1 Basis of Payment. The tonnage, determined as provided above, shall be paid for at the contract unit price per ton bid for "Dry Choked Stone or Slag Base Course" which price and payment shall be full compensation for furnishing all material, for hauling, placing, rolling and finishing and for all labor, equipment, tools and incidentals necessary to complete the item.

(Item 56)
(Item 57)

56 DRY CHOKED STONE OR SLAG BASE COURSE
(Cubic Yard Basis)

56-1.1 Description. This item shall consist of a foundation course for a surface course or pavement or for another base course and shall be constructed on a prepared subgrade in accordance with these specifications and in conformity with the lines, grades and typical cross sections indicated on the plans.

-2.1 Materials. Material shall meet all the requirements prescribed for "Material" in Item 55.

-3.1 Construction Methods. The Construction Methods shall be as required under "Construction Methods" in Item 55.

-4.1 Method of Measurement. The yardage to be paid for shall be the number of cubic yards of material furnished, and placed in accepted base course, measured in the vehicle.

-5.1 Basis of Payment. The yardage measured as provided above shall be paid for at the contract unit price per cubic yard bid for "Dry Choked Stone or Slag Base Course" (Cubic Yard Basis) which price and payment shall constitute full compensation for furnishing and hauling all material and preparing, placing and rolling same, including all labor, equipment, tools and incidentals necessary to complete the item.

57 RECONSTRUCTED BASE COURSE
(Gravel, Clay Gravel or Chert)

57-1.1 Description. This item shall consist of the reshaping of the existing road and the addition of the required amount of new material, all of which shall be compacted to form a foundation course for a surface course or pavement or for another base course. This base course shall be constructed in accordance with these specifications and in conformity with the lines, grades and typical cross section shown on the plans.

-2.1 Materials. The material to be added shall, unless otherwise specified, be of the same type or character as the material encountered on the existing road bed; provided, however, that whenever it is found advantageous to the work and is so ordered in writing the contractor shall furnish gravel, clay gravel or chert, whichever is ordered and which will, when blended with the available material on the existing roadbed and tested by laboratory methods using sieves with square openings shall meet the following requirements:

	Percent
Passing 1-1/2 inch sieve	100
Passing 3/4 inch sieve	85 - 100
Passing No. 4 sieve	20 - 70

-3.1 Construction Methods. The existing roadbed shall be scarified as directed to a uniform depth below the surface and for the full width of the base course sufficient to eliminate all depressions and to permit uniform reshaping. The scarified surface shall then be reshaped. Additional approved material shall be added to bring the base course to the required thickness. The shoulders shall be completed and shaped to the final height, and aligned to the edge of the base course, before compaction begins.

-3.2 Roller Compaction. The base shall be rolled with a power roller weighing not less than 10 tons, until it is firmly keyed together into an even compacted surface. Any depressions or irregularities that develop under the first rolling shall be corrected by loosening the surface and adding or removing materials until the surface presents a smooth, regular appearance.

Rolling shall begin at one edge of the roadway with wheel overlapping the shoulders about 1/2 the width of the rear wheel and progress gradually to the center of the road overlapping by 1/2 the width of the rear wheel each preceding track in such a manner as to insure uniform compaction of the chert material. Rolling shall then begin at the opposite edge and proceed as above until the whole surface has been rolled with the rear wheels. The roller shall be run in lines as nearly parallel to the center line of the roadway as possible and be a continuous operation. The rolling shall continue until the maximum amount of compaction has been secured. After rolling has been completed, the base shall be machined with a road machine, the blade of which is at least ten feet long and which machine shall weigh not less than 3 tons. Machining shall be continuous and rolling done as directed, thereby maintaining a smooth, even, uniformly compacted base until the surface is placed thereon.

Unless the materials contain sufficient moisture to insure proper compaction and bonding, the surfacing material shall be sprinkled with sufficient water to secure proper compaction and bond by rolling.

-3.3 Traffic Compaction. In lieu of rolling, where so ordered in writing, the completed base course shall be compacted and maintained under traffic by repeated machining with a blade grader and dragging with an approved long base maintainer or drag and by adding material where necessary, until thoroughly compacted. Such machining and dragging shall be continued at least twice daily or as may be directed by the engineer. Machining and dragging shall be done at such time as to take advantage of weather conditions and to secure maximum advantage of rainfall.

The contractor shall keep the traffic distributed over the entire width so that uniform compaction is secured by effectively blocking off parts of the traveled width as designed by the engineer.

-3.4 Testing Finished Surface. The finished surface shall be checked with a templet cut true to the required cross section and shall be parallel to the grade line shown on the profile. Also a 10-foot straightedge placed parallel to the center of the roadway so as to bridge any depressions and ordinates measured from the bottom of the straightedge to the surface of the roadway shall not exceed 1/2 inch at any point.

Any variation in excess of above requirements shall be corrected immediately by readjusting the defective surface, or if deemed necessary by complete removal and replacement of all unsatisfactory areas as may be directed by the engineer.

-4.1 Method of Measurement. The square yardage to be paid for shall be the number of square yards of reconstructed base course completed and accepted.

The tonnage to be paid for shall be the number of tons (of 2,000 pounds) of additional supplementary foundation material furnished, incorporated and accepted; provided that when called for in the Bid Schedule the unit shall be the cubic yard measured in the vehicle.

The length used shall be the length measured along the center line of surface of the course and the width shall be the width shown on the typical cross section on the plans. The contractor will not be paid for any yardage of existing

base course that the engineer deems satisfactory for use without disturbing or reshaping.

-5.1 Basis of Payment. The accepted square yardage, measured as provided above, shall be paid for at the contract unit price per square yard bid for "Reconstructed Base Course" complete in place, which price and payment shall be full compensation for all scarifying, mixing, shaping, machining, watering, rolling, maintaining; and for all labor, equipment, tools and incidentals necessary to complete the item except the additional "Base Course Material" required.

The tonnage, or cubic yardage, as the case may be, of additional foundation material, determined as provided above, shall be paid for at the contract unit price per ton or per cubic yard bid for "Base Course Material," which price and payment shall constitute full compensation for furnishing and placing the material.

58 ROAD FOUNDATION REFORMED AND STABILIZED

58-1.1 Description. This item shall consist of the reshaping of the existing road, the incorporation of approved additional material as required to stabilize the existing metal, and the mixing, shaping and compacting of the blended materials to form a foundation for a surface course or pavement or for another base course, in accordance with these specifications and in conformity with the lines, grades and typical section shown on the plans.

-2.1 Materials. The additional or supplementary foundation material for this item shall be composed of gravel or of chert as required by the contract. Before any material is used in the construction of the course, it shall first have been approved by the engineer and shall be from pits indicated on the plans or Special Provisions.

The material shall be composed of hard, durable rock of high resistance to abrasion, with sand and clay or other satisfactory binding material, and shall be free from elongated pieces.

The blended material when tested by laboratory methods using square opening sieves shall meet the following requirements:

	Percent
Passing 1 inch sieve	100
Passing 3/4 inch sieve	85 - 100
Passing No. 4 sieve	55 - 85
Passing No. 10 sieve	40 - 65
Passing No. 40 sieve	25 - 50
Passing No. 200 sieve less than	25

Material of greater maximum size may be used but the largest aggregate should not exceed 1/3 the thickness of the stabilized layer and not more than 10 percent of the material should exceed 1 inch.

The fraction passing the No. 200 sieve shall be less than 1/2 the fraction passing the No. 40 sieve. The material passing the No. 40 sieve shall have a plasticity index not to exceed 6 and have a liquid limit of not more than 25 when tested in accordance with the methods of the Bureau of Public Roads.

-3.1 Construction Methods. The existing roadbed shall be scarified as directed to a uniform depth below the surface and for the full width of the base course sufficient to eliminate all depressions and to permit uniform reshaping. The scarified surface shall then be reshaped. The additional material shall be added to stabilize the existing metal and bring the entire course to the required thickness. The shoulders shall be completed and shaped to the height, and aligned with the edges of the course before compaction begins.

-3.2 Blending and Incorporating. The additional, supplementary materialse shall be thoroughly mixed and blended with the existing metal by use of scarifying equipment and by appropriate use of disc and other harrows, road machines or by other means that will incorporate the new material and produce a uniform, homogeneous material without causing accumulation of lumps on the surface. Areas where any segregation occurs shall be remixed and reshaped or reblended if and as necessary to correct any unsatisfactory condition.

-3.3 Roller Compaction. The base shall be rolled with a power roller weighing not less than 10 tons, until it is firmly keyed together into an even compacted surface. Any depressions or irregularities that develop under the first rolling shall be corrected by loosening the surface and adding or removing materials until the surface presents a smooth, regular appearance.

Rolling shall begin at one edge of the roadway with wheel overlapping the shoulders about 1/2 the width of the rear wheel and progress gradually to the center of the road overlapping by 1/2 the width of the rear wheel each preceding track in such a manner as to insure uniform compaction of the material. Rolling shall then begin at the opposite edge and proceed as above until the whole surface has been rolled with the rear wheels. The roller shall be run in lines as nearly parallel to the center line of the roadway as possible and be a continuous operation. The rolling shall continue until the maximum amount of compaction has been secured. After rolling has been completed, the course shall be machined with a road machine, the blade of which is at least 10 feet long and which machine shall weigh not less than 3 tons. Machining shall be continuous and rolling done as directed, thereby maintaining a smooth, even, uniformly compacted foundation or base until the intended surface course, pavement or other base course is placed thereon.

Unless the materials contain sufficient moisture to insure proper compaction and bonding, the material shall be sprinkled with sufficient water to secure proper compaction and bond.

-3.4 Finished Surface. The finished surface shall be checked with a templet cut true to the required cross section and shall conform thereto. The surface shall also be checked with a 10-foot straightedge placed parallel to the center of the roadway so as to bridge any depressions and ordinates measured from the bottom of the straightedge to the surface of the roadway shall not exceed 1/2 inch at any point.

Any variation in excess of above requirements shall be immediately corrected by readjusting the defective surface, or if deemed necessary by complete removal and replacement of all unsatisfactory areas as may be directed by the engineer.

-4.1 Method of Measurement. The square yardage to be paid for shall be the number of square yards of foundation course completed and accepted.

The tonnage to be paid for shall be the number of tons (of 2,000 pounds) of additional supplementary foundation material furnished, incorporated and accepted; provided that when called for in the Bid Schedule the unit shall be the cubic yard measured in the vehicle.

(Item 58)
(Item 59)

The length used shall be the length measured along the center line of surface of the course and the width shall be the width shown on the typical cross section on the plans. The contractor will not be paid for any yardage of existing base course that the engineer deems satisfactory for use without disturbing or reshaping.

-5.1 Basis of Payment. The accepted square yardage, determined as provided above, shall be paid for at the contract unit price per square yard bid for "Road Foundation Reformed and Stabilized" complete in place, which price and payment shall be full compensation for all scarifying, mixing, shaping, machining, watering, rolling, maintaining and for all labor, equipment, tools and incidentals necessary to complete the item except the additional "Foundation Material" required.

The tonnage, or cubic yardage, as the case may be, of additional foundation material, determined as provided above, shall be paid for at the contract unit price bid per ton, or per cubic yard for "Stabilizing Foundation Material," which price and payment shall constitute full compensation for furnishing and placing the material.

59 RECONDITIONING OF USED ROADBED
(Preparatory to Bituminizing)

59-1.1 Description. This item shall consist of scarifying, reshaping, patching, and recompacting the existing surface immediately prior to the application of prime coat or placing of bituminous wearing course.

-3.1 Construction Methods. Where the existing surface is of untreatede crushed stone or crushed gravel, the existing road including the shoulders shall be lightly scarified, if necessary, with a four-wheeled scarifier having a wheel base of not less than 16 feet to a depth just sufficient to eliminate all irregularities of the surfacing, and to permit reshaping. The road shall then be bladed to the cross section shown on the plans and compacted to a smooth riding profile, including watering and rolling if directed by the engineer.

Where a hard and well compacted base is encountered which might be weakened by scarifying the engineer may eliminate the scarifying and require hand patching, watering, tamping and rolling to correct all existing depressions, includinge aggregate for patching not to exceed 100 tons per mile.e

Where the existing surface has been previously bituminized all depressions shall be corrected by patching with bituminous coated aggregate in accordance with approved maintenance procedure or as directed by the engineer not to exceed 100 tons per mile so that a uniformly compacted and bituminized surface of the required cross section and profile will result.

-4.1 Method of Measurement. The mileage to be paid for under this item shall be the actual number of miles of "Road Reconditioning" completed and accepted.

"Watering" shall be paid for by the thousand gallon units measured in the vehicle at the point of delivery on the road.

"Roller Operation" shall be paid for by the actual number of hours which the roller is operated as ordered by the engineer.

-5.1 Basis of Payment. The mileage, determined as provided above, shall bee paid for at the contract unit price per mile bid for "Road Reconditioning" which price and payment shall be full compensation for furnishing all material and for all labor, equipment, tools and incidentals necessary to complete this item except watering and rolling.

Watering and rolling, determined as provided above, shall be paid for at the contract unit price per thousand gallon unit bid for "Watering" and the actual hours of "Roller Operation" which prices and payments shall be full compensation for the furnishing of water, distribution and rolling required including the furnishing of operators, gas, oil, and all labor, equipment, tools and incidentals necessary to complete the item except the furnishing and maintaining of water plant for the securing of water and the furnishing and maintaining of roller on the job. These items will be paid for at the respective lump sum price each bid for "Providing and Maintaining Water Plant" and "Providing and Maintaining Roller on the Job," as the case may be.

60 BITUMINOUS MACADAM BASE COURSE
(Asphalt or Tar Hot Application)

60-1.1 Description. This item shall consist of a base course or foundation for a pavement or another base course composed of bituminous macadam, constructed on the prepared subgrade or subbase or other base course in accordance with these specifications and in conformity with the lines, grades and typical cross section shown on the plans.

-1.2 For single course work this item shall consist of 350 pounds of crushed stone or crushed slag per square yard of completed base course, placed in graduated spreads and two penetration applications of bituminous binder in the amount per square yard ordered. For multiple course work the number of courses shall be as stated on the plans and each course shall consist of 350 pounds of crushed stone or crushed slag and bituminous binder, as prescribed for single course work.

-1.3 The sequence of operations and the amount of material in each shall be in accordance with the following Table I, which comprises one course. At the start of and during progress of the work, the weights of materials in the individual operations shall be varied and adjusted as ordered by the engineer in writing but the total weight per square yard of mineral aggregate for one course work, including maintenance piles, in all cases shall be the total appearing in Table I. The gallons of bituminous material in the individual operations and/or in the total base course shall be varied and adjusted as ordered by the engineer in writing at the start of operations and during progress of the work. When slag is used the amount of bituminous binder shall be increased 10 percent unless otherwise ordered.

TABLE I

	Amounts per Square Yard			
	Bit. Binder Gals.	Coarse Aggregate	Key Rock	Key Rock or Mineral Chips
First spreading		285 lbs.		
First application	1.85			
Second spreading			30 lbs.	
Second application	.30			
Third spreading			25 lbs.	
Maintenance aggregate				10 lbs.

-2.1 Materials. The aggregate shall be crushed stone or crushed slag.

Crushed stone shall consist of clean, tough, durable fragments, free from an excess of flat, elongated, soft or disintegrated pieces, dirt or other objectionable matter.

Crushed slag shall be air-cooled blast furnace slag and shall consist of angular fragments reasonably uniform in density and quality, and reasonably free from thin, elongated, or glassy pieces, dirt or other objectionable matter.

The aggregate shall be of such nature that when once thoroughly coated with the bituminous material proposed for the work the coating will not slough off upon contact with water.

The crushed stone or crushed slag, furnished respectively for "Coarse Aggregate," "Key Rock" and "Mineral Chips," shall meet the respective requirements for abrasion, toughness and weight per cubic foot when tested by A.A.S.H.O. Tests T-3, T-5 and T-19, all as specified in Table II, and the grading requirements when tested by A.A.S.H.O. Test T-27 specified in Table III.

TABLE II

	"Extra Hard" Aggregate		"Hard" Aggregate and Slag		
	Coarse	Filler	Coarse	Filler	Mineral Chips
Percentage of Wear (T-3)	3	3	6	6	6
Toughness	12	12	5	5	5
Weight per cubic foot (T-19)					70 lbs. (for slag)

TABLE III

Passing (Square Opening)	"Extra Hard" Aggregate		"Hard" Aggregate and Slag		
	Coarse	Filler	Coarse	Filler	Mineral Chips
	2½-inch	3/4-inch	3½-inch	1½-inch	3/4-inch
	Percent	Percent	Percent	Percent	Percent
3½ inches			100		
3 inches			90-100		
2½ inches	100				
2 inches	90-100		0-15		
1½ inches	5-25			100	
1 inch				90-100	
3/4 inch	0-5	100			100
1/2 inch		90-100		0-15	90-100
No. 4		0-15			0-15
No. 8		0-5			0- 5

-2.2 Bituminous Material. The material supplied under this specification shall be (1) asphalts prepared by the distillation of asphaltic petroleum or by the fluxing of hard native asphalts with suitable petroleum flux, or (2) refined tar.

Those materials only which have been demonstrated by service tests as satisfactory for the intended use will be acceptable under this specification. Only one kind, type and grade of material shall be used in any one contract.

The asphalt shall be homogeneous, free from water, shall not foam when heated to 347°F. and shall meet one of the following sets of requirements:

Designation	A.A.S.H.O. Test	AP-3		AB-2	
		Min.	Max.	Min.	Max.
Specific gravity	T-43	1.000		1.040	1.060
Flash point	T-48	347°F.		347°F.	
Softening point	T-53	104°F.	140°F.	140°F.	122°F.
Penetration	T-49	85	100	100	120
Loss at 325°F.	T-47		1%		3%
Pene. drop	T-49		40%		50%
Bitumen (Sol. CS_2)	T-44	99.5%		95%	
(a) Organic Insols			0.2%		
(b) Inorganic insols				1.5%	3%

Petroleum asphalt for any one contract shall not vary more than 0.020 in specific gravity nor more than 18°F. in softening point within the test limits above specified. No mineral matter other than that naturally contained in the asphalt shall be present.

-2.3 Refined tar shall be homogeneous and free from water and shall meet the following requirements:

Designation	A.A.S.H.O. Test	TP-4-25		TP-3-25	
		Min.	Max.	Min.	Max.
Specific gravity	T-43	1.200	1.260	1.15	1.20
Float test at 122°F.	T-50	130	190	130	190
Total distillate	T-52				
To 338°F.			1%		1%
To 518°F.			10%		10%
To 572°F.			20%		20%
Soft. pt. of residue	T-53		149°F.		149°F.
Bitumen (Sol. CS_2)	T-44	80%	95%	95%	

-2.4 Sources of Supply. Approval of sources of supply of the mineral aggregate shall be obtained from the engineer prior to delivery of material. Samples of each shall be submitted as directed.

A sample of the asphalt cement or refined tar that the contractor proposes to use in his work, together with a statement as to its source and character and, in the case of asphalt, the crude petroleum from which manufactured must be submitted and approved before construction begins. If the contractor proposes to prepare the asphalt cement at the paving plant then a sample each of flux and refined asphalt must be submitted and approved before construction begins, together with a statement as to the source and character of each and proportions in which they will be combined to produce the asphalt which he proposes to use. No asphalt cement, flux or refined asphalt, or refined tar other than that represented by the sample submitted, shall be used.

-2.5 Field Laboratory. The contractor shall provide a field laboratory in which to house and use the testing equipment. This laboratory is to be maintained to be used exclusively by the engineers or inspectors and shall be located in accordance with the engineer's instructions.

-3.1 Construction Methods. Performance methods employed and all equipment, tools and machinery used in any part of the work shall be subject to the approval of the engineer before the work is started and whenever found unsatisfactory thereafter shall be changed and improved as required by the engineer. All equipment, tools and machinery used must be maintained in a satisfactory working condition.

-3.2 The equipment outfit used by the contractor shall be made up of suitable units such as tractor-drawn or motor bladers, approved distributors and rollers supplemented by spreading and smoothing apparatus, steel brush or broom drag and other necessary finishing equipment designed and operated to avoid causing, as well as to remedy, corrugations and irregularities and to produce true riding surface of uniform texture.

-3.3 The Heating equipment supplied shall be of adequate capacity to heat properly the bituminous material involved. In all cases the heating of cars, tanks and distributors must be accomplished without introducing steam or moisture into the bituminous material. The use of any agitating accessory to aid in the heating will be prohibited if, in the opinion of the engineer, it injures or in any way changes the characteristics of the bituminous material. Any heating system or accessory which results in coking or burning of the material will be cause for disapproval of the equipment.

-3.4 Tank wagons and trucks used for the transportation or application of asphalt shall have either a steam or air-kerosene, or equivalent, system for the clearing of lines and pumps. Evidence of fluxing with kerosene or emulsification by steam will be sufficient cause for rejection of the delivery. Distributors shall have tires of sufficient width so that the load produced on the road surface shall be not greater than 650 pounds per inch width of tire. Pneumatic dual tires are required except that for reasonable cause the engineer by written order may waive this particular requirement.

-3.5 Distributors shall be equipped with suitable manifold and appliances so designed as to distribute evenly heated material at the temperature specified with an efficient positive control of the heat at all times. Sufficient and proper screens shall be installed between the tank and the nozzles, and the same shall be cleaned frequently to prevent clogging of the nozzles.

The distributor shall be so designed as to keep a constant and uniform pressure upon the bituminous material as it passes through the nozzles, and shall be equipped with devices and charts to provide at all times for accurate and rapid determination and control of the amount of bituminous material being applied per square yard of surface. Distributors shall be of an approved type equipped with thermometers reading temperature of tank contents, and tachometers reading speeds in feet per minute.

All self-powered distributors or trucks or other hauling units shall have sufficient power to maintain a constant and uniform speed over the aggregate. The equipment shall be so designed and articulated that uniform application of bituminous material may be made in controlled amount, ranging from 0.05 to 2.0 gallons per square yard of surface and at pressures of 25 to 75 pounds per square inch, and to a width of at least 15 feet.

-3.6 Rollers. All rolling required by the specifications shall be done with power rollers weighing not less than 12 tons with a compression on the rear wheels of at least 400 pounds per lineal inch of tire width. If excessive crushing of the stone is noted a roller weighing not less than 10 tons with a compression on the rear wheels of at least 300 pounds per lineal inch of tire width may be substituted upon written permission of the engineer. A sufficient number of rollers shall be furnished on the work to provide one roller for each 200 tons of macadam laid per 8-hour day.

-3.7 Conditioning of Existing Subgrade or Base Course and Shoulders. The subgrade upon which this base course is to be laid shall have been prepared as prescribed under "Preparation of Subgrade." If this base course is to be laid upon an existing base of a macadam type, it shall be swept thoroughly clean and, in case of a waterbound base course, in such manner as to expose the embedded aggregate to a depth of not more than 1/4-inch. This sweeping shall be done within 500 feet immediately in advance of spreading.

Except where there are curbs or headers, before placing any surface course stone the shoulders shall be constructed to the height of the finished macadam and of a width sufficient to carry the roller. The shoulders shall be true to alignment and grade and so constructed that the side next to the proposed edge of the macadam shall be approximately vertical.

-3.8 Spreading Coarse Aggregate. Upon this conditioned subgrade or base course between the shoulders the coarse aggregate shall be spread in the amount of 285 pounds per square yard. It shall be spread, from dumpboards, by means of approved stone spreaders or by other approved methods. It shall be spread to a uniform depth and in such manner that there shall be no deviation greater than 1/2-inch horizontally from the alignment and so that a true grade will be formed parallel to the profile grade shown on the plans. A testing templet cut to the crown of the finished course shall be furnished by the contractor and used to secure uniformity of crown. Power graders will not be permitted for use as spreaders.

Any thin, flat or oversized aggregate that appears on the surface at any time during the process of construction shall be removed therefrom. The coarse aggregate shall have a uniform distribution of size and all patches or areas of fine or undersized material shall be removed and replaced with suitable material before rolling. This correction shall be accomplished by hand picking wherever ordered and shall be continued after the initial rolling until the appearance and texture are uniform and all ridges are removed.

-3.9 Rolling. The coarse aggregate shall be dry rolled until the aggregate is compacted and keyed together. Rolling shall start at the side and progress toward the center parallel with the center line of the roadway, uniformly lapping each preceding track by at least one-half the width of the rear wheel and continuing until the material does not creep or wave ahead of the roller. At the edges the outside driver of the roller shall cover equal portions of the spread aggregate and the shoulder and the roller run forward and backward until the shoulder and metal are firmly bound together. The rolling shall stop before the voids are closed enough to prevent free and uniform penetration of the bituminous material; any irregularities greater than 3/8-inch when tested with a 10-foot straightedge applied parallel to the center line of the base course shall be loosened and reshaped with the same size and kind of material as that of which this course is constructed, and again rolled as required above. Material which crushes under the roller so as to prevent the free and uniform penetration of the bituminous material shall be removed and replaced by suitable material. Any depression shall be suitably eliminated. The compacted coarse aggregate shall present a firm, even

surface, true to the cross section shown on the plans and parallel to the finished grade and shall present a texture which will allow of uniform penetration of the bituminous material.

Along curbs, headers and other structures, and all places not accessible to the roller, the course shall be thoroughly tamped with machine or hand tampers. Hand tampers shall weigh not less than 50 pounds and shall have a face area of not more than 100 square inches.

Any aggregate in this or any subsequent spread which becomes coated or mixed with dirt or clay prior to the application of the bituminous material shall be removed, replaced with clean aggregate and rerolled.

After the stone has been spread and rolled and prior to applying any bituminous material, test holes shall be dug each 200 linear foot of base course to determine the uniformity of the depth of aggregate in place, which shall be measured and recorded carefully for purposes of information. These test holes shall be dug on each 200 feet of roadway, in two alternating series of three holes each. On the first section series No. 1 shall be dug, one test hole at the center of the base course and one on each side approximately six inches from the edges. On the second section series No. 2 shall be dug, one test hole at the center and one on each side at the quarter points. These alternate series shall be continued throughout the length of the pavement. The Government also reserves the right to make such additional tests of the completed surface course as may be deemed necessary to fully satisfy the engineer that the requirements have been fulfilled.

These test holes shall be dug and refilled by the contractor under the direct supervision of the inspector, which work shall be included in the contract unit price per square yard of pavement, complete in place.

-3.10 First Application of Bituminous Material. Over the clean surface of the coarse aggregate placed as required above, an application of bituminous material heated to not less than 250°F. nor more than 350°F. for asphalt, and not less than 200°F. nor more than 300°F. for tar, shall be made in the quantity of 1.85 gallons per square yard of surface unless increased by written order. No bituminous material shall be applied unless the entire depth of the stone surface course is thoroughly dry and the air temperature is at 40°F., or above, and in no case shall bituminous material be applied when conditions do not permit satisfactory penetration and adhesion.

The bituminous binder shall be distributed over the surface by approved distributors operating under a pressure at the nozzles of 25 to 75 pounds per square inch as may be directed. The area of distribution permitted before covering the bituminous binder with the next spreading shall be gaged according to the labor and equipment on hand for doing the work and as regulated by the engineer.

In order to insure uniformity at the junction of two loads, when the last of any load starts to thin, distribution shall be shut off, and upon resuming distribution building paper shall be spread over the latter portion of the previous application and the distributor shall lap back over this paper sufficiently to start the sprayers full force when the uncovered surface is reached. This building paper shall then be removed and destroyed. If building paper is not available a trough or other equivalent accessory may be used to collect the bituminous material until the full pressure of the distributor is obtained.

-3.11 Spreading Key Rock. Immediately after the application of the bituminous binder, key rock at the rate of 30 pounds per square yard shall be spread evenly

over the surface to fill the voids nearly to the surface. The key rock shall be added in small amounts as may be most effective while the rolling continues until the coarse aggregate is filled and firmly keyed. The surface shall then be rolled, care being taken that the rolling starts while the surface is still warm, until the bituminous binder is set up and the whole work is rolled to refusal and has become bonded to form a stable base course. The time, extent and manner of rolling shall be subject to the direction of the engineer.

Continuous care shall be taken in spreading this material to insure uniformity of surface. Sweeping the surface with push brooms or broom dragging shall be resorted to if in the opinion of the engineer it is necessary. No key rock shall be distributed over any portion of the coarse aggregate which has not received the first application of bituminous material and in no case shall the key rock be dumped directly on either the treated or untreated coarse aggregate.

-3.12 Second Application of Bituminous Material. After the work has been rolled to refusal, the base course shall be swept clean of all loose material and treated with a second application of bituminous material under the same conditions and in the same manner as specified above except that the rate of application shall be 0.30 gallons per square yard, as directed by the engineer. Bituminous material when applied to the upper course of stone shall have a temperature of not less than 300°F. nor more than 350°F. for asphalt, and not less than 200°F. nor more than 275°F. for tar. The contractor shall not allow the bituminous material to be overheated or burned. After the second application of bituminous material, key rock or mineral chips, as ordered, shall be spread at the rate of 25 pounds per square yard.

-3.13 For multiple course work the material and operations herein above prescribed shall be repeated in duplicate for each course shown and required by the typical cross section.

-3.14 Aggregate for Maintenance. Aggregate for maintenance shall be furnished by the contractor in the amount of ten pounds per square yard of base course. It shall consist of key rock or mineral chips, as ordered, and shall be of the same quality specified for use in the base course. It shall be neatly piled on the side of the road at such points as may be designated by the engineer.

-3.15 Testing Surface. The finished surface of the bituminous macadam base course shall conform so nearly to that required by the plans that it will nowhere vary more than 3/8-inch when tested with a 10-foot straightedge applied to the surface parallel to the center line of the base course or from a templet conforming with the cross section shown on the plans. In making this test the straightedge shall be advanced by increments of half its length, measurements shall be taken of the greatest space found between its lower edge and the base course surface which at no point shall exceed 3/8-inch. The entire road shall be thus tested at the center line and the quarter and third points, and elsewhere as ordered. Such portions of the completed pavement as are defective in finish, compression, or composition or that do not comply in all respects with the requirements of these specifications shall be taken up, removed and replaced with suitable material properly laid in accordance with these specifications.

-3.16 If at any time before the work is accepted any soft or imperfect places or spots shall develop in the surface, all such places shall be removed and replaced with new material and then rolled until thoroughly compacted and until the joints or edges at which the new work connects with the old become invisible. All such removal and replacing of unsatisfactory base course shall be done at the expense of the contractor.

-4.1 Method of Measurement. The tonnage to be paid for shall be the number of tons of aggregate of all gradings furnished and placed in the macadam, and in

the maintenance piles completed and accepted. The gallonage of bituminous material furnished and used in the completed work shall be determined from the manufacturer's invoices, which invoices shall show the actual gallons at the loading temperature, corrected to gallons at 60°F., in accordance with the A.S.T.M. D206-34. The gallonage so reported shall be checked by the engineer in the field.

If local stone or stone not shipped by rail is used it shall be weighed on scales furnished by and at the expense of the contractor. Said scales shall be sealed at the expense of the contractor as often as is necessary to insure their accuracy.

If the stone is shipped by rail or trucks, the actual car weights or quarry weights may be accepted, but scales shall be used as above, if so directed. The unit of measure shall be the ton of 2,000 pounds.

-5.1 Basis of Payment. The tonnage and gallonage, determined as provided above, shall be paid for at the contract unit prices per ton bid for "Bituminous Macadam Base Course" and per gallon bid for "Macadam Base Asphalt" or "Macadam Base Tar," as the case may be, which prices and payments shall constitute full compensation for furnishing all material, for hauling, placing, rolling, for applying bituminous material and finishing and for all labor, equipment, tools and incidentals necessary to complete the item.

61 HOT BITUMINOUS CONCRETE BASE COURSE

61-1.1 Description. This item shall consist of a base course composed of bituminous concrete, constructed on the prepared subgrade or sub-base in accordance with these specifications and in conformity with the lines, grades, thickness and typical cross section shown on the plans.

The bituminous concrete base course shall be composed of a mixture of "Mineral Aggregate" and "Bituminous Material." The mineral aggregate shall be a blend of a coarse material with fine materials as herein prescribed.

-1.2 General Composition of Base Course Mixture. The blended mineral aggregate, prepared as detailed hereinafter, shall be graded and combined to meet the following composition limits by weight.

Proportionate Amount (Square Mesh Sieves)	Percent
Passing 1-1/2 inch	100
Passing 1 inch	75 - 90
Passing 1/2 inch	35 - 65
Passing No. 4	25 - 40
Passing No. 200	0 - 5
The proportion of bitumen to total aggregate by weight shall be:	
Bitumen (Sol. CS_2)	4.5 - 7

-1.3 Formula for Job Mix. The general composition limits prescribed above are master ranges of tolerance to govern mixtures made from any raw materials meeting specifications, and they are maximum and minimum for all cases. A closer control

appropriate to the job materials is required for the specific project in accordance with the job mix formula as follows. No work shall be started on the specific project nor any mixture accepted therefor until the contractor has submitted and received approval of his intended job mix formula, indicating in writing the single definite percentage for each sieve fraction of aggregate, and for asphalt, which he chooses as the fixed mean in each instance, and also the temperature at which he proposes to deliver the mixture at the job. The submission of such job mix formula shall, upon approval and thereafter, bind the contractor to furnish paving mixture not only within the above master ranges, but, as a further requirement, also meeting the exact formula thus set up for the project, within allowable job tolerances of plus or minus .4 percent for asphalt, plus or minus 7 percent for the 1/2-inch, and for larger screen requirements, and plus or minus 4 percent for the No. 4 and for smaller sieve requirements, and for delivery temperature or mixture plus or minus 20 degrees. Samples of the actual mixture in use will be taken as many times daily as necessary in the discretion of the engineer, and the mixture must be maintained uniform throughout the project within the above tolerances. If an additional source of supply for materials is approved the job mix formula will be readjusted as necessary. Any job mix formula submitted but found unacceptable shall be readjusted to the satisfaction of the engineer.

-2.1 Materials. The bituminous material shall be asphalt prepared by thee distillation of asphaltic petroleum or by the fluxing of hard native asphalts with aesuitable petroleum flux, and shall meet the requirements tabulated for AP-6, AB-6 or AT-6.e

The asphalt shall be homogeneous, free from water, shall not foam when heated to 347°F, and shall meet one of the following sets of requirements:

Designation	A.A.S.H.O.	AP-6		AB-6		AT-6	
		Min.	Max.	Min.	Max.	Min.	Max.
Sp. gr.	T-43	1.010		1050	1070	1.200	1.250
Flash pt.	T-48	347°F.		347°F.		347°F	
Soft. pt.	T-53	104°F.	140°F.	113°F.	131°F.	113°F	131°F.
Pene.	T-49	50	60	50	60	50	60
Duct. 77°F.	T-51	40		40		40	
Loss 325°F.	T-47		1%		3%		3%
Pene. drop	T-49		40%		50%		50%
Sol. CS_2	T-44	99.5%		94%		68%	
Insol. CS_2	T-44						
Organic			0.2%				
Inorganic				2.5%	4%	20%	30%

The material furnished under this specification shall be uniform in character and shall not vary more than 18°F. in softening point from the test limits specified, nor more than 0.020 in specific gravity where no maximum limit is specified. No mineral matter other than that naturally contained in the asphalt shall be present.

Those materials only, which have been demonstrated by service tests as satisfactory for this specific type of mixture and use, will be acceptable under this specification. Unless otherwise required by Special Provisions, the contractor may elect to furnish any type covered by the tabulation. Only one kind, type and grade of material shall be used in any one contract.

-2.2 Coarse Mineral Aggregate. The coarse material shall be either broken stone or broken slag. Only one kind and type of material shall be used in any one contract except by written permission from the engineer.

Broken stone shall consist of clean, tough, durable fragments, free from an excess of flat, elongated, soft or disintegrated pieces, dirt, or other objectionable matter.

The stone shall come from ledges conforming to the following requirements:

Percent of wear, not more than	6
Toughness, not less than	6

-2.3 Broken slag shall be air cooled, blast furnace slag, and shall consist of angular fragments reasonably uniform in density and quality and reasonably free from thin, elongated or glassy pieces, dirt or other objectionable matter.

The dry slag shall meet the following requirement:

Weight per cubic foot	Not less than 70 pounds

-2.4 Fine Mineral Aggregate. The fine material shall consist of sand (ore a blend of sand and stone screenings) composed of clean, tough, rough-surfaced and angular grains. The material after drying shall be free from lumps or balls of clay, or of clay and sand.

-2.5 Sources of Supply. Approval of sources of supply of mineral aggre-e gate shall be obtained from the engineer prior to delivery of material. Samples of each shall be submitted as directed.

A sample of the asphalt cement that the contractor proposes to use in his work, together with a statement as to its source and character, must be submitted and approved before construction begins. If the contractor proposes to prepare the asphalt cement at the paving plant then in lieu of the above, a sample each of flux and refined asphalt must be submitted and approved before construction begins, together with a statement as to the source and character of each and proportions in which they will be combined to produce the asphalt cement which he proposes to use. No asphalt cement, flux or refined asphalt, other than that represented by the sample submitted, shall be used by any contractor except with the written consent of the engineer, and provided that the asphalt cement used shall comply in all respects with the requirements of these specifications.

-2.6 Field Laboratory. The contractor shall provide a field laboratory ine which to house and use the testing equipment. This laboratory is to be maintained to be used exclusively by the engineer or inspectors, and shall be so located that details of the contractor's plant are plainly visible from one window of the building.

-2.7 Pavement Samples. The contractor shall furnish for test, when required by the engineer, samples cut from the completed work. The areas of pavement so removed shall be replaced with new mixture and refinished. No additional compensation will be allowed for furnishing test samples and replacing the areas with new pavement.

-2.8 Inspection of Paving Plant Operation. For checking the adequacy ofe the equipment in use, inspecting the conditions and operation of the plant, for the verification of weights or proportions and character of materials and for the determination and checking of temperatures being maintained in the preparation of the mixtures, the engineer or his authorized representative shall have access at any time to all parts of the paving plant.

-3.1 Construction Methods. The methods employed in performing the worke and all equipment, tools, and plant machinery used in handling materials and

executing any part of the work shall be subject to the approval of the engineer before the work is started and whenever found unsatisfactory shall be changed and improved as required by the engineer. All equipment, tools, machinery and asphalt plants used must be maintained in a satisfactory working condition.

-3.2 Plant and Machinery. The paving plant used by the contractor in thee preparation of the bituminous concrete shall comply with the following requirements.

The drier shall be of the rotating cylindrical type suitably designed to heat and dry the aggregates to specification requirements, without any direct flame coming in contact with the aggregate, and to agitate continuously the aggregate during heating. The drier shall be capable of preparing aggregate to the full rated capacity of the paving plant.

All plant screens shall be designed, constructed and operated so as to screen all aggregates to their specified sizes and proportions and shall have a capacity, when operated at normal speed, slightly in excess of the maximum capacity of the mixer.

The plant shall have a hot storage bin of sufficient capacity to furnish the necessary amount of all aggregates up to the maximum rated capacity of the plant with no undue periods of waiting for material.

Bins shall be divided into at least three compartments so proportioned as to insure adequate storage of appropriate fractions of the aggregate. To insure this provision, compartment spaces should be adjustable within reasonable limits. Each compartment shall be provided with an overflow pipe which shall be of such size and at such location to prevent all backing up of material into other bins.

The plant shall have a weigh box of sufficient capacity to hold the maximum amount of the aggregate material for one batch. The weigh box or hopper shall be supported on fulcrums and knife edges so constructed that they will not be easily thrown out of alignment or adjustment. Said weighing hoppers must be free from contact on all edges, ends or sides with any supporting rods or columns or other equipment that will in any way affect its proper functioning. In addition, there must be sufficient clearance between the hopper and supporting devices so that foreign materials will not accumulate. The discharge gate of the weigh box shall be so hung that the aggregates will not be segregated when dumped in the mixer. If necessary to correct any such tendency, baffles shall be inserted or other means provided to discharge the materials in a blended condition.

Scales for the weigh box may be either of the beam or springless dial type and shall be of a standard make and design, sensitive to one-half of one percent of the maximum load that may be required. When of the beam type, there shall be a separate beam for each size of aggregate and there shall be a "telltale" dial scale attached which will start to function when the load being applied is within 100 pounds of that desired. Sufficient vertical movements shall be provided for the beams to permit the "telltale" dial scale to function properly. Each beam shall have a locking device designed and so located that the beam can easily be suspended or thrown into action. Beam scales shall be balanced on knife edges and fulcrums and be so constructed that they cannot be easily thrown out of alignment and adjustment.

Dial scales shall be of a standard make and of sufficient size that the numerals on the dial can be read at a distance of not less than 25 feet. The dials shall be of the compounding type having full complement of index pointers. Any pointers so placed as to give excessive parallax errors shall not be used. They shall be substantially constructed, and makes of this type of scale which easily get out of adjustment shall be replaced with other makes when so ordered. All dial scales shall be so located that they will be in plain view of the operator at all times.

Scales for the weighing of asphalt cement shall conform to the specifications for the aggregate scales except that beam scales shall be equipped with a tare beam and a full capacity beam. The value of the minimum gradation in any case shall not be greater than two pounds. Dial scales for weighing the asphaltic cement shall have a capacity of not more than twice the weight of the material to be weighed and shall read to the nearest pound.

The contractor shall provide and have at hand the necessary number of standard test weights for frequent testing of all scales.

The weighing equipment, in addition to complying with the above requirements, must be constructed with the necessary adjustable devices that will permit any part thereof that gets out of alignment or adjustment to be readjusted easily so that the weighing device will function properly.

The asphalt weigh bucket shall be steam jacketed and have a capacity equal to 12 percent of the maximum capacity of mixer. It shall be supported on fulcrums and knife edges in the same manner as the weigh box.

Kettles for storage of asphalt cement shall have a total capacity sufficient for one day's run and shall be capable of heating the asphalt cement with an effective and positive control of the heat at all times to a temperature of between 250°F and 350°F. Heating of the asphalt cement by steam coils is preferred.

Under no circumstances will a direct flame from oil or other fuel be permitted to come in direct contact with the heating kettles. The asphalt circulating system shall be constructed of adequate size to give the proper and continuous circulation of asphalt cement throughout the operating periods. All asphalt lines and fittings shall be steam jacketed.

An armored thermometer reading from 200°F to 400°F shall be fixed in the asphalt line at a suitable location near the weigh bucket discharge valve.

The plant shall be further equipped with an approved dial scale mercury actuated thermometer, an electric pyrometer or other approved thermometric instrument so placed at the discharge chute of the drier as to register automatically the temperature of the heated aggregates. This device shall also be in full view of the drum fireman or head feeder.

The engineer reserves the right to pass upon the efficiency of the above instrument, and for better regulation of temperature of the aggregates, may direct the replacement of the instrument by some approved temperature recording apparatus and may further require daily charts of said regulator be filed with the engineer.

The mixer shall be a batch mixer of the standard twin pug mill type, steam jacketed, or of an approved rotary drum type, steam jacketed, equipped with a sufficient number of paddles or blades and set in proper order to produce properly mixed batches of any material required under these specifications. When the clearance in the twin pug type is equal to or exceeds 2 inches, either the shortened blades or the worn liners (or both) shall be replaced to reduce the clearance to 2 inches or less. Where the engineer encounters difficulty in securing proper mixing or the specified mixing time he may require that the mixers be provided with an approved accurate time lock that will lock the discharge gates of the weigh box after all the aggregates have been placed in the mixer, and that will not release the gates until the specified time has elapsed. For the minimum mixing time of 45 seconds hereinafter prescribed the mixer capacity shall be a 1500-pound batch, provided that where smaller mixers are approved no decrease in time of mixing will be allowed, and if sufficient mixing and coating is not secured the right is reserved to increase the required mixing time as may be judged necessary by the engineer.

-3.3 Preparation of Asphalt Cement. The bituminous material shall be meltede in kettles or tanks designed to secure uniform heating of the entire contents. The material shall be brought to a temperature of 250°F to 350°F.

When refined asphalt is to be combined with a flux the mixture shall be thoroughly agitated until a homogeneous asphalt cement of the required penetration is produced. The penetration of the asphalt shall be tested at suitable intervals to insure that it is maintained at a uniform consistency throughout the period of use.

-3.4 Preparation of Mineral Aggregate. The aggregate for the mixture shalle be dried and heated, at the paving plant before entering the mixer. The aggregates shall be heated to a temperature between 225°F and 350°F as determined on the mixing platform. When more than two ingredients enter into the composition of the mineral aggregate they shall be combined as directed by the engineer.

The aggregates, immediately after heating, shall be screened into three or more fractions and conveyed into separate bins, ready for batching and mixing with bituminous material.

-3.5 Preparation of Bituminous Concrete Mixture. The dried mineral aggregate, prepared as above prescribed, shall be combined in uniform batches by weighing and conveying into the mixer the proportionate amounts of each aggregate required to meet the job mix formula. The required quantity of hot asphalt cement for each batch shall be measured by weight using scales attached to the asphalt cement bucket. The mixture shall be made by first charging the mixer with the mineral aggregates. After these have been thoroughly mixed the asphalt cement shall be added and the mixing continued for a period of at least 45 seconds or longer if necessary to produce a homogeneous mixture in which all particles of the mineral aggregate are uniformly coated. Each batch must be kept separate throughout the heating and mixing operations.

The ingredients shall be heated and combined in such a manner as to produce a mixture which shall be at a temperature, when discharged, of not less than 250°F nor more than 350°F.

-3.6 Transportation and Delivery of Mixture. The mixture shall be transported from the paving plant to the work in tight vehicles previously cleaned of all foreign materials and when directed by the engineer each load shall be covered with canvas or other suitable material of sufficient size and thickness to protect it from the weather conditions. No loads shall be sent out so late in the day as to interfere with spreading and compacting the mixture during daylight, unless artificial light satisfactory to the engineer is provided. The mixture shall be delivered at the temperature specified by the engineer within 20°. The temperature will be specified in writing and will be between 225°F and 325°F.

-3.7 Prior to the arrival of the bituminous concrete mixture the underlyinge course shall have been brought to exact line, grade and cross section contour and shall be cleaned of all loose and foreign materials. Mixtures shall be laid only where the surface to be covered is dry and only where weather conditions in the opinion of the engineer are suitable. When the compacted thickness specified is greater than 3 inches, the base course shall be spread and compacted in separate layers of not over 3 inches compacted depth.

-3.8 Grade Control Forms. The alignment and grade of all forms set shalle be approved before and immediately prior to the placing of any material against them. Forms shall be cleaned thoroughly each time they are used. They shall remain in place until after the placing and final compaction of the surface course or courses. The forms shall be set at least 200 feet ahead of placing mixture. Sufficient forms shall be provided so that it will not be necessary to remove them in

less than one hour after all rolling and back finishing of the corresponding pavement surface is completed.

Except under conditions hereinafter given, fixed side forms for grade control shall be provided along both projected edges of the pavement and shall be of steel set to grade, whether the finishing machine, or the combined spreading and finishing machine, is of a type designed to ride entirely upon two side forms, or is of a type where the side forms carry only the weight and pressure of a reciprocating screed assembly. String or wire lines staked to grade will not be accepted as an equivalent for grade control forms.

(a)e In cases where a grade control form would come on a worn, hardenede pavement or where conditions would be adverse to setting conventional side forms with stakes, or for other reasons, narrow strips of bituminous concrete may be constructed, not less than 8 inches in width and laid and compacted to exact grade, or to a surface parallel to the grade, and may be used as grade control forms. Such bituminous strips shall be constructed of materials meeting the requirements of the particular course of which they form a part. They shall be armored with appropriate bearing plates if necessary for satisfactory use with the type of equipment employed.

(b) Where a suitable abutting curb or header is available and is approved by the engineer as in conformance with the intended profile grade, it may be utilized as a grade control form. Curbs or headers shall be armored with appropriate bearing plates if necessary to secure satisfactory results.

(c)e Where approved mechanical finishing, or approved mechanical spreading and finishing equipment, is in use which is provided with a screed or strike-off assembly one end of which is carried on and, as to elevation, is controlled by a grade control form and is so articulated with the machine that if one end, riding on the grade control form or approved equivalent, is correctly at grade, the other end and the entire strike-off may be controlled and held at grade by an approved leveling device, arranged so that the operator can positively and precisely maintain the assembly accurately level, no grade control form need be provided to carry such controlled end of the assembly.

(d)e Grade control forms may be waived where the pavement is being placede on a base which is parallel to the proposed finished surface of the course being laid and has been finished to the same surface tolerance as is required for such course, provided that the finishing machine in use has a longitudinal wheel-base of approximately 10 feet or more or the screed or strike-off action is controlled by a means of support of approximately 10 feet or more in length measured parallel to the direction of advance when in operation and that such wheel-base or support, except as otherwise permitted below, is in contact with such finished base surface and advances along it so as to provide continous and positive mechanical control of the screed or strike-off assembly, and so as to strike off the mixture to the exact grade and elevation intended without the aid of manual adjustment during operation.

Machines otherwise meeting all requirements and having the forward supports riding on and in contact with such finished base surface may have the rear supports arranged to ride on the newly struck surface if in practice it is found that such method of support does not introduce or add any element of nonuniformity or inaccuracy and does not result in injury to the pavement due to sudden or severe application of power to such means of support riding on the newly struck course.

-3.9 Timber for Grade Control Forms. Wood will not be permitted for gradee control forms where the form is 3 inches or less in depth. Where conditions and the course being laid are such as to require grade control forms of 3 inches or

less in depth, steel forms or bituminous strips shall be used unless other equivalents herein provided are available and utilized. Where grade control forms are more than 3 inches in depth wood may be used and in such cases shall meet the following specification.

Timber grade control forms shall be made of common structural, or better, joist and plank grade, or of common structural, or better, beam and stringer grade as the circumstances require. Pieces shall not be less than 16 feet long. When set in position the horizontal dimension shall not be less than 4 inches (nominal). The face next the pavement and the bottom and top faces shall be surfaced. Timber forms shall rest on the ground and on 2-inch by 3-inch supporting stakes, not less than 8 inches long, not more than 4 feet apart and shall be secured by side stakes not more than 4 feet apart driven vertically at intermediate points between the supporting stakes; the side stakes shall be not less than 1⅛ inches by 3 inches, and not less than 18 inches long. Timber forms shall be spliced with a section of plank. The joints of timber forms shall be so placed as to provide a gap of one-quarter inch between the ends of timbers, and shall rest upon supporting stakes of the size specified above.

The top edge of timber grade control forms shall be temporarily faced with steel strips during the passing of the paving machine. The steel strip shall be not less than 5/8 inch by 2½ inches in cross-section and not less than 8 feet long. The strips shall be firmly attached to the tops of the forms and a sufficient number of strips shall be provided to keep the forms faced well ahead of paving operations and prevent delay to the work. The steel strips may be removed after passing of the paving equipment.

-3.10 Retaining Forms. Where the plan of construction and the equipment and type of grade control forms in use are such that any edge of any bituminous course will be left unsupported during the construction operations retaining forms of any suitable material and design shall be used so far as considered necessary to prevent squeezing out or side shoving under the roller or other lateral displacement.

-3.11 Spreading and Finishing. Upon arrival at the work the mixture shalle be spread and struck off between fixed grade control forms, or equivalents therefor as hereinbefore provided, exactly conforming to the profile grade or to a predetermined surface parallel thereto. It shall be handled by mechanical spreading and finishing equipment provided with a screed or strike-off assembly, either a combination machine or in multiple units, to distribute it into place either for the entire width or for such partial width lanes as may be practicable, and to strike it off to the transverse crown required. The screed assembly shall be adjustable to give the cross section shape prescribed and shall be so designed and operated as to leave the pavement course of the weight per square yard required.

All spreading and finishing machines shall have a floating screed or strike-off assembly arranged to ride directly upon or to be controlled as to elevation of strike-off directly by the grade control forms or one of the equivalents hereinbefore permitted. Blade graders shall not be used. If during construction it is found that the spreading and finishing equipment in operation leaves in the new pavement tracks or indented areas, which are not satisfactorily corrected by the scheduled operations or produces other permanent blemishes, the use of such equipment shall be discontinued and other satisfactory spreading and finishing equipment provided by the contractor.

The term "screed" includes any cutting, crowding or other practical action which is effective on the mixture at the workability specified and obtainable, without tearing, shoving or gouging, and which produces a finished surface of the evenness and texture specified.

Except where the spreader is integral with the screeding machine, in order to secure a uniform distribution of the loose material, it will be necessary to use in front of the finishing machine a mechanical rake or equivalent to thoroughly loosen the material in order that the machine will produce uniform results.

Mixtures shall be laid only where the surface to be covered is dry and only when weather conditions, in the opinion of the engineer, are suitable.

On areas where on account of irregularities or unavoidable obstacles, the use of the mechanical spreading and finishing equipment is impracticable, the mixture shall be hand spread and screeded. On such areas the mixture shall be dumped on steel dump boards and spread and screeded to leave the weight required.

The contractor shall provide suitable means for keeping all small tools clean and free from bituminous accumulations. The contractor shall provide and have ready for use at all times sufficient tarpaulins or covers as may be directed by the engineer for use in any emergency such as rains, chilling winds, or unavoidable delays, for the purpose of covering or protecting any material that may be dumped and not spread.

-3.12 Compaction. After placing and while still hot the work shall bee thoroughly and uniformly compressed by rolling. Two rollers shall be used for securing compression. One shall be an 8 to 10-ton tandem roller and the other shall be a 10 to 12-ton 3-wheel power roller. The latter may be replaced by a 10-ton tandem roller upon written permission by the engineer. All rollers shall be kept in good condition, and shall weigh not less than 250 pounds to the inch width of tread. Each roller shall be in charge of a competent, experienced roller operator, and while the work is under way must be kept in continuous operation as nearly as practicable. The ashes from the roller must not be dumped upon the course. Rolling shall start longitudinally at the sides and proceed toward the center of the work, overlapping on successive trips by at least one-half of the width of the rear wheel of the roller. The work shall be subjected to a diagonal rolling in two directions, the second diagonal rolling crossing the lines of the first. If the width of work permits, it shall in addition be rolled at right angles to the center line. Rolling shall be continued until all roller marks are eliminated. The motion of the roller at all times shall be slow enough to avoid displacement of the hot mixture; and any displacement occurring as a result of the reversing of the direction of the roller, or from any other cause shall at once be corrected by the use of rakes and of fresh mixture when required. Rolling shall proceed at an average rate not to exceed 150 square yards per hour, per roller. To prevent adhesion of the mixture to the roller, the wheels shall be kept properly moistened, but excess water or oil will not be permitted. Care shall be exercised in rolling not to displace the line and grade of the side forms.

Along forms, curbs, headers and similar structures and all places not accessible to the roller, the mixture shall be thoroughly compacted with hot tampers. Such tampers shall weigh not less than 25 pounds and shall have a tamping face area of not more than 50 square inches. The surface of the mixture after compression shall be smooth and true to the established crown and grade. Any mixture which becomes loose and broken, mixed with dirt, or in any way defective prior to the application of the finish coat shall be removed and replaced with fresh hot mixture, which shall be immediately compacted to conform with the surrounding area. Areas of one square foot or more showing an excess of asphalt cement shall be removed and replaced.

-3.13 Joints. Placing of the course shall be as nearly continuous as possible; and the roller shall pass over the unprotected end of the freshly laid mixture only when the laying of the course is to be discontinued for such length of time as to permit the mixture to become chilled. In all such cases, including the formation of joints as hereinafter specified, provision shall be made for

proper bond with the new surface for the full specified depth of the course. Joints shall be formed by cutting back on the previous day's run so as to expose the full depth of the course. When the laying of the course is resumed the exposed edge of the joint shall be painted with a thin coat of hot asphalt cement, or asphalt cement thinned with naphtha; and the fresh mixture shallobe raked against the joint, thoroughly tamped with hot tampers and rolled.

-3.14 Surface Test of the Course. No portion of the finished course shall o be more than 3/8 inch below a templet, cut to the crown shown on the cross section drawings, placed on the courseoat right angles to the center line of the road ando no portion shall be more than 3/8 inch below a straightedge 10 feet in length, laid on the course parallel with the center line of the road. Tests for conformity with the specified crown and grade shall be made by the contractor immediately after initial compression, and variations corrected by removing or adding material as needed. The rolling shall then be continued as specified. After the final rolling and before acceptance of the work the smoothness of the course shall again be checked and all humps or depressions exceeding the tolerances specified shall be corrected by removing the defective work and replacing with new material as specified.

-3.15 Protection of the Work. Sections of the newly finished work shall be kept clean prior to laying the surface course or courses. No traffic except in connection with laying the surface course or courses shall be permitted on the base course.

-4.1 Method of Measurement. The tonnage to be paid for under this item shall be the number of tons (of 2,000 pounds) of hot asphalt concrete base course completed and accepted. The tonnage shall be actual weight.

oIf slag is to be used in competition, a separate total amount and bid itemo will be provided in the Bid Schedule and a separate unit price per ton of hoto asphalt concrete base course, slag aggregate will be required.

-5.1 Basis of Payment. The tonnage measured as provided above shall be paid for at the contract unit price per ton bid for "Hot Asphalt Concrete Base Course" or "Hot Asphalt Concrete Base Course, Slag Aggregate" which price and payment shall be full compensation for furnishing, hauling and placing all materials, for the preparation of all materials and for all labor, equipment,otools ando incidentals necessary to complete the item.