

2021.5

**DIVISION II  
CONSTRUCTION DETAILS**

**2021  
Mobilization**

**2021.1 DESCRIPTION**

This item shall consist of preparatory work and operations, including, but not limited to, those necessary for the movement of personnel, equipment, supplies and incidentals to the Project site; for the establishment of all Contractor's offices and buildings or other facilities necessary for work on the Project.

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**2021.5 BASIS OF PAYMENT**

Based on the lump sum Contract price for mobilization, partial payments will be made as follows:

- (a) On the first partial estimate that shows work performed on at least one major Contract item, 50 percent of the amount bid for mobilization will be paid, but not more than 3 percent of the original Contract amount; or
- (b) On the first partial estimate that shows work performed on each and every major Contract item, 100 percent of the amount bid for mobilization will be paid; or
- (c) When any previous partial estimate shows that 25 percent or more of the original Contract amount has been earned, exclusive of mobilization payments and all payments made for materials on hand but not yet incorporated in the work, 100 percent of the amount bid for mobilization will be paid on the next partial estimate.

The original Contract amount shall be the total value of all Contract items, including the mobilization item. Major Contract items may be listed as such in the Special Provisions or Bid Schedule. In the absence of such listing, these items shall be any Contract item or items having an individual amount in excess of 5 percent of the original Contract amount. In case no single Contract item exceeds 5 percent of the Contract, exclusive of the mobilization item, 50 percent of the mobilization will be paid upon completion of 5 percent of the original Contract amount, the remaining 50 percent will be paid in accordance with (c) above.

When the amount bid for the mobilization item exceeds 5 percent of the total original Contract amount, the Department reserves the right

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to withhold (on any partial estimate) the portion in excess of 5 percent until 95 percent or more of the original Contract amount is earned.

The total sum of all payments shall not exceed the original Contract amount bid for the mobilization item, regardless of the fact that the Contractor may have, for any reason, shut down work on the Project or moved equipment away from the Project and then back again.

Nothing herein shall be construed to limit or preclude partial payments otherwise provided by the Contract.

<b>Item No. Item</b>	<b>Unit</b>
2021.501 Mobilization .....	Lump Sum

**2031**

**Field Office and Laboratory**

**2031.1 DESCRIPTION**

This Specification covers the furnishing, maintaining, and removing field office and laboratory facilities for the exclusive use of Department personnel in making field tests and reports, for storage of records and equipment, and as field headquarters for the Engineer.

**2031.2 GENERAL PROVISIONS**

The Contractor shall furnish all field office and laboratory facilities in accordance with these provisions. The facilities shall remain the property of the Contractor. The Contractor shall furnish, maintain, and service the facilities with fuel, electrical power, sanitary services, access roads, and other required items. The Contractor shall provide telephone service to all field office and laboratory facilities. The phone service shall include a modular jack and a voice activated, beeperless, telephone recorder. The Contractor shall pay for the telephone installation, basic monthly phone service charges, and the removal of the telephone. The Contractor shall submit invoices for long distance telephone charges to the Engineer for payment.

The Contractor shall not place field offices, laboratories, equipment, or supplies within a distance of 8 m (**26 feet**) outside of the dripline of specimen trees or other vegetation designated to be preserved without approval of the Engineer. The Contractor shall also restrict traffic movement from this protected area. The Engineer may specify temporary fence and other protection measures according to 2572.

The Contractor shall locate, relocate, and maintain the facilities as approved by the Engineer unless the Contract specifies otherwise. The Contractor shall locate the field office and laboratory sites within the Right of Way whenever possible. If it is not possible within the Right of Way, the Contractor shall arrange for a site adjacent to the Right of Way. If it is necessary to rent the site, the Contractor will receive compensation for rent costs as Extra Work. The Engineer will give the

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Contractor reasonable advance notice before any unit is to be delivered to the Project, readied for occupancy, and relocated or removed. The Contractor shall not relocate or remove any unit from the Project without the Engineer's consent. However, the Contractor shall remove the facilities from the Project when released by the Engineer.

The Engineer may utilize field office units for the full life of the Contract including periods of work suspension and until the Certificate of final acceptance has been executed.

The Engineer will release field laboratory units upon completion of all field inspection work and acceptance as provided for in 1516, unless otherwise specified in the Contract. The Engineer will not utilize the laboratory units during periods of authorized winter suspension without the Contractor's permission or unless such use is otherwise specified in the Contract.

The Engineer will decide all disputes concerning site selection, placement conditions, service needs, and other functional matters.

#### 2031.3 REQUIREMENTS

##### A Basic Requirements

Each field office and laboratory shall be a separate mobile unit or building. The Engineer may approve other equivalent facilities. Separate quarters in stationary structures or combination trailer units will be accepted only if and when the location and mobility needs can be satisfied without appreciable inconvenience or loss of serviceability to the Department.

Each field office or laboratory unit shall be constructed and equipped to meet the following basic requirements:

- (1) Weatherproof thermal resistant construction with finished interior walls, ceiling, and floor, capable of being easily maintained and cleaned.
- (2) Exterior width of 2.4 m (**8 feet**) or more, and a floor to ceiling height of not less than 2.1 m (**7 feet**).
- (3) Two or more entrance doors with inside latches, at least one of which shall be an exterior door equipped with an outside lock and an opening of not less than 750 x 1930 mm (**30 x 76 inches**).
- (4) Commercial type windows of normal number and size, with a total window area not less than 20 percent of the unit floor area, and with inside latches on all vent windows.
- (5) Ceiling ventilator or exhaust fan, insect-proof screening on each exterior door and all vent windows, and Venetian blinds or effective awnings over all windows.
- (6) Artificial lighting system with fixtures providing adequate illumination over each desk and all work areas.
- (7) Portable or wall mounted plans rack.

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- (8) One or more multipurpose fire extinguishers that comply with applicable Federal and State safety and health regulations.
- (9) Electric heating system capable of maintaining a reasonably uniform temperature of 22°C (**70° F**) or more throughout the interior in all zones.
- (10) Minimum floor area, based on exterior dimensions, of not less than 21 m<sup>2</sup> (**230 square feet**) for the field office or 14 m<sup>2</sup> (**150 square feet**) for the field laboratory.

The exterior doors shall provide convenient and safe egress from the ends of the unit. Dimensions of the main door shall be not less than 750 x 1930 mm. (**30 x 76 inches**) A smaller auxiliary door may be allowed on laboratory units, at the discretion of the Engineer, provided it fulfills the basic needs for an emergency exit. The doors and passageways shall provide easy access to all areas of the unit.

#### **B Specific Requirements**

The interior layout of each unit shall be designed or arranged to make the furnishings easy to use, accommodate the use and storage of ordinary office machines and testing apparatus, and provide a reasonably modern and universally acceptable facility. Built-in furnishings and fixtures shall meet conventional standards. All desk, table, and work top surfaces shall be surfaced or finished with mar resistant materials.

All appliance installations, sanitary facilities, electrical circuitry, waste and water supply systems, venting, and safety features, shall meet Federal, State, and local regulations.

The field office or laboratory shall also be equipped to meet the following specific requirements:

- B1 Field Office Furnishings
  - B1a Two or more pedestal type desks with supply drawers, and a top width of at least 750 mm (**30 inches**). The desks may be either the portable or built-in type, having a top length of at least 1500 mm (**60 inches**). If one or both ends of the desk are mounted flush with a wall, however, the top length shall be at least 1800 mm (**72 inches**). Vacant wall space shall be provided for placement of a Department-furnished stenographic desk if one is not furnished.
  - B1b Three or more letter or legal size file drawers, either of the built-in or portable cabinet type, located for convenient access.
  - B1c One drafting desk with plan sheet and pencil drawer and with top dimensions not less than 900 x 1800 mm (**36 x 72 inches**). It shall be a commercially built, tilt or slant top desk of the wall mounted, pedestal, or cabinet style, but neither end shall be mounted flush with a wall.

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- B1d An enclosed storage cabinet or closet with adequate space for the usual outdoor garments, office supplies, and other materials not separately stored on open shelves or in desk drawers.
- B1e At least 6 m (**20 linear feet**) of open shelving not less than 300 mm (**12 inches**) wide above desks or at other convenient locations.
- B1f One drafting stool and sufficient desk chairs, preferably of a swivel type, for all desks and for at least two additional persons.
- B2 Field Laboratory Furnishings
- B2a One sturdily built work-bench situated along a side wall, with a work top not less than 3 m x 600 mm (**10 feet x 24 inches**), and with open space below for placement of a curing tank or other needed equipment.
- B2b One 300 mm (**12 inches**) deep service sink located near one end of the work-bench and with a capacity of not less than 75 L (**20 gallons**). The sink shall be recessed into the work-bench and have a water supply, faucet, and an outside drain.
- B2c An enclosed storage cabinet or closet with adequate space for the usual outdoor garments, standard supplies, and other miscellaneous equipment or apparatus that would ordinarily be stored for convenience or protection.
- B2d One desk or table with a suitable work top not less than 750 x 1500 mm (**30 x 60 inches**) located conveniently for clerical use and plans reviewing.
- B2e Two or more letter or legal size file drawers, either of the built-in or portable cabinet type, located for convenient access.
- B2f Two or more stools or chairs of suitable height to provide seating at both workbench and clerical desk.
- B2g At least 3600 mm (**12 linear feet**) of open shelving not less than 300 mm (**12 inches**) wide above the workbench or at other convenient locations.
- B2h One electric kitchen stove with four heating plates and electric oven. Separate heating plates may be substituted only with approval by the Engineer.
- B2i Blank
- B2j An electric exhaust fan or other approved mechanical means of achieving satisfactory air circulation and of exhausting air pollution.

#### **C Special Requirements**

All units shall be leveled and supported at the site as necessary for satisfactory placement. Unless other means are provided for acceptable weigh scale support, the field laboratory shall be rigidly supported to

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eliminate floor and work bench vibrations to an acceptable degree for accurate weighing on a bench-supported scale.

A curing tank shall be furnished by the Contractor for concrete test cylinder curing when the construction work involves casting of standard concrete test cylinders. The tank shall have adequate capacity and have dimensions that permit its installation below a laboratory workbench. The Engineer may authorize outside placement of the tank when it is to be used at the site of a field office.

The field office or laboratory shall also be equipped with the following special services, as indicated for the Type specified.

#### C1 Type A Service

Water supply of sufficient capacity to serve all needs for materials testing and test cylinder curing, as required for the work in progress. A storage tank with a capacity of 180 L (**50 gallons**) or more shall be furnished and installed at each field laboratory site where a pressurized water supply is not provided. The tank installation shall provide sufficient gravity pressure to maintain constant flow through the sink faucet.

#### C2 Type B Service

All Type A services, together with toilet and lavatory facilities, drinking water facilities, and trash disposal service. Detached portable toilets shall be conveniently located. A closed, faucet equipped, drinking water container or cooler with adequate supply of potable water shall be furnished when a potable pressure water system is not provided. Suitable trash containers shall be furnished and the accumulated trash shall be regularly removed from the premises. All of these facilities and services shall be provided to the satisfaction of the Engineer.

#### C3 Type C Service

All Type B services, together with electrical power supply and fixtures, including duplex outlet receptacles capable of providing adequate amperage for electric lighting and other appliance needs.

An electrically powered mechanical sieving apparatus shall also be furnished for determining particle size distribution of fine aggregate (minus 4.75-mm (#4) sieve). The apparatus shall accommodate six full height 200-mm (**4 inch**) round sieves with pan and cover (which will be furnished by the Department). The apparatus shall be equipped with an automatic timing device of at least 15 minutes duration. The complete apparatus must be approved by the Materials Engineer, by verification of sieving sufficiency in accordance with AASHTO T-27, before its acceptance.

#### C4 Type D Service

All Type C services, together with a thermostatically controlled heating and cooling system capable of maintaining a uniform temperature between 22 and 29°C (**72 and 85° F**) in all zones. Separate systems may be provided.

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C5      Type X Service

Type X Service shall apply only to field laboratory units, and then only in combination with one of the above described Types. When Type AX, BX, CX, or DX Service is specified, the Engineer shall have the right to utilize the prescribed laboratory unit as a combination office-laboratory facility for the full life of the Contract, including periods of work suspension and until the Certificate of Final Contract Acceptance has been executed according to 1516. Otherwise, the service requirements shall be as indicated for the first "letter" of the type designation.

**2031.4    METHOD OF MEASUREMENT**

The accepted field office and field laboratory units will be measured separately by the number and type furnished and utilized in accordance with the provisions of the Contract, regardless of the duration of its use at any one or different locations.

**2031.5    BASIS OF PAYMENT**

Payment for field office or field laboratory units of each type at the Contract bid price, or at any adjusted price provided for in the Contract, shall include full compensation for all costs of furnishing, placing, relocating, maintaining, and servicing the complete facility as required, including any removal and relocation costs incurred, but not including any costs incurred for public utility connections made necessary as the result of relocating the unit at the Engineer's direction, after its initial placement. Once the initial public utility connections have been made at the original site, any charges for utility connections will be at the Department's expense, unless the move is made by request of the Contractor. No extra compensation will be made for ordinary relocation expenses not involving public utility changes.

No payment will be made for field office or field laboratory units if the facility is not for the exclusive use of Department personnel for the contracted Project.

Payment for field office and laboratory facilities will be made on the basis of the following schedule:

<b>Item No.</b>	<b>Item</b>	<b>Unit</b>
2031.501	Field Office, Type .....	Each
2031.503	Field Laboratory, Type.....	Each

**2051**

**Maintenance and Restoration of Haul Roads**

**2051.1    DESCRIPTION**

This work shall consist of the maintenance, repair, and restoration of designated haul roads over which materials of the kinds and for the purposes named are hauled for the work covered by the Contract.

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### **2051.2 DEFINITIONS**

For the purpose of this Specification, the term "designated haul road" means any public road or street officially designated as a "haul road" (except a Minnesota trunk highway or road which has been officially designated by the Commissioner as a detour around a construction Project), over which materials from any source, of the kinds and for the purposes listed below are hauled. The hauling may be to points within the geographic limits of the Project or to points outside those limits if use of the material outside such limits is required.

- (a) Soil or other material for embankment construction.
- (b) Sand, gravel, or other material for backfill.
- (c) Sand, gravel, or crushed rock for base or surfacing courses.
- (d) Aggregates for bituminous surfacing, including the hauling of bituminous mixtures from the mixing plant.
- (e) Aggregates for concrete base or pavement, including the hauling of concrete batches from batch plants.
- (f) Bituminous materials and Portland cement for paving mixtures.

### **2051.3 DESIGNATION AND USE OF HAUL ROADS**

Where Maintenance and Restoration of Haul Roads is a bid item under the Contract, material of the kinds and for the purposes described above shall not be hauled from any source until the haul road from that source has been officially designated as a haul road. Thereafter, all materials hauled from that source shall be hauled over that road.

All vehicle trips, either loaded or unloaded, between material source(s) and the Project for the purpose of hauling materials described above shall be made only on a designated haul road.

If the Contract is with the Minnesota Department of Transportation for State Trunk Highway Projects, the Contractor shall select a haul road (or roads) to haul the materials previously described, and notify the Engineer as to the road (or roads) so selected. Within 15 calendar days after being notified of the haul road selection, the Commissioner will determine if the selected road (or roads) is an acceptable route. If the route is acceptable, the Commissioner will designate that road as a temporary trunk highway haul road.

If the Contract is with or for a governmental agency other than the Minnesota Department of Transportation, the Contractor shall select a haul road (or roads) to haul the materials, as previously described, and notify the Engineer representing that governmental agency as to the road (or roads) so selected. Within 15 calendar days after being notified of the haul road selection, the Engineer will determine if the selected road (or roads) is an acceptable route. If the route is acceptable, the Engineer will approve that road as a designated haul road.



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After a haul road has been officially designated, the Contractor may select a different road for official designation under the same conditions as previously stated. However, any changes made in haul road designation shall not relieve the Contractor of the obligation to restore the previously designated haul road if any of the above described materials were hauled over that road.

The Contractor will be required to reimburse the local government agency(s) for its haul road use on certain bituminous roadways as set forth below.

The Contractor shall verify spring load capacities of proposed haul roads with the local government agency(s). Reimbursement to local government agency(s) for concrete surfaced roadways is not required.

When a designated haul road has a bituminous surface and a spring load capacity of less than nine (9) **tons**, reimbursement to the local government agency(s) for haul road use shall be made at the rates as follows: \$0.007/metric ton of material per kilometer (**\$0.01/ton of material hauled per mile**).

The contractor shall make full payment to the local government agency(s) upon receiving notice of payment due and computations from the Engineer. The contractor shall provide the Engineer with confirmation of payment to the local agency(s). Should the amount due an individual local government agency be less than \$500, no payment will be required.

#### **2051.4 MAINTENANCE AND RESTORATION**

While hauling operations are in progress, the Contractor shall maintain the haul road in a condition satisfactory to the Engineer. This work shall include application of water, bituminous material, or calcium chloride to the road surface as may be necessary to alleviate dust nuisance and eliminate traffic hazards.

When hauling operations over any haul road are completed, the Contractor shall either:

- (a) Restore that haul road to a condition at least equal to that which existed at the time the hauling operations were started, or
- (b) Compensate the local road authority in an amount satisfactory to that road authority and concurred in by the Engineer for the restoration of that haul road by the local authority.

The fact that other traffic has used the haul road concurrently with the hauling of the above described materials shall not relieve the Contractor of the obligation to maintain and restore the haul road as above provided, except that, if any other contractor (or contractors) engaged in highway construction under a contract with the same governmental agency also has materials of the kinds and for the purposes described above hauled over that road concurrently with the

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hauling of materials for the Contract work, the Engineer will determine the amount of maintenance and restoration obligation to be shared by each.

The Engineer's determination as to the kind and amount of maintenance and restoration work required to restore the haul road to a condition equal to that which existed at the time the hauling operations were started shall be final, binding, and conclusive.

When hauling over any designated haul road has been completed and the Contractor has restored that road or has compensated for that restoration as required, the Engineer will accept such restoration or concur in such financial settlement for the restoration of the haul road in writing, and such acceptance will relieve the Contractor of any additional obligation in connection with the restoration of that road.

**2051.5 BASIS OF PAYMENT**

Payment for the Item, Maintenance and Restoration of Haul Roads, at the Contract lump sum shall be considered to be compensation in full for all costs of maintenance and restoration of all haul roads that have been officially designated and used in conjunction with the Contract work.

No payment will be made under the these provisions unless one or more haul roads have been both officially designated and used for hauling materials of the kinds and for the purposes described. When these two conditions are met, payment will be made at the lump sum Contract price regardless of the amount of maintenance and restoration work required, provided work has been completed acceptably or receipt of payment for such restoration has been certified by the local road authority.

If the Contractor fails or refuses to perform haul road restoration or to make satisfactory financial settlement for such restoration as required within the period specified in a written notice by the Engineer, the Department will cause the restoration work to be done and deduct the costs from any moneys that are or may become due the Contractor or require reimbursement from the Contractor's Surety.

Payment for maintenance and restoration of haul roads will be made on the basis of the following schedule:

<b>Item No.</b>	<b>Item</b>	<b>Unit</b>
2051.501	Maintenance and Restoration.....	
	of Haul Roads .....	Lump Sum

## 2101

### Clearing and Grubbing

#### 2101.1 DESCRIPTION

This work consists of removing and disposing of the trees, brush, stumps, roots, and other plant life, including dead and decayed matter, that exist within the construction area and that are not specifically designated to remain.

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#### 2101.3 CONSTRUCTION REQUIREMENTS

The Engineer will establish the Right of Way lines and construction limits within which the clearing and grubbing operations are to be confined. The Engineer will designate those trees, brush, and other vegetation that are to be preserved and those that are to be removed. The Contractor shall remove and dispose of the trees, brush, stumps, and roots from the limits designated for clearing and grubbing.

The Contractor shall salvage topsoil to the extent feasible in accordance with 2105.

The Contractor shall protect the items designated to remain in accordance with 1712 and 2572, place temporary fence, and conduct all clearing and grubbing operations in a manner that will not damage or jeopardize the surrounding plant life and property.

The Contractor shall prune low hanging, unsound, or unsightly branches from the trees and brush designated to remain. Pruning shall be performed in accordance with 2571.3.

#### **A Clearing and Grubbing Operations**

The Contractor shall cut off, remove, and dispose of the trees, brush, stumps, and roots from designated areas within the construction limits as a clearing and grubbing operation, for clearing operations, and for grubbing operations. The Contractor shall perform clearing and grubbing as required on the Project to construct the proposed improvements as planned, including the clearing and grubbing of designated areas outside those construction limits, either as indicated in the Plans or as designated by the Engineer in consideration of the following:

- (1) Within the Right of Way, the Engineer will designate and require the removal of trees, brush, stumps, and aesthetically undesirable items that can be viewed from the traveled way.
- (2) Within 5 m (**15 feet**) of the construction limits outside of structures, the Engineer will designate and require the removal of trees, stumps, roots, brush, and branches as necessary to protect and maintain the completed improvements.

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#### **B Clearing Operations**

The Contractor shall cut off, remove, and dispose of trees and brush in the areas designated as a clearing operation. When grubbing is not required, the point of cut off shall be within 150 mm (**6 inches**) of the ground.

#### **C Grubbing Operations**

The Contractor shall remove and dispose of the brush, stumps, roots, and other remains in the designated areas as a grubbing operation. Stumps shall be removed completely unless permitted to remain. If stumps are permitted to remain, they shall be cut off not more than 150 mm (**6 inches**) above ground, and flush with or below ground surface if so directed.

The Contractor shall fill all depressions resulting from the grubbing operations with suitable material and compact the material to the satisfaction of the Engineer, except in those areas to be excavated as part of the Contract work.

#### **D Disposal Limitations**

The Contractor shall dispose of trees, brush, stumps, roots, and other debris or byproducts by chipping, marketing, burning, or burying. The Contractor:

- (1) May chip the wood through a chipping machine and use or dispose of the chips to the satisfaction of the Engineer.
- (2) Shall use unchipped marketable trees or make them available to wood-using industries and individuals.
- (3) Shall comply with the disposal requirements for pine, elm, and oak wilt infected red oak trees.
- (4) Shall conduct burning according to 2104.3, Minnesota Rules Chapter 7009 and any applicable local ordinances. At no time shall waste tires, rubber or plastics or similar materials be used to ignite these wastes.
- (5) Shall conduct burying operations according to 2104.3, Minnesota Rules Chapter 7035 and any applicable local ordinances. The Contractor must first receive approval from the Engineer to bury vegetation material.

#### **D1 Marketable Trees**

The Contractor shall make marketable trees, which are designated for removal, available to wood-using industries or individuals. Marketable trees are all trees, except elm and oak wilt infected red oak trees, that have a diameter of 150 mm (**6 inches**) or more measured at a point 600 mm (**24 inches**) above the ground surface. The Contractor:

- (a) Shall not burn or waste marketable trees without having written proof from three potential wood-using industries or individuals that the wood is not wanted. This requirement only applies when the

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volume of marketable trees on the Project exceeds 75 m<sup>3</sup> (**100 cubic yards**).

- (b) Shall not dispose of marketable material remaining after harvesting by wood-using industries or individuals, without having written proof of first offered them to the public for use as firewood in accordance with the intent of Minnesota Statute 116F.30.
- (c) Is not required to make non-marketable trees available to wood-using industries or individuals.
- (d) Is not required to cut trees in lengths of less than 2.5 m (**6 feet**).

D2 Elm and Oak Wilt Infected Red Oak Trees

D2a Elm Trees

The Contractor shall dispose of all elm trees, brush, stumps, roots, and debris, together with the bark and byproducts with adhering bark of elm tree origin according to Minnesota Rules 1505.0230, 1505.0240, and 1505.0250 and local ordinances.

D2b Oak Wilt Infected Red Oak Trees

The Contractor shall dispose of all stumps, roots and debris from all oak wilt infected oak trees of the red oak and white oak families consistent with Minnesota Rules 1505.0320 and 1505.0340 and local ordinances.

D2c Disposal Deadlines and Locations

The Contractor shall dispose of elm and oak wilt infected red oak trees:

- (1) Within 20 calendar days of notification or of clearing and grubbing, whichever comes first, when the cutting operations are performed between April 1 and September 15.
- (2) By April 1 when cutting operations are performed between September 15 and March 31.
- (3) Within the Right of Way by burning, burying, or chipping, when allowed.
- (4) Off the Right of Way provided the trees, with intact bark, are processed within the time limitations.

D3 Pine

The Contractor shall dispose of all non-marketable pine trees, brush, stumps, roots, and debris by chipping, debarking, burning, burying, or covering with an air tight tarp within 20 calendar days of being cleared during the growing season.

D4 Blank

D5 Burning..... 2104.3

D6 Burying..... 2104.3

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The Contractor must obtain the Engineer's approval before burying vegetation material.

**E Temporary Fencing ..... 2572**

### 2101.4 METHOD OF MEASUREMENT

The Department will measure clearing and grubbing by area, lump sum, or individual unit basis as indicated in the Contract. Diameter will be determined by dividing the measured circumference by 3.14.

#### **A Qualifying Trees and Stumps**

The Engineer will only measure trees for payment that have a diameter of more than 100 mm (**4 inches**) at a point 600 mm (**24 inches**) above the ground surface.

The Engineer will only measure stumps for payment that have a diameter of more than 100 mm (**4 inches**) at:

- (a) A point 600 mm (**2 feet**) above the ground surface when the tree was cleared under the same Contract, or
- (b) The point of cutoff when the tree was not cleared under the same Contract.

No measurement will be made for the removal and disposal of brush nor of stumps having a diameter of 100 mm (**4 inches**) or less at the point of cutoff.

#### **B Area Basis**

When the hectare is the unit, quantities will be determined by measuring (to the nearest 0.02 ha (**0.5 acre**)) all areas cleared and all areas grubbed, within the limits shown in the Plans or staked by the Engineer. All measurements will be made horizontally to points 3 m (**10 feet**) outside the trunks of qualifying trees or stumps on the perimeter of the area being measured. Separate areas smaller than 0.02 ha (**0.05 acre**) will be considered to be 0.02 ha (**0.05 acre**).

Whenever isolated trees or stumps are to be removed outside the areas designated to be cleared or grubbed by the hectare, and no unit price is provided in the Contract for clearing and grubbing individual trees or stumps, payment will be made on the following basis:

- (1) Each isolated qualifying tree measuring less than 1 m (**40 inches**) in diameter at a point 600 mm (**2 feet**) above the ground surface, and each isolated qualifying stump measuring less than 1 m at the point of cutoff, will be considered as being 0.02 ha (**0.05 acre**).
- (2) Each isolated tree or stump measuring 1 m (**40 inches**) or more in diameter, at the points described above, will be considered as being 0.04 ha (**0.1 acre**).

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**C Individual Unit Basis**

When the tree is the unit, quantities will be determined by counting the number of qualifying trees cleared and the number of qualifying stumps grubbed.

**D Lump Sum Basis**

No measurement will be made of an individual area, tree, or stump when clearing and grubbing is a lump sum item.

**2101.5 BASIS OF PAYMENT**

Payment for the accepted quantities of clearing and grubbing at the Contract prices per unit of measure will be full compensation for all removal and disposal costs, including the costs of securing outside disposal sites as needed and of carrying out the specified treatment in disposing of elmwood, oak wilt infected red oaks, pine, and marketable trees.

Payment of the lump sum item for clearing and grubbing, regardless of the size of the trees and stumps, will be compensation in full for all costs of clearing and grubbing required.

The Contractor shall remove and dispose of brush and stumps having a diameter of 100 mm (**4 inches**) or less at the point of cutoff as an incidental item to the Contract.

The Contractor will not receive compensation for pruning except as allowed in 2572.5.

When the Proposal does not contain a pay item for clearing and grubbing, the Contractor will receive compensation as Extra Work for clearing and grubbing of qualifying trees and stumps, as described in 2101.4, required for construction of the Project. The Department will not make payment for clearing and grubbing non-qualifying trees and stumps.

Payment will be as follows:

<b>Item No.</b>	<b>Item</b>	<b>Unit</b>
2101.501	Clearing .....	hectare ( <b>acre</b> )
2101.502	Clearing .....	tree
2101.506	Grubbing.....	hectare ( <b>acre</b> )
2101.507	Grubbing.....	tree
2101.511	Clearing and Grubbing .....	lump sum

**2102**

**Pavement Marking Removal**

**2102.1 DESCRIPTION**

This work shall consist of the removal of pavement markings that conflict with revised traffic patterns. The markings will generally be in

### **2102.1**

the form of 100 mm (**4 inches**) wide paint film applied in solid or skip lengths, but may include other patterns, widths, or materials such as thermoplastic tape.

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### **2102.3 REMOVAL REQUIREMENTS**

Before effecting a change in traffic pattern, the Contractor shall remove all conflicting pavement markings approved by the Engineer, using methods and equipment that will not significantly damage the pavement structure or surface texture. Should the removal operations result in significant damage, as determined by the Engineer, the Contractor shall repair the damaged areas as the Engineer directs at no expense to the Department.

Whatever methods of removal are employed, the Contractor shall control or restrict operations to avoid exposing traffic to hazardous or detrimental conditions. Any expended materials or agents used in the removal process shall not be allowed to accumulate on the pavement surface but shall be promptly removed by suction or other approved methods as the work progresses.

Linear paint markings shall be removed so as not to leave a distinguishing pattern of removal. Where unsatisfactory results are achieved, the Contractor shall obliterate any deceptive lines remaining by applying a color-matched paint or asphalt sealer that will blend with the surface texture satisfactorily.

### **2102.4 METHOD OF MEASUREMENT**

Pavement marking removal will be measured by either area or length of the original markings as acceptably removed. Unless otherwise provided, markings of all types will be included for payment under a single Contract item.

Removal areas will be computed on the basis of nominal widths and actual lengths as originally applied and still evidenced at the time of removal. Other irregular shaped markings will be measured as enclosed within rectangular boundaries of least dimension as determined by the Engineer.

Removal length will be computed by the actual length of each pavement marking removed and will not include the gap between the broken lines.

### **2102.5 BASIS OF PAYMENT**

Payment for pavement marking removal at the Contract price per unit of measure will be compensation in full for all costs of obliterating the markings as specified and for all costs of restoring the original pavement texture as needed.



**2103.3**

Payment for this work will be made on the basis of the following schedule:

<b>Item No.</b>	<b>Item</b>	<b>Unit</b>
2102.501	Pavement Marking Removal ...	square meter ( <b>square foot</b> )
2102.502	Pavement Marking Removal .....	meter ( <b>linear foot</b> )

**2103**

**Building Removal**

**2103.1 DESCRIPTION**

This work consists of removing from the Right of Way those buildings that have been vacated and are not considered to have salvage value as buildings.

This work includes sewer and water service disconnections.

This work does not include the removal of sidewalks, driveways, or miscellaneous structures unless so indicated in the Contract.

**2103.2 BLANK**

**2103.3 REMOVAL REQUIREMENTS**

**A General**

The Contractor shall do all work in accordance with the applicable laws and ordinances.

The Contract will list the buildings to be removed, show the approximate location of each building by the street address or by reference to a survey station, and give a general description of the building. Building removal shall also include the listed miscellaneous removals from the locations indicated in the Contract.

In doing building removal work, the Contractor may remove any buildings (including all fixtures except those owned by public or private utilities) by demolition before removal from the Right of Way or remove any buildings from the Right of Way without demolition.

If the Contractor elects to move any building to another location, the Contractor shall obtain all necessary permits including those required by the Department.

The Department assumes no responsibility for the condition of any buildings at any time, and no guarantee is made or implied that any building will remain in the condition the bidder finds it at the time of examination before preparing the Proposal.

**B Removal**

The Contractor shall entirely remove all buildings and structures, including steps, basement walls, floor slabs, and footings from the Right of Way. Where the building rests on a concrete surface slab, the Contractor shall remove the entire slab and related footings.

**2103.3**

**C Utilities..... 1507**

**C1 Disconnection of Sewer and Water Services**

The Contractor shall locate, expose, cut off, and plug all sewer and water service connections at the sewer and water mains. The Contractor shall, at no additional compensation, plug all sewers leading from the building using watertight plugs.

The Contractor shall abandon wells in accordance with 2104.

**C2 Other Utilities**

The utility owners are responsible for disconnecting telephone, electric power, and other wire services, and gas service pipes outside the buildings, and removing fixtures belonging to such utility companies; however, the Contractor's attention is directed to 1507.

**D Disposal of Materials and Debris**

All materials removed, other than utility owned fixtures, and all debris resulting from the removal operations, shall become the property of the Contractor and the Contractor shall dispose of them in accordance with 2104.3C.

**E Filling Basements**

If the building was removed under a separate Contract, the Contractor shall fill all basements and other excavations made, as specified in the Contract. The Contractor shall fill the excavation to the level of the existing ground surface using sand, gravel, clay, loam, or other inorganic soil. The Contractor shall furnish the fill material from sources outside the Right of Way, subject to 1405. The Engineer will not require mechanical compaction of the fill material.

If the building removal is included in the same Contract as the grading, the Contractor shall remove the foundations according to 2103.3B and fill basements according to 2105.3G.

**2103.4 METHOD OF MEASUREMENT**

**A Building Removal**

The Department will measure all buildings listed for removal as a single lump sum.

**B Basement Fill**

When the Contractor is required to furnish the material for filling basements, and only then, the Engineer will measure basement fill as the volume of the air space within the basements, below the ground surface.

**C Disconnection of Sewer and Water Services**

The Department will measure each sewer and water service connection cut off and plugged at the main.

**2103.5 BASIS OF PAYMENT**

The Department will pay for the building removal item at the Contract lump sum as compensation for all costs of the work described

**2104.3**

above, except filling basements when the Contractor is required to furnish the fill material and for sewer and water disconnections.

The Department will pay for disconnect of sewer and water services at the main at the Contract unit price for each disconnection. This payment will be compensation in full for all costs involved, including restoration of street and property surfaces.

The Department will pay for building removal by the following schedule:

<b>Item No.</b>	<b>Item</b>	<b>Unit</b>
2103.501	Building Removal.....	lump sum
2103.505	Disconnect Sewer Service .....	each
2103.507	Disconnect Water Service .....	each
2103.511	Basement Fill.....	cubic meter ( <b>cubic yard</b> )

**2104**

**Removing Pavement and Miscellaneous Structures**

**2104.1 DESCRIPTION**

This work shall consist of the removal, in part or wholly, and satisfactory disposal of pavement, sewers, culverts, guardrails, abandoned structures, and other obstructions existing on the Right of Way, but not including bridges, covered under 2442, and buildings. The work shall include salvaging designated materials and backfilling the resulting trenches, holes, and depressions.

**2104.2 BLANK**

**2104.3 CONSTRUCTION REQUIREMENTS**

**A General**

Those structures and facilities that are to remain in place will be indicated in the Contract or designated by the Engineer.

The Engineer may determine that the existence of a structure or an obstruction does not interfere with, endanger, or detract from the new construction in any way, and therefore, may remain in place.

The Contractor shall remove and dispose of all structures and obstructions specifically included for payment in the Contract, except those that are specified to be removed by others or that are permitted to remain by the Engineer.

In an excavation area, excavation includes removal of all obstructions unless the obstruction is specifically identified for removal in the Contract as a separate pay item. If obstructions are encountered in the excavation operations that require removal, and that require equipment and handling substantially different from that employed in

### 2104.3

the excavation operation, the Engineer may pay for the removal as Extra Work.

#### **B Removal Operations**

All removal operations that may endanger new construction shall be completed prior to construction of the affected work. All materials that have been designated for salvage shall be removed in a manner that will not result in unwarranted damage. The salvaged material shall be dismantled into section or assembly units as required to facilitate removing in undamaged condition and permit convenient handling. Pipe materials shall be completely emptied of infiltrated material prior to being stockpiled.

##### **B1 Remaining Portion of Structure**

Where a portion of an existing structure is to be retained for use, that portion shall not be damaged during the removal operations. Where a portion of a reinforced concrete structure is to be removed and the structure extended, existing reinforcement bars shall be left in place for a distance of not less than 40 diameters from the face of the cut, to provide bond between the old and new concrete. Where a concrete box culvert is to be extended, the old structure shall be removed to the extent shown in the Plans.

##### **B2 Pavements and Sidewalks**

In removing pavements, sidewalks, and similar structures, where the cut will be exposed in the finished work, the structure shall be sawed along the removal line(s) with a concrete saw, unless the removal is made to an existing joint. The use of wedges driven into the saw cut to break off the portion to be removed will not be permitted. Elsewhere, the structure shall be cut and chipped to true lines and vertical faces.

The Contractor shall saw the existing concrete or bituminous pavement at the location(s) shown in the Plans and as staked by the Engineer for the purpose of establishing a neat line from which to extend the new work.

##### **B2a Sawing Concrete Pavement**

The Contractor shall saw concrete pavement along the removal line(s) to the depth indicated in the Plans, the pertinent Specification, or, in the absence thereof, to a depth 30 percent of the thickness of the concrete prior to breaking off the pavement.

##### **B2b Sawing Bituminous Pavement**

When sawing is specified, the Contractor shall saw bituminous pavement along the removal line(s) to a minimum depth of 75 mm (**3 inches**) prior to breaking off the pavement. When sawing is not specified, the Contractor may use other methods of removal that will produce a neat line acceptable to the Engineer.

## 2104.3

### B3 Integrant Curb

The Contractor shall remove integrant curb by controlled blasting, utilizing detonating cord of sufficient core load and so placed that the explosive force will effectively remove the curb to within 15 mm (**0.5 inches**) of the designated break line conforming to the normal pavement surface. Any projections extending more than 15 mm (**0.5 inches**) above the designated break line after blasting shall be removed by chipping with pneumatic hammers or by other approved methods. Overbreakage shall be held to a practical minimum by careful control of the blasting force. If any unacceptable overbreakage occurs, repairs shall be made as directed by the Engineer, using suitable patching mixture properly placed to restore the surface acceptably. Unless otherwise approved, the patching material shall be a suitable Portland cement concrete or mortar mix. All loose material shall be removed from the areas to be patched and an approved bonding agent shall be applied to the depression surfaces prior to placing the patching mixture.

After each blasting operation, the Contractor shall clean the traveled portions of the roadway of all debris before allowing resumption of traffic. All shoulder depressions resulting from the Contractor's operations shall be backfilled to the Engineer's satisfaction, prior to suspension of each day's operations.

All concrete removal debris shall be disposed of outside the Right of Way in accordance with this Specification.

### B4 Blank

### B5 Concrete and Masonry Structures

Within municipalities the Contractor shall entirely remove concrete and masonry structures located within the roadbed. Elsewhere, concrete and masonry structures located within the roadbed shall, unless they are specified to be removed entirely, be removed to an elevation at least 1200 mm (**4 feet**) below the surface of the subgrade. Concrete and masonry structures located outside the roadbed shall be removed to an elevation not less than 600 mm (**2 feet**) below the final ground surface.

The Contractor shall remove septic tanks, cisterns, and cesspools to the extent required above and in accordance with Minnesota Department of Health regulations.

The Contractor shall rebuild and reconnect live sewers when related manholes, catch basins, and drop inlets are removed. The Contractor shall provide a by-pass and maintain the service during the operations, to the satisfaction of the Engineer.

The upgrade ends of all drainage or sewer pipes leading from abandoned basements, manholes, or similar structures shall be plugged with concrete or masonry.

### 2104.3

Before filling abandoned basements, manholes, cesspools, septic tanks, cisterns, and similar structures that are not completely removed, the Contractor shall make holes in the bottom to prevent the entrapment of water.

#### B6 Timber Structures and Underground Tanks

The Contractor shall completely remove all timber structures and all underground tanks in accordance with applicable regulations.

#### B6a Underground Petroleum Tank

Contractors removing underground petroleum tanks and all related liquids and sludge residues must have MPCA certification.

The Contractor shall:

- (1) Give written notification to the Engineer at least 15 days prior to removal of the underground tank,
- (2) Obtain any required permits,
- (3) Have a MPCA Certified Supervisor on site during tank removal,
- (4) Drain all connecting pipes,
- (5) Close all connections except vents,
- (6) Remove all fluids, sludge residue, and explosive vapors from the tank,
- (7) Dispose of tanks in accordance with applicable Motor Carrier Safety and Hazardous Materials Transport requirements. During transport, all tanks shall be secured so that no material leaks from the tank onto the vehicle or onto the road, and
- (8) Give written certification to the Engineer within 30 days after removal of the tank that the tank, liquids, and residue have received proper disposal.

#### B7 Wells and Holes

All wells, well shafts, elevator shafts, environmental bore holes, and the like that are to be abandoned shall be filled and sealed by a Contractor licensed by the Minnesota Department of Health in accordance with the "Water Well Construction Code," Chapter 4725. Until permanently abandoned in accordance with the Code, wells, shafts, etc., shall be sealed or otherwise protected as necessary during the work to prevent any surface drainage from entering the opening. After abandonment and sealing has been completed, wells, shafts, etc., shall be removed to the elevations specified on the Plans or as designated by the Engineer. A copy of the completed Well Sealing Certificate shall be filed with the Department's Central Office Property Management Supervisor

#### B8 Miscellaneous Items

When removing railroad tracks, the Contractor shall remove all rails, ties, paving, crossings, track encasements, and other appurtenances.

### 2104.3

When removing guardrail and fences that are to be salvaged, the Contractor shall neatly coil the wire and cable, pull posts from the ground, and remove nails and staples from posts and boards.

#### **C Disposal of Materials and Debris**

The Contractor shall provide the Engineer with information and documentation substantiating proper disposal arrangements and operations. The Contractor's attention is directed to burying regulations, including Minnesota Rules 7035.2825. If waste materials or debris have been or are being disposed of improperly, the Engineer may order the Contractor to take corrective action. The Engineer may withhold payments until compliance is ensured.

The Contractor shall dispose of trees, brush, stumps, roots, and related vegetation according to 2101.3 and these requirements.

#### **C1 Disposal of Salvageable Materials**

The Contractor shall stockpile materials designated for salvage by the Department on the Right of Way at locations approved by the Engineer upon being removed, dismantled, and cleaned as required.

The Contractor shall dispose of materials not designated for salvage by the Department and all debris resulting from the removal and demolition operations as provided for in these requirements and in specific regulations imposed by laws, ordinances, orders, and decrees.

Materials of marketable value that are removed in accordance with these provisions, but that are not to be possessed by the Department, shall become the property of the Contractor and shall be removed from the Right of Way.

#### **C2 Disposal Within Right of Way**

The Contractor may dispose of noncombustible materials and debris other than metallic substances in the roadway embankments in accordance with 2105 for rock placement or by burying them under a minimum covering of 600 mm (**2 feet**) of earth material at locations approved by the Engineer.

The Contractor may burn combustible materials and debris within the Right of Way, provided the required burning permits are obtained. The Contractor shall conduct burning operations under the constant care of a competent caretaker and in accordance with all applicable regulations.

The Contractor may bury metallic materials and combustible materials or remains within the Right of Way at locations approved by the Engineer outside the roadbed, but not within the limits of a municipality. Before burying, the bulk must be reduced to a practicable minimum prior to being covered with earth.

### 2104.3

#### C3 Disposal Outside Right of Way

The Contractor shall dispose of all materials and debris outside the Right of Way when so designated in the Contract. The Contractor shall also dispose of all materials and debris, resulting from removal or demolition operations, which have no specific disposal provisions, at locations outside the Right of Way. The Contractor shall dispose of the materials and debris in a manner that will not create a public nuisance nor result in unsightly conditions within view of a public road, recreational area, residential district, or other place of public concern.

The Contractor shall arrange for and secure suitable disposal sites for materials and debris to be removed from the Project for disposal outside the Right of Way. The Contractor shall assume full responsibility for acceptable disposition of the material as well as for damages resulting from the disposal operations.

The Engineer will not give final acceptance of the work:

- (a) Unless disposal is made at a publicly controlled dumping site or some other established facility where the Engineer is satisfied that the material will be properly disposed of by and at no additional expense to the Department.
- (b) Until the disposal areas are in acceptable condition with respect to the Contractor's obligations.

#### **D Backfilling Depressions**

If the remains of partially removed structures prevent natural filtration of water, the Contractor shall make perforations in the structure bottoms prior to placing the backfill to prevent entrapment of water.

All depressions and air spaces within partially removed structures shall be backfilled with suitable material in accordance with 2105.

### **2104.4 METHOD OF MEASUREMENT**

No measurement will be made of any removals that are not required nor of any removals that are specifically designated as being covered by other Contract items.

Removal and salvage items will be measured separately by type of structure as identified in the item name. Measurements will be separated by size and kind of material only to the extent stated in the item Name.

#### **A Area**

Pavements, sidewalks, surfacing, and other uniform thickness items will be measured by area, without specifying thickness.

Pavement removal will be classified by kind of paving material whenever the material is comprised entirely of Portland cement concrete (remove concrete pavement) or entirely of bituminous-aggregate mixtures (remove bituminous pavement). Otherwise, when the pavement is comprised of a combination of different paving materials



## 2104.5

such as a concrete base or pavement overlaid with bituminous surfacing, removal of the entire structure will be accomplished under the unclassified item of "remove pavement." Regardless of classification, pavement removal shall include the removal of any integrant curb removed in conjunction therewith.

Removal of pavement in connection with the excavation of trenches for installation of drainage structures or utility items will be measured separately from other pavement removals, under the item of remove trench pavement, which shall include the removal of all paving courses including unclassified materials.

Removal of surfacing will be limited to the stripping of a wearing course overlaid on a concrete base preparatory to placement of a new wearing course thereon. This item will be classified by kind of material, such as: remove bituminous surfacing, remove brick surfacing, etc. Removal shall include any granular cushion course existing on top of the concrete base, if so required.

### **B Length**

Length measurements will be made along the longitudinal centerline of the structure, parallel to the base or foundation upon which the structure is placed, and from end to end of the structure as removed.

Pipe measurements will be made from center to center of junction fittings, catch basins, or manholes, and will include the length of any aprons required to be removed in conjunction therewith.

Sawing of concrete and bituminous pavements will be measured by length along the saw cut line(s) as staked by the Engineer when these pay items appear in the Proposal.

### **C Volume**

In the case of concrete or masonry structures, volume will be determined from measurements taken on the in place structure as it is being uncovered and removed except where the structure dimensions or volumes are otherwise established.

### **D Number (Complete Unit)**

All items designated for payment on a per each basis will be measured separately by the number of individual units removed, salvaged, or abandoned, including all appurtenances.

## **2104.5 BASIS OF PAYMENT**

Payment for the accepted quantities of remove, salvage, or abandon items at the Contract price per unit of measure will be compensation in full for all costs of removing the material or specified portions thereof, for disposing of the materials removed and the salvaging of parts thereof as may be specified, for the backfilling of depressions and other restoration work required, and for well abandonment procedures and the performance of all other work of a special nature that may be specified or imposed by laws, ordinances, and regulations.

**2104.5**

Payment for sawing will only be made for acceptable sawing of concrete and bituminous pavements when these pay items appear in the Proposal. All other sawing will be considered as incidental work to the Contract item.

Unless the Proposal includes an item for fence removal, the removal of abandoned fences shall be done at no expense to the Department, without any direct compensation being made therefor.

No direct compensation will be made for removing bituminous curbing, bituminous pavements less than 150 mm (**6 inches**) in thickness, and other minor encumbrances encountered within the limits of the roadway excavation that are not to be salvaged and that can be excavated and disposed of in the embankment or elsewhere without separate handling or the use of special equipment.

No direct compensation will be made for removing open metal flumes, metal curbs and gutters, and other similar metal items unless such materials are required to be salvaged.

In the case of salvage items, only those item units that are removed in acceptable condition will be measured for payment under the salvage items. Where removal is necessary, unacceptable units that are either damaged or deteriorated will be measured for payment under appropriate removal items or as Extra Work items in absence thereof. Otherwise, materials having insufficient salvage value shall be left in place where possible, without incurring removal expense.

If any materials designated for salvage are damaged due to negligence by the Contractor, the Department will deduct from any moneys due or becoming due the Contractor an amount equal to 60 percent of the current delivered price of new material of the same type and size as that damaged and equal to the quantity of material so damaged. The damaged material shall then become the property of the Contractor.

Removing the ends of old box culverts preparatory to extending the structure will be paid for by the cubic meter of removal or by each unit.

Backfilling depressions resulting from the removal of structures will be considered to be embankment construction, and no extra compensation will be made.

Payment for removing miscellaneous structures will be made on the basis of the following schedule:

<b>Item No.</b>	<b>Item</b>	<b>Unit</b>
2104.501	Remove (1).....	meter ( <b>linear foot</b> )
2104.503	Remove (1).....	square meter ( <b>square foot</b> )
2104.5075	Remove (1).....	square meter ( <b>square yard</b> )
2104.507	Remove (1).....	cubic meter ( <b>cubic yard</b> )
2104.509	Remove (1).....	each

**2105.2**

2104.511	Sawing Concrete Pavement .....	meter	<b>(linear foot)</b>
2104.513	Sawing Bituminous Pavement.....	meter	<b>(linear foot)</b>
2104.521	Salvage (1).....	meter	<b>(linear foot)</b>
2104.523	Salvage (1).....		each
2104.525	Abandon (1).....		each

NOTE: (1) Specify item name, such as: culvert pipe, sewer pipe, drain pipe, curb and gutter, curb, sidewalk, fence, concrete or masonry structures, railway track, manholes or catch basins, integrant curb, concrete pavement, bituminous pavement, pavement, trench pavement, guardrail, water well, etc.

**2105**

**Excavation and Embankment**

**2105.1 DESCRIPTION**

This work shall consist of constructing roadway excavations and embankments within the Right of Way and easements, including any grading that may be specified on roadside areas.

**2105.2 MATERIALS**

**A Excavation Material**

Classification of excavated materials on each section of the Project will be made by the Engineer as the work progresses. The excavations will be classified for payment in accordance with the following provisions:

**A1 Common Excavation**

Common excavation shall consist of all excavation materials not classified herein as rock excavation, muck excavation, common channel excavation, or rock channel excavation, and shall include the excavations classified as subgrade excavation when a separate item therefor is not included in the Proposal.

**A2 Rock Excavation**

Rock excavation shall consist of all materials that cannot, in the Engineer's opinion, be excavated without drilling and blasting or without the use of rippers, together with all boulders and other detached rock each having a volume of 1 m (**1 cubic yard**) or more, but exclusive of those quantities that are to be paid for separately under the item of rock channel excavation.

**A3 Muck Excavation**

Muck excavation shall consist of all saturated and unsaturated mixtures of soil and organic matter not suitable for foundation material regardless of moisture content, that is removed from below the natural

## 2105.2

ground level of marshes, swamps, and bogs over which embankments are to be constructed, where the excavation is required:

- (a) To provide a stable foundation for embankments, or
- (b) To accelerate the subsidence of unstable material under embankment load.

### A4 Subgrade Excavation

Subgrade excavation shall consist of all excavations made below the top of the final graded surface of the road and between the shoulder slopes that are not made for the purpose of obtaining topsoil and where the excavation materials are not classified for payment as rock excavation or muck excavation.

### A5 Common Channel Excavation

Common channel excavation shall consist of the excavation of channel changes outside the limits of the normal roadway excavation and embankment, together with the excavation of waterways leading to and from culverts but outside the roadway section, and includes the excavation of all materials encountered except for that which is to be classified for payment as rock channel excavation.

### A6 Rock Channel Excavation

Rock channel excavation shall consist of the same material as previously described for rock excavation, but includes only the material that is excavated in areas outside the normal roadway grading section as defined for common channel excavation.

### A7 Unclassified Excavation

Unclassified excavation does not include excavation that would be classified as muck excavation, common channel excavation, or rock channel excavation, but includes all other excavations, regardless of character or classification of material, that are not included for payment under separate items.

## **B Borrow Material**

Borrow material is material required for embankment construction or other specified purposes that is not available or is not to be obtained from the roadway excavations defined in 2105.2A. Unless otherwise provided in the Contract, borrow material shall be furnished by the Contractor from sources selected by the Contractor outside the Right of Way, subject to 1405 and 1602.

Borrow material will be classified in accordance with the material requirements given below. All borrow material furnished from sources selected by the Contractor must be approved by the Engineer prior to being delivered to the Project. The Contractor shall give the Engineer sufficient notice to permit any testing of the material that may be required for approval.

**2105.2**

When measurement of borrow material is to be made at the source by cross-section methods, the Contractor shall allow sufficient time, and arrange the operations, so as to leave the excavated areas in a condition that will permit the taking of original and final cross-sections as necessary for accurate determination of quantities.

Borrow material shall be furnished and placed only to the extent that the required materials are not obtainable from the excavations within the Right of Way.

If the Contractor places more borrow material than is required or ordered by the Engineer, and thereby causes materials excavated from within the Right of Way to be wasted, the quantity wasted will be deducted from the borrow material measurements.

If materials are encountered within the planned roadway excavation limits which are excess materials and which meet all specified requirements for a Plan designated borrow item, the Contractor may, at his/her option, utilize those materials in that portion of the roadway where said borrow item was designated. This does not apply to topsoil items.

If the Contractor elects to use such excess material as a borrow item, payment will be made at the respective Contract unit prices for both the excavation of the material and the item for which the excavated material is used. If the particular borrow item is not established in the Plan as a (P) Plan Quantity measurement, the Contractor shall perform its operations in cooperation with and as directed by the Engineer to provide for measurement of the material by the Department.

Whether the Contractor chooses to provide borrow from outside the excavation limits or as outlined above, any resultant excess material shall be disposed of outside the Right of Way at no additional cost to the State.

B1 Granular Borrow..... 3149

Material meeting the requirements for select granular borrow shall be furnished if so specified.

B2 Common Borrow

Common borrow shall consist of materials approved by the Engineer for use in the embankment construction or other specified purposes as the Engineer considers suitable.

B3 Topsoil Borrow ..... 3877

Material meeting the requirements for select topsoil borrow shall be furnished if so specified.

**C Salvage Material**

Salvage material shall consist of material available on the Project, such as native topsoil or aggregates in existing pavement and base courses, which is to be reserved for a specific use, either in the work

**2105.3**

under Contract or in future construction. Salvage of these materials will be required only when the Proposal contains separate and specific items therefor.

The material to be salvaged shall be stockpiled for future use or utilized in the new construction as indicated in the Plans. All salvage material used in the new construction shall be placed in accordance with the Specification requirements for the class of work in which it is used. Salvage operations shall be in accordance with the following provisions.

**C1 Salvaged Aggregate**

Salvage aggregate shall include all existing sand, gravel, or crushed rock materials that can be salvaged and utilized without pulverization.

**C2 Salvaged Topsoil**

Salvaged topsoil for general use as a growth medium shall be obtained from the soil horizons normally designated as "A" or "B", or shall be obtained from alluvial deposits.

As part of the salvaging operations, all debris and any stones exceeding 75 mm (**3 inches**) in greatest dimension shall be removed prior to stockpiling.

**D Stabilizing Aggregate ..... 3149**

**2105.3 CONSTRUCTION REQUIREMENTS**

**A General**

The Contractor shall complete all clearing and grubbing operations in an area according to 2101 prior to excavation and embankment operations. During winter construction, the Contractor shall remove all ice and snow from an area just prior to excavation or embankment construction operations.

The Contractor shall not begin excavation operations on any area until the necessary cross-sections have been taken and the necessary construction stakes and grades have been established to the satisfaction of the Engineer. No excavating shall be performed beyond the elevations, slopes, and limits established, without approval of the Engineer.

The Contractor shall schedule and conduct erosion control operations according to 1803.5.

The Contractor shall maintain all excavations and embankments in a well drained condition at all times. The Contractor shall install planned drainage facilities concurrently with the embankment construction, temporarily crown grades to minimize infiltration, and install temporary drainage facilities as directed by the Engineer. No material shall be stockpiled in a manner that will restrict surface drainage.

If the Contractor interrupts existing surface drainage, sewers, or subsurface drainage, the Contractor shall, at no expense to the

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Department, provide and maintain temporary drainage facilities as approved by the Engineer until permanent facilities are completed and operative.

#### **B Preparation of Embankment Foundation**

Before placing embankment on an existing slope steeper than 1 vertical to 4 horizontal, the Contractor shall either:

- (a) Flatten the existing slope to the extent that it will not be steeper than 1 vertical to 4 horizontal; or
- (b) Construct steps in the slope, with the back surface being as nearly vertical as practicable and with the horizontal cuts being made as close together as the slope permits, but with no step being less than 300 mm (**12 inches**) in width. All work required by these provisions is incidental work for which no direct compensation will be made.

Before placing any embankment 1 m (**3 feet**) or less in height, all soil that the Engineer considers unsuitable for use in the upper 1 m (**3 feet**) of the roadbed shall be removed from the area between the shoulder lines and disposed of as hereinafter provided.

Where embankment is to be constructed over swamp or marsh areas or at other locations where the foundation material is unstable, the foundation shall be excavated to remove unstable material as indicated in the Plans or as directed by the Engineer. Where non-granular soils are to be used for excavation backfill and embankments, the foundation area shall be free of standing water. No direct compensation will be made for removing such water from the excavation.

Wherever practicable, the foundations for all embankments shall be compacted between the shoulder lines by a tamping roller. Four passes shall be made on each strip the width of the roller. Other rollers may be used with permission of the Engineer. No direct compensation will be made for compacting the embankment foundations.

Before placing embankment over an old road, the Contractor shall remove any surfacing that is specified to be salvaged and excavate the old road core to an elevation 300 mm (**12 inches**) below subgrade, unless a greater depth is required by the Plans.

Before backfilling depressions within the roadway caused by the removal of foundations, basements, and similar structures, the Contractor shall enlarge the depressions as directed and use the material in the embankment.

#### **C Excavating Operations**

All excavations shall be made in conformity with the lines, grades, and slopes staked by the Engineer and as the Engineer may otherwise direct, based on the typical section and elevation controls shown in the Contract. Any excavating performed beyond the limits described by the

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stakes that was not authorized or ordered by the Engineer will be considered to be unauthorized work.

Excavations below final grade, for the purpose of removing unstable foundation materials or removing materials that are considered unsuitable for use in the upper portion of the roadbed, shall be conducted with the understanding that the excavation limits staked will be subject to change as the actual subsurface conditions are disclosed. Where granular backfill is used, seepage trenches shall be excavated for drainage as directed by the Engineer.

Excavations in rock shall be made to secure uniformity of grade and cross-section. All rock outcroppings shall be removed from within the slope lines staked and above the elevations shown in the Plans. All loosened material shall be removed from the backslopes. Roadbed excavating shall be conducted to provide drainage to the shoulder slopes and not to leave depressions that cannot be drained. Unless otherwise specified, presplitting will be required for all rock backslopes steeper than 1:1 in hard rock types such as igneous, metamorphic, and carbonates.

Blasting operations shall be controlled to produce a shattering effect on the rock that will not throw the material out of the excavation areas. The "coyote" method of blasting will not be permitted. Any rock blasted away from the excavation and embankment areas shall be recovered as directed. If seismic methods are used to monitor blasting, a record shall be furnished to the Engineer.

#### **D Disposition of Excavated Material**

Excavated materials shall be utilized, to the fullest extent practicable and so far as the material is suitable, for construction of the embankments or as otherwise indicated in the Plans. Each layer of the roadbed shall be constructed of uniform material. When excavation operations disclose the presence of different types of soil, the Contractor shall select the different materials and place them in the embankments or elsewhere as directed. In general, when granular materials are uncovered, they shall be placed in the uppermost portion of the embankment. Granular material shall not be removed from the Project without the written approval of the Engineer.

When the soils are so varied that selection and placement of uniform soils is not practical, the Contractor shall use disks, plows, graders or other equipment to blend and mix suitable soils to produce uniformity, to secure a uniform moisture content and to ensure uniform density. No capping of granular materials with nongranular materials will be permitted at or within 300 mm (**12 inches**) of the subgrade surface. In the event that the Engineer orders the Contractor to select materials to an extent greater than could be normally expected with the loading method employed by the Contractor, any additional costs incurred by the Contractor will be compensated for as Extra Work.



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The Engineer will designate those soils that are considered unsuitable or unstable with respect to the requirements of the Plans and the provisions hereof.

The Contractor shall remove the topsoil, store it in locations selected by the Contractor, and use it for topsoil covering at locations and to the minimum depths shown in the Plans. The Plans will indicate the quantity of topsoil considered necessary. If, at the time the Plans are prepared, it is known that there will not be sufficient topsoil available in the areas indicated above, the Proposal will contain a bid item for topsoil borrow, in which case the Contractor shall furnish the topsoil in excess of the quantity available within the Right of Way.

Peat, muskeg, and other unstable materials that are not to be used in the roadbed embankments shall be deposited in the areas indicated in the Plans or elsewhere as approved by the Engineer. All other material, including bituminous and concrete waste, that is considered unsuitable for use in the upper portion of the roadbed shall be placed in embankments at least 1 m (**3 feet**) below the top of the subgrade or outside of a 1:1 slope down and outward from the shoulder lines on fills under 10 m (**30 feet**) in height or outside of a 1 vertical to 1.5 horizontal slope down and outward from shoulder lines on fills over 10 m (**30 feet**) in height, or used to flatten the embankment slopes, or disposed of elsewhere as approved by the Engineer.

If no other disposition is specified, the excavated materials in channels outside of the roadway construction limits shall be used to fill abandoned portions of the channels and any remaining material shall be deposited in spoil banks or elsewhere as approved by the Engineer. Spoil banks shall be properly shaped and shall be provided with sufficient openings to permit natural drainage from adjoining property. Any topsoil excavated shall be used to cover the other fill material.

Snow, ice and frozen lumps exceeding 150 mm (**6 inches**) in greatest dimension will not be permitted in the roadbed embankments. Sod and frozen lumps less than 150 mm (**6 inches**) in greatest dimension may be placed only in that portion of the embankment which is outside of a 1:1 slope down and outward from the shoulder lines, but not over or adjacent to structures.

No stone, broken concrete or bituminous fragments exceeding 75 mm (**3 inches**) in greatest dimension will be permitted in the upper 150 mm (**6 inches**) of the roadbed embankment nor within 500 mm (**20 inches**) of a structure. No stones exceeding 150 mm (**6 inches**) in greatest dimension will be permitted in the upper 300 mm (**12 inches**) of the roadbed embankment. Stones or broken concrete exceeding 150 mm (**6 inches**) in greatest dimension, and other solid materials shall not be placed in embankment areas where piling is to be installed. Concrete and bituminous pavement or other such slabs of solid materials shall be processed or pulverized to the extent that the

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maximum size particles shall not exceed 150 mm (**6 inches**) in greatest dimension when used in the upper 1 m (**3 feet**) of embankment or backfill.

All combustible debris materials (stumps, roots, logs, brush, etc.), together with all noncombustible materials other than soils (oversized rock, broken concrete, metals, etc.) that cannot be placed satisfactorily in the embankments, shall be disposed of in accordance with 2104.3C.

All surplus excavated soils and rock that are not wasted, stockpiled, or otherwise disposed of as specifically allowed or required by the Contract shall become the property of the Contractor and shall be disposed of by the Contractor outside of the Project limits in accordance with a satisfactory Disposal Plan. This disposal plan shall constitute the Contractor's proposal for acceptable disposition of surplus materials outside of the Project limits in compliance with applicable environmental regulations, permit requirements, and any requirements or limitations imposed by the Contract. A satisfactory Disposal Plan shall be submitted to the Engineer prior to starting the disposal operations.

In the absence of Contract provisions requiring off-project disposal, such disposition of material will only be ordered as Extra Work, in which case an acceptable disposal plan will be required as a basis for agreement.

Whenever disposal sites are indicated in the Contract, whether on or off the Project, they are to be considered as being possible sites with the Contractor having the option of choosing other sites after award of the Contract under the disposal plan provisions, except in cases where mandatory disposition is intended.

#### **E Placing Embankments**

Roadbed embankments shall not be constructed during periods when the embankment material freezes while being placed and compacted, nor shall any embankment material be placed on soil that is frozen to a depth greater than 100 mm (**4 inches**). Where the foundation soil is frozen to a depth exceeding 100 mm (**4 inches**), at a time when weather conditions are such that embankment construction could be continued without the material freezing as it is being placed and compacted, the Contractor may be permitted to excavate the frozen foundation soil and proceed with the embankment construction for so long as the weather will permit, but only if and to the extent approved by the Engineer, and with the understanding that the additional costs involved shall be borne by the Contractor. The frozen soil shall be pulverized or wasted and replaced with other suitable soil as may be necessary to construct the embankments as specified.

Excavations below subgrade, together with any seepage trenches excavated to provide drainage, shall be backfilled in accordance with the requirements for embankment construction and with the

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material specified in the Contract, or with suitable materials obtained from the excavations if no other material is specified.

Before backfilling roadbed subcuts that are 750 mm (**30 inches**) or less in depth, the upper 150 mm (**6 inches**) of soil below the bottom of the excavation shall be compacted to 95 percent of maximum density.

Embankment material shall be deposited and spread in relatively uniform layers approximately parallel to the profile grade, and extending over the full width of the embankment. Earth moving equipment shall be routed evenly over the entire width of the roadway being constructed. Embankment widening construction shall proceed from the toe of the proposed slope inward toward the existing fill slope.

Layers in the upper 1 m (**3 feet**) of the roadbed shall not be more than 200 mm (**8 inches**) in thickness (loose measurement) and those below the upper 1 m (**3 feet**) shall be not more than 300 mm (**12 inches**) in thickness (loose measurement), except under the following conditions:

- (1) Where the foundation for the embankment (or backfill) is under water or is so unstable that it will not support the hauling equipment without appreciable displacement of the underlying soils, the embankment thereon may be constructed as one layer up to the lowest elevation at which the hauling equipment can operate over it without causing intrusion of the underlying soils into the upper 200 mm (**8 inches**) of the embankment so placed, but in no case shall the top of that layer be less than 1 m (**3 feet**) below the subgrade. The top of that layer shall be compacted to the satisfaction of the Engineer before any additional material is placed thereon.
- (2) When the embankment material is of a granular nature, not more than 20 percent of which will pass a 75  $\mu\text{m}$  (**#200**) sieve, the thickness of the layers in the upper 1 m (**3 feet**) of the roadbed may be increased to not more than 300 mm (**12 inches**) provided compaction is obtained by an approved compactor.
- (3) When the embankment material consists predominantly of stone, broken concrete, or rock fragments of such sizes that the material cannot be compacted, that material may be placed in the embankment up to an elevation 300 mm (**12 inches**) below the bottom of the subgrade, in layers not to exceed 600 mm (**24 inches**) in thickness, and with the exception that larger stones may be placed outside of the shoulder lines but not within the median area of a roadway.
- (4) Except as otherwise permitted in (2) above, embankment materials placed adjacent to structures within the roadbed shall be placed in layers not more than 200 mm (**8 inches**) in loose thickness, for a distance of at least 15 m (**50 feet**) on each side of pipes 1200 mm (**4 feet**) or less in diameter and 30 m (**100 feet**) on each side of

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other structures, and for the full height from the embankment foundation to the top elevation of the structure.

- (5) Except as may be necessary to obtain satisfactory compaction, layer construction will not be required in constructing such items as ditch blocks and entrances where the use of conventional equipment is impractical, nor in constructing such items as channel fills, spoil banks, and berms that do not provide foundation support for structural items.

Each layer consisting predominantly of rock or broken concrete shall be leveled prior to placing the next layer thereon, using suitable equipment operated in a manner that will provide even distribution of the larger rock or broken concrete and fill the voids with the spalls and finer material to form a compact mass.

If sufficient suitable material has not been made available to construct the embankments as specified, additional suitable material shall be obtained from sources designated by the Engineer. If additional material is obtained from sources outside the Right of Way, the furnishing of that material will be paid for as Extra Work.

If, at any time prior to or during construction, the Engineer determines that it is necessary to resort to a surcharge, the Contractor shall construct the embankment as directed by the Engineer. The surcharge shall continue until the Engineer considers that satisfactory subsidence has been obtained. If, at any time during the construction, the Engineer considers it necessary, the Contractor shall excavate relief trenches as directed by the Engineer adjacent to the toes of the embankment, and backfill them as required.

The Department reserves the right to install settlement plates within the approach embankments at any bridge site as well as in other embankment areas, together with measurement control points outside the embankments, all in such locations and numbers as the Engineer deems necessary to determine the stability of the embankments. The Contractor's operations shall not disturb such installations. Any settlement plates damaged or destroyed by the Contractor's operations shall be replaced at no expense to the Department. No compensation in addition to Contract prices will be made to the Contractor for any inconvenience or expense incurred as a result of these settlement plate installations.

At a time designated by the Engineer, the Contractor shall complete the embankment by adding more material or removing any excess. After satisfactory settlement of the embankment has been obtained and the slopes have been roughly finished, the excavated material temporarily deposited outside the embankment slopes shall be disposed of as shown in the Plans or as approved by the Engineer.

If embankment surcharge is ordered to achieve subsidence, in the absence of Contract provisions requiring the same, any equipment

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movement required thereby that would not otherwise be necessary will be compensated for as Extra Work. Unless otherwise specified, removal of excess materials deposited by order of the Engineer will be paid for as Extra Work to the extent the removal is ordered by the Engineer.

Before any embankment is placed behind abutments that support steel superstructures, the Contractor shall place temporary hardwood wedges, as directed by the Engineer, between the superstructure and abutment parapets. These wedges shall be removed when, in the opinion of the Engineer, satisfactory settlement of the embankment has been secured.

When the design of a structure is such that the strength of the substructure is dependent upon the restraining effect of the superstructure, the abutting embankment shall not be constructed until the superstructure has been completed to the extent necessary to provide the required restraint.

#### **F Compacting Embankments**

All roadbed embankment material shall be compacted as required herein for the specified density Method, except as otherwise provided for specific materials or portions of embankments.

Materials placed outside of a 1 vertical to 1.5 horizontal slope down and outward from the grading shoulder PI (point of intersection) on fills over 10 m (**30 feet**) in height, or outside of a 1:1 slope down and outward from the grading shoulder PI on fills of 10 m (**30 feet**) or less in height, will not be subject to the specified density requirements but shall be compacted in substantial conformance with the quality compaction method.

Mechanical compaction will not be required on those portions of the embankment that are constructed with material consisting predominantly of stone or rock fragments, nor in conjunction with placement of topsoil covering or roadside grading involving the filling of channels and depressions where acceptable consolidation is obtained with the grading equipment.

Density control shall not apply to waste materials (peat, muskeg, etc.) nor to any other non-rock material utilized for incidental drainage or landscape filling outside the roadbed embankment. However, such materials shall be consolidated to the satisfaction of the Engineer.

The Engineer shall have full authority to suspend hauling operations and the placement of additional embankment materials at any time, until the preceding layer has been fully compacted and its surface has been properly leveled.

#### **F1 Specified Density Method**

Where this method is specified, the Engineer will sample and test the soils that are to be used, to determine the maximum density and Optimum Moisture, and will make density and moisture tests on the

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compacted embankment, using methods described in the Mn/DOT Grading and Base Manual.

The upper 1 m (**3 feet**) of the embankment, together with those portions of the embankment that are below the upper 1 m (**3 feet**) but that are adjacent to structures and are subject to the same maximum layer thickness as the upper 1 m (**3 feet**), shall be compacted to a density of not less than 100 percent of maximum density. Those portions of the embankment that are below the upper 1 m (**3 feet**) and that are not adjacent to structures shall be compacted to a density of not less than 95 percent of maximum density.

At the time of compaction, the moisture content of the embankment material shall be not more than 115 percent of Optimum Moisture where 95 percent of maximum density is required and shall be not less than 65 percent nor more than 102 percent of Optimum Moisture where 100 percent of maximum density is required.

The minimum moisture requirement shall not apply to materials classified by the Engineer as Granular Material, nor shall the above specified moisture controls apply to materials placed without specified density control.

#### F2 Quality Compaction (Visual Inspection) Method

When this method is specified, the equipment used in constructing the embankment shall meet 2123 and each layer of embankment material shall be compacted until there is no evidence of further consolidation. Embankment construction shall not continue when, in the opinion of the Engineer, the existing soil moisture content does not allow proper compaction.

Compaction shall be obtained with a tamping roller or an approved type of vibratory compactor, except as otherwise provided for specific materials and portions of the embankments.

In plastic soils, pneumatic-tired, steel-wheeled, or grid rollers may be used for compacting embankment layers 75 mm (**3 inches**) or less in loose thickness or for compacting the upper 75 mm (**3 inches**) of thicker layers where a tamping roller will not produce an increase in density. In nonplastic soils, pneumatic-tired, steel-wheeled, or grid rollers may be used for compacting layers of 200 mm (**8 inches**) or less in loose thickness.

Compaction shall be obtained with special compacting equipment or by hand tamping methods where the use of conventional rollers is not feasible.

#### G Finishing Operations

All excavation, embankment and roadside areas involved in or disturbed by the construction shall be finished in reasonably close conformity with the established lines and grades, including any

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tolerances specified. The subgrade shall be finished and maintained as required by the applicable provisions of 2112. When compaction was obtained by the quality compaction method, the final shaping of the roadbed shall be done when, in the opinion of the Engineer, the moisture content of the upper portion of the roadbed is suitable for that work. If necessary, in conjunction with the final shaping, the Contractor shall, at no expense to the Department, scarify the roadbed to a depth of 150 mm (**6 inches**) and recompact it.

In conjunction with the final subgrade finishing operations, the upper portion of a granular subgrade shall be stabilized by incorporation of stabilizing aggregate if necessary to achieve satisfactory surface stability as determined by the Engineer. The aggregate shall be spread to the depth and width shown in the Plans or as needed and shall be mixed (if required) with the subgrade to the extent that stability is best achieved. After incorporation of the aggregate, the subgrade shall be recompact and shaped to produce a stable surface meeting the specified surface tolerances. When the material needing stabilization was furnished by the Contractor as a borrow material item, the furnishing and placing of stabilizing aggregate shall be at no expense to the Department. Otherwise, this work will be compensated for under the item "stabilizing aggregate", or as Extra Work in the absence of a Contract item therefor.

Earthwork finishing and topsoil covering operations shall be conducted concurrently with the grading operations so as to permit prosecution and completion of erosion control items at the earliest practicable time. Topsoil covering operations shall be carried out as soon as possible after the subsoil has been finished to grade on any significant area. At the time the topsoil covering is placed, the subsoil shall be in a loose, friable condition for a uniform depth of at least 75 mm (**3 inches**), and there shall be no erosion rills or washouts in the subsoil surface exceeding 75 mm (**3 inches**) in depth. To achieve this condition scarification of the subsoil will be required as directed by the Engineer, wherever the subsoil has been compacted by equipment operation or has become dried out and crusted, and where necessary to obliterate erosion rills.

Subsoiling shall be required to reduce soil compaction in all areas where turf establishment is shown on the Plan. Subsoiling shall be performed by the prime or excavating contractor and shall occur after topsoil placement.

The contractor shall schedule a 15 meter (**50 foot**), two directional test and demonstrate competence to the Engineer prior to continuing operations. The Engineer shall identify the test area. Subsoiled areas shall be loosened to less than 1400 kPa (**200 psi**) to a depth of 500 mm (**20 inches**) of the in-place and top soil. When directed by the Engineer, the Contractor shall verify that the subsoiling work conforms to the specified depth. To test for conformance, the Contractor shall use a

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cone penetrometer that meets standard ASAE Soil Testing Specifications of a 20 mm (**13/16 inch**) insertion rate per second.

After obtaining approval by the Engineer that the equipment and methods are sufficient to perform the work, the Contractor may proceed and complete the subsoiling operation. Work done without the Engineers approval will be considered as unauthorized work.

Subsoiling shall form a two-directional (90<sup>0</sup>) grid. Channels shall be created by a commercially available, multi-shanked, parallelogram implement attached to track-type equipment. The equipment shall be capable of exerting a penetration force necessary for the site. No disc cultivators, chisel plows, or spring-loaded equipment will be allowed. The grid channels shall be spaced a minimum of 300 mm (**12 inches**) to a maximum of 910 mm (**36 inches**) apart, depending on equipment, site conditions, and the Plan. The channel depth shall be a minimum of 500 mm (**20 inches**) or as specified in the Plan. If soils are saturated, the Contractor shall delay operations until the soil dries to field capacity or less.

Only one pass shall be performed on erodible slopes greater than 1 vertical to 3 horizontal. Work shall be at right angles to the direction of surface drainage, whenever practical. Exceptions to subsoiling include areas within the dripline of any existing trees, over utility installations within 750 mm (**30 inches**) of the surface, where trenching/drainage lines are installed, where compaction is by design (abutments, footings, or inslopes), and inaccessible slopes, as approved by the Engineer. In cases where exceptions occur, the Contractor shall observe a minimum setback, as directed by the Engineer.

Those portions of an old road that are abandoned, which are outside the grading areas as staked, shall be graded and finished to an acceptable contour that blends with the adjoining terrain. On all areas where an old roadbed or temporary haul road have been located, and are to receive turf, the existing soils and granular material shall be removed and replaced and/or subsoiled to provide not less than 500 mm (**20 inches**) of loose, friable soil below the finished surface. All structural material including granular, shall be removed. Any temporary haul removal costs will be incidental to the Project. Removed material may be disposed of off the Project site or recycled on the Project if approved by the Engineer.

All depressions resulting from structure removals, debris burying, grubbing operations, and other causes, shall be backfilled with suitable material to the designated contour and so as to conform with any pertinent requirements. All debris and any stones exceeding 75 mm (**3 inches**) in diameter on the soil surface at the time of performing the final blading operations shall be removed from the Project site. They shall be disposed of in accordance with 2104.3C (Disposal of Materials



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and Debris). If pre-existing to the Project, debris and stone removal will be paid for as Extra Work.

All work involved in the finishing operations, as specified herein and as otherwise required by the Contract, shall be compensated for as part of the payment for Contract items covering excavation, removals, or the furnishing of material.

#### 2105.4 METHOD OF MEASUREMENT

The Department will determine quantities for excavation and embankment according to 1901 as modified by these provisions.

##### A Excavation Material

The Department will determine the quantities by excavated volume (EV) of the excavation material in its original position. Volumes will be computed by the average end area method determined from original and final cross-sections.

In excavations classified as rock, the measurement will include a volume allowance for overbreakage if the plane of the bottom of the excavation falls within a layer or stratum of rock. Unless other limits are shown on the typical grading sections, measurements will include a 150 mm (**6 inches**) overbreak allowance outside the grading section as staked, with the exception that 500 mm (**20 inches**) (measured horizontally) will be allowed outside of backslopes in hard rock types where pre-splitting is not required. No overbreak allowance will be made for pre-split backslopes.

The Engineer will determine the actual limits between different material classifications by field measurements during construction as true elevations are disclosed. If any changes are made in the Plan grading sections or grades that affect the excavation limits as indicated in the Contract, measurements will be taken as necessary to establish the actual limits of excavation. Where topsoil covering is required, measurements will be taken on the finished surface after placement of the topsoil, and a quantity allowance will be made equal to the thickness of topsoil placed. In excavations made below finished grade, the limits of excavation measurement will be as defined by the grades and slope lines staked, unless actual field measurements are taken.

The Contractor may dispute the Engineer's determination of excavation quantities after completing the excavations within a specific balance (as planned) when the Contractor has a reasonable cause for dispute. The Contractor must submit a written dispute within 7 days after completing the excavations within a balance except for final finishing. The Contractor shall have waived the right to dispute the pay quantity determinations in that balance if these conditions are not met. However, at any time prior to completion of all roadway excavations on the Project, the Engineer will honor any request for investigation of quantity irregularities that may be submitted in writing by the Contractor, and if findings so warrant, quantity adjustments will be

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made on the basis of any measurements taken at the Engineer's discretion.

The limits for determination of quantities will be defined by the cross-sections. The limits for quantity determinations will not extend beyond the authorized grading sections as staked, except for the allowances specified. Quantity deductions will be determined by actual or fixed dimensions to exclude materials encompassed by the excavation measurements that are to be removed or salvaged under other Contract items. Excavation quantities, will be recomputed or otherwise adjusted on the basis of actual limits as measured or otherwise fixed, and payment for excavation items will be made as altered thereby.

##### **B Borrow Material**

The Engineer will measure borrow material by volume according to 1901 and as specified in the Contract as one of the following:

- (1) Excavated volume (EV),
- (2) Loose volume (LV),
- (3) Compacted volume (CV), or
- (4) Stockpile volume (SV).

Only those materials accepted for use on the Project will be measured for payment under the borrow material items.

##### **C Salvage Material**

The Engineer will measure salvage material by loose volume unless a different basis of measure is indicated in the item name, in which case the designation symbols will be the same as given for borrow materials in 2105.4B. The Engineer will select either:

- (1) Loose volume (LV), or
- (2) Stockpile volume (SV).

Salvaging, processing, stockpiling (if necessary), and placing operations will all be considered a single operation (one complete unit of measure), unless the item name is expanded to include the words "in Stockpiles" or "from Stockpiles." Also see 1901.

The operations of salvaging material from the existing roadway, processing the material as specified, and placing the processed material in stockpiles will be one operation constituting a complete unit of measure. The operations of removing material from stockpiles and placing it in the work as specified will be one operation constituting a complete unit of measure.

##### **D Stabilizing Aggregate**

The Engineer will measure stabilizing aggregate according to 1901 by mass or loose volume (LV) as furnished and incorporated into the subgrade.

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### **E Subsoiling**

The Engineer will measure subsoiling according to 1901 by area field measurement.

### **2105.5 BASIS OF PAYMENT**

If it should be ordered by the Engineer, but not otherwise required by the Contract, that excavated material or salvage material be stockpiled and later loaded and hauled to a different location, rehandling the material will be paid for at the same Contract prices as that paid for the initial excavation or salvage work.

Payment for salvage material under items of salvaged aggregate or salvaged topsoil at the Contract prices per unit of measure will be compensation in full for all costs of excavating, processing, loading, hauling, and placing the material in the new construction as specified. Salvage material "in Stockpiles" will cover all costs incurred in production of the stockpiled material, and salvage material "from Stockpiles" will cover all costs of placing stockpiled material in the new construction as specified.

Payment for the accepted quantities of borrow material or stabilizing aggregate at the Contract prices per unit of measure will be compensation in full for furnishing and placing the material as specified, including final finishing operations.

No separate compensation will be made for any incidental pit stripping, waste excavation, clearing and grubbing, topsoil replacement, pit shaping, seeding, or other expenses incurred in supplying borrow material from Contractor selected sources, whether indicated as a possible source or not. However, when the Contractor is required to obtain borrow material from a source specifically stipulated in the Contract, any required incidental pit excavation (stripping, waste, etc.) will be compensated for separately, or as Extra Work in the absence of such payment provisions.

Payment for the accepted quantities of roadway excavation items at the Contract prices per unit of measure of excavation, subject to the price adjustment and Extra Work compensation specified herein, will be compensation in full for all costs of scalping and preparing the excavation and embankment construction areas; of excavating, loading, hauling and placing, or disposing of the materials as specified; of compacting the embankments and finishing the construction areas as specified; and of all other operations incidental to the work. No direct compensation will be made for water used in conjunction with the mixing, placing, and compacting operations.

Extra Work compensation will be provided for the removal and disposal of any debris encountered in the excavations to the extent that its existence was not known to the Contractor at the time of bidding, and then only when its satisfactory removal and disposition requires separate handling or the use of special equipment.

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Compensation for roadway excavation items will include any increased haul costs not qualifying for Extra Work compensation or bid price adjustment in consideration of 1402.

When the Proposal contains an item for common excavation but does not provide an item for common channel excavation, any excavation ordered and performed that would otherwise be classified as common channel excavation will be paid for separately at the Contract price for common excavation plus \$1.30 additional per cubic meter (**\$1.00 per cubic yard**).

If the Proposal fails to include a bid item for rock excavation or rock channel excavation, and material is uncovered that is so classified, excavation of the rock will be paid for separately at the Contract price for common excavation or common channel excavation, plus an additional \$16 per cubic meter (**\$12.00 per cubic yard**). If no bid item is provided for common channel excavation, excavation of materials classified as rock channel excavation will be paid for at the Contract price for common excavation plus an additional \$18 per cubic meter (**\$13.50 per cubic yard**). Such stipulated prices for rock excavation will apply up to a maximum of 200 m<sup>3</sup> (**260 cubic yards**) of excavation per item or to such quantity as may be performed by mutual consent prior to execution of an Extra Work agreement.

When payment for muck excavation on the basis of equipment rental is specified, all operations of excavating and disposing of the materials so classified will be paid for at the Contract prices for the equipment used, in accordance with 2123. In the absence of Contract prices covering removal of material classified as muck excavation, payment will be made for its removal as Extra Work.

If any muck excavation in addition to that indicated in the Plans is required by the Engineer, when payment is made on the basis of excavation volumes, the increased quantity will not be considered as a basis of claim for increased compensation, except as provided by the following:

- (a) That portion of the additional excavation that is removed from below a plane parallel to and 5 m (**15 feet**) below the natural ground surface will be measured in 2 m (**5 foot**) depth zone increments and paid for separately at adjusted unit prices. The adjusted unit price will be equal to the Contract bid price for muck excavation plus \$0.20 per cubic meter (**\$0.15 per cubic yard**) for the additional excavation within the 5-7 m (**15-20 foot**) depth zone and an additional \$0.05 per cubic meter (**\$0.05 per cubic yard**) for each additional 2 m (**5 foot**) increment of depth beyond 7 m (**20 feet**).
- (b) If any portion of the additional excavated material should be required to be placed in a disposal area other than shown or

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described for the planned excavation, any additional costs incurred will be compensated for as Extra Work.

The adjusted unit prices specified above for muck excavation will be compensation in full for all additional costs incurred in excavating to depths greater than planned, in finishing the additional disposal quantities and areas, and in rehandling any materials deposited within the extended excavation limits. Payment at the Contract price will include full compensation for all pumping and dewatering specifically required, for all rehandling and hauling of the excavated material that is necessary for its disposal as planned, and for all finishing of the planned disposal areas.

Partial payments will be subject to withholding of a portion of the Contract amount to cover the reasonable value of any uncompleted operations that are designated as a part of the complete unit. The amounts so withheld will be based upon the estimated surface area exposed to probable erosion without the required surface finishing and turf establishment operations being completed.

All areas within the grading construction limits, exclusive of roadbed areas, on which the natural vegetation has been rendered ineffective by the grading or grubbing operations, will be considered as being exposed to probable erosion until such time that the final surface finishing and turf establishment operations have been completed.

The amounts to be withheld on each partial estimate will be the product of \$7413 per hectare (**\$3000 per acre**), unless otherwise stated in the Contract, and the estimated number of unfinished hectares exposed to probable erosion at the time the estimate is prepared. This withholding will apply to the entire Project or to any area, as determined by the Engineer.

For application and release purposes, the Project may be divided into separate control areas based on earthwork balance points, drainage area boundaries, or roadway segments as indicated in the Contract or as otherwise deemed appropriate by the Engineer.

Upon completion of the rough grading operations and placement of topsoil in each control area, the amount withheld for that area will be reduced by 50 percent. Once mulch has been placed, the amount will be reduced by an additional 30 percent. Full release of the amount withheld will be made when the seeding has been accepted.

Whenever the possibility for erosion damage or water pollution exists, release of withheld amounts will not be made for a control area until adequate temporary or permanent erosion control measures have been provided.

Topsoil borrow will be accepted for payment in accordance with the provisions of Table 2105-1.

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**TABLE 2105-1  
TOPSOIL BORROW ACCEPTANCE SCHEDULE**

REQUIREMENT	FULL PAYMENT RANGE	PRICE REDUCTION RANGE		CORRECTIVE ACTION REQUIRED WHEN
		5 %	15 %	
Percent passing the 2.00 mm (#10) Sieve	85% or Greater	80.0 - 84.9	75.0 - 79.9	Less than 75.0%
Clay Content	5% or Greater	3.0 - 4.9	2.0 - 2.9	Less than 2.0%
	30% or Less	30.1 -35.0	35.1 -40.0	More than 40.0%
Silt Content	10% or Greater	7.0 - 9.9	4.0 - 6.9	Less than 4.0%
	70% or Less	70.1 -75.0	75.1 -78.0	More than 78.0%
Sand and Gravel Content	10% or Greater	7.0 - 9.9	4.0 - 6.9	Less than 4.0%
	70% or Less	70.1 -75.0	75.1 -78.0	More than 78.0%
Organic	3% or Greater	2.0 - 2.9	1.5 - 1.9	Less than 1.5%
	20% or Less	20.1 -22.0	22.1 -25.0	More than 25.0%
pH	6.1 or Greater	(A)	(A)	Less than 6.1
	7.8 or Less	7.9 - 8.0	8.1 - 8.2	More than 8.2

NOTE: The price reductions for multiple failure are cumulative.

(A) May be corrected by the addition of agricultural lime at a rate determined by the Engineer.

Payment for excavation and embankment construction will be made on the basis of the following schedule:

<b>Item No.</b>	<b>Item</b>	<b>Unit</b>
2105.501	Common Excavation .....	cubic meter ( <b>cubic yard</b> )
2105.503	Rock Excavation.....	cubic meter ( <b>cubic yard</b> )
2105.505	Muck Excavation.....	cubic meter ( <b>cubic yard</b> )
2105.507	Subgrade Excavation .....	cubic meter ( <b>cubic yard</b> )
2105.511	Common Channel Excavation ....	cubic meter ( <b>cubic yard</b> )
2105.513	Rock Channel Excavation.....	cubic meter ( <b>cubic yard</b> )
2105.515	Unclassified Excavation .....	cubic meter ( <b>cubic yard</b> )
2105.521	Granular Borrow (1) .....	cubic meter ( <b>cubic yard</b> )
2105.522	Select Granular Borrow (1) .....	cubic meter ( <b>cubic yard</b> )
2105.523	Common Borrow (1) .....	cubic meter ( <b>cubic yard</b> )
2105.525	Topsoil Borrow (1) .....	cubic meter ( <b>cubic yard</b> )
2105.526	Select Topsoil Borrow (1) .....	cubic meter ( <b>cubic yard</b> )
2105.533	Salvage Aggregate (1) .....	cubic meter ( <b>cubic yard</b> )

### 2111.3

2105.535	Salvaged Topsoil (1).....	cubic meter ( <b>cubic yard</b> )
2105.541	Stabilizing Aggregate .....	cubic meter ( <b>cubic yard</b> )
2105.543	Stabilizing Aggregate .....	metric ton ( <b>ton</b> )
2105.605	Subsoiling .....	hectare ( <b>acre</b> )

NOTE: (1) Specify basis of measure: EV, LV, SV, or CV. See 2105.4 and 1901.

See 2105.4C and insert the words "in Stockpile" or "from Stockpile" if appropriate.

## 2111

### Test Rolling

#### 2111.1 DESCRIPTION

This work shall consist of testing the bearing capacity of the roadbed by rolling with heavy rollers.

Test rolling will be required only when and where specifically provided in the Contract.

#### 2111.2 EQUIPMENT

The roller shall be pneumatic-tired, towed by suitable tractive equipment and shall conform to the following requirements:

- (a) The roller shall have 2 wheels spaced not less than 1.8 m (**6 feet**) apart (center to center transversely).
- (b) The tire size shall be either 18 x 24 or 18 x 25. Each tire shall be inflated to a pressure of 650 kPa (**95 psi**).
- (c) The gross mass of the roller shall be not less than 13.5 metric tons (**14.9 tons**) and not more than 13.7 metric tons (**15.1 tons**) on each wheel.

#### 2111.3 CONSTRUCTION REQUIREMENTS

Test rolling shall be performed on the roadbed as required at a time when the grading grade is completed within 100 mm (**4 inches**) of the grade staked by the Engineer, and shall cover the full top width of the proposed pavement structure as defined by the bottom width of the typical subcut sections shown in the Plans, unless other specific dimensions are given. Test rolling shall not be performed until the Engineer and Contractor mutually agree that the subgrade has been properly prepared and is acceptable for test rolling.

The test rolling shall be performed by making two passes over each strip covered by the width of a tire. Unrolled areas between tire paths shall not be wider than 300 mm (**12 inches**). The roller shall be operated at a speed of not less than 4 km/h (**2.5 mph**) nor more than 8 km/h (**5 mph**) and in a pattern approved by the Engineer.

### 2111.3

The Contractor shall take precautions to protect culverts and other structures during the test rolling. Where a culvert or other structure has, or will have, insufficient protective cover to withstand test rolling, the test rolling may be performed prior to installing the structure or performed on the surface of any additional cover that may be provided as protection for in place structures. Any structures damaged by the test rolling shall be replaced at no expense to the Department.

On those portions of a Project where the Plans require treatment or stabilization of the upper portion of a granular subgrade by the addition of bituminous material, aggregate, or binder soil, the test rolling may be performed either before or after the treatment or stabilization work is performed.

The roadbed will be considered to be unstable if, under the operation of the roller, the surface shows yielding or rutting (at the time the roller passes over the grade) of more than 50 mm (**2 inches**) measured from the top of the constructed grade to the bottom of the rut, except that an additional 25 mm (**1 inch**) will be allowed when a granular subgrade is to be treated or stabilized after test rolling. The Contractor will be required to furnish a device that will mark the surface of the roadbed where rutting or yielding occurs.

Where test failure occurs on a roadbed not constructed by the Contractor under the same Contract, the unstable sections shall be repaired by the Contractor, as directed by the Engineer, at the Department's expense.

If, on a roadbed constructed by the Contractor under the same Contract, test rolling shows any sections of the roadbed to be unstable, the Contractor shall, at no expense to the Department, scarify the roadbed and aerate or add moisture to the material as necessary, and recompact the material to the extent that it will be stable when retested by rolling. However, where test failure occurs on an isolated section of roadbed less than 50 m (**2 road stations**) in length, retesting of that section by rolling will not be required if the Engineer is satisfied that the corrective measures taken have eliminated the cause of failure and have produced acceptable stability as evidenced by density tests or visual inspection.



**2112.3**

**2111.4 METHOD OF MEASUREMENT**

If the roadbed tested was constructed under a previous Contract, and only then, test rolling (together with any retesting required by the Engineer after unstable sections have been repaired) will be measured by length where such work is performed. The work on each separate roadbed, in the case of divided highways, will be measured separately. If the Engineer orders testing on any portion of the roadbed to an extent less than the full width specified, the measurement will be in proportion to the width tested.

**2111.5 BASIS OF PAYMENT**

If the roadbed tested was constructed by the Contractor under the same Contract, the Contractor shall perform test rolling (including all repairs to unstable sections and retesting) as incidental work with no direct compensation.

If the roadbed tested was constructed under a previous Contract, and only then, all repairs to unstable sections ordered by the Engineer will be paid for as Extra Work and the test rolling will be paid for on the basis of the following schedule:

<b>Item No.</b>	<b>Item</b>	<b>Unit</b>
2111.501	Test Rolling .....	meter ( <b>road station</b> )

**2112**

**Subgrade Preparation**

**2112.1 DESCRIPTION**

This work shall consist of shaping and compacting the subgrade prior to placing a base or surface course thereon.

**2112.2 BLANK**

**2112.3 CONSTRUCTION REQUIREMENTS**

This work shall be performed after any unstable sections of the subgrade have been repaired and after any existing base or surface courses required to be removed have been removed.

The Contractor shall compact and shape the subgrade for its full width as may be necessary to produce, at the time the base or surface course is placed, the required density and stability in the top 150 mm (**6 inches**) of the subgrade and the required grade and cross-section.

The Contractor shall scarify, dry the material, or apply water as may be necessary to obtain the required density and stability. Unless otherwise provided in the Contract, the density shall be 100 percent of maximum density.

The required stability shall be such that when any material for base or surface courses is deposited on the subgrade, no rutting or displacement of the roadbed will occur.

### 2112.3

The required grade and cross-section shall consist of a smooth subgrade surface conforming to the prescribed elevations for the particular subgrade being prepared prior to constructing an additional course thereon. The prescribed elevation for any point on the subgrade surface where measurement is made shall be as determined from the grades staked by the Engineer and the typical sections shown in the Plans, within the following tolerances:

- (a) When the subgrade is being prepared for placement of an aggregate wearing course or is being finished for acceptance of the grading construction, the elevation of the finished surface shall not vary by more than 30 mm (**0.1 foot**) from the prescribed elevation at any point where measurement is made.
- (b) When the subgrade is being prepared for placement of an aggregate base course, the elevation of the finished surface at the time the next layer is placed, shall not vary by more than 15 mm (**0.05 foot**) above or 30 mm (**0.1 foot**) below the prescribed elevation at any point where measurement is made.
- (c) When the subgrade is being prepared for placement of a bituminous or concrete base, stabilized base, or surface course, the elevation of the finished surface at the time the next layer is placed, shall not vary by more than 15 mm (**0.05 foot**) from the prescribed elevation at any point where measurement is made.

In conjunction with the operations of subgrade preparation, the Contractor shall produce, load, and haul aggregate (of the same type as that used in the subgrade or in the course to be constructed) where and in such quantities as the Engineer directs, and incorporate such material into the subgrade. This work will be paid for at the appropriate Contract prices for the material in place or, in the absence of such prices, as Extra Work.

### 2112.4 METHOD OF MEASUREMENT

Subgrade preparation will be measured by length, along the centerline of the roadbed. The work on each separate roadbed, in the case of divided highways will be measured separately. Locations where grading or subgrade excavation (as described in 2105) is required will not be included in the measurements. On ramps and loops, the length will be measured between the ends of the exit and entrance noses, along the centerline of the ramp or loop roadbed.

### 2112.5 BASIS OF PAYMENT

If the roadbed or other course being prepared was constructed under the same Contract, the Contractor shall perform subgrade preparation as incidental work with no direct compensation. Payment for subgrade preparation, as a separate item, will be made only when the roadbed or other course being prepared was constructed under a previous contract.

**2118.4**

Payment for subgrade preparation at the Contract price per unit of measure will be compensation in full for all costs of preparing the subgrade as specified, except that any expenses incurred in correcting unstable conditions below the top 150 mm (**6 inches**) will be compensated for separately as Extra Work, or at the Contract prices for the equipment used if so provided for in the Contract.

Payment for subgrade preparation will be made on the basis of the following schedule:

<b>Item No.</b>	<b>Item</b>	<b>Unit</b>
2112.501	Subgrade Preparation.....	meter ( <b>road station</b> )

**2118**

**Aggregate Surfacing**

**2118.1 DESCRIPTION**

This work shall consist of constructing an aggregate wearing course on a prepared Subgrade.

**2118.2 MATERIALS**

**A Aggregate ..... 3138**

The class of aggregate to be used will be as shown in the Contract.

**2118.3 CONSTRUCTION REQUIREMENTS**

The specified quantity of aggregate shall be deposited on the road and spread to the required cross-section only when the roadbed is so dry and compact that no rutting or displacement will occur, and only on sections of such length as will meet the Engineer's approval. Aggregate shall be deposited and spread on public road approaches and private entrances in the quantities directed by the Engineer.

Aggregate windrows shall be moved as necessary to permit drying and reshaping of the subgrade. The aggregate shall be mixed prior to spreading, as necessary to produce uniformity in the gradation of the material.

No compaction will be required of the aggregate surfacing unless the quantity of aggregate placed results in a surface thickness in excess of 50 mm (**2 inches**), in which case the aggregate surfacing shall be compacted in accordance with 2211.3, quality compaction method.

**2118.4 METHOD OF MEASUREMENT**

Aggregate surfacing will be measured, as indicated in the Proposal, by mass (**weight**) or by volume (vehicular measure) of aggregate deposited on the road.

**2118.5**

**2118.5 BASIS OF PAYMENT**

Payment for the accepted quantity of aggregate surfacing at the Contract price per unit of measure will be compensation in full for all costs of furnishing and placing the aggregate surfacing as specified.

Payment for the aggregate surfacing will be made on the basis of the following schedule:

<b>Item No.</b>	<b>Item</b>	<b>Unit</b>
2118.501	Aggregate Surfacing, Class __ .....	metric ton ( <b>ton</b> )
2118.502	Aggregate Surfacing, Class __ ...	cubic meter ( <b>cubic yard</b> )

**2120**

**Earth Shouldering**

**2120.1 DESCRIPTION**

This work shall consist of constructing earth shoulders adjacent to pavements and bituminous surfacing.

When the work involves shoulder widening or the use of material obtained under any item of roadway excavation, the shoulder construction will be considered a part of the roadway excavation and embankment construction and will be measured and paid for in accordance with 2105.

**2120.2 MATERIALS**

**A Earth Material**

Earth shoulder material shall consist of selected mineral soil free from roots, plants, and stones over 75 mm (**3 inches**) in greatest dimension. The material shall be furnished by the Contractor from sources outside the Right of Way, subject to 1405.

**2120.3 CONSTRUCTION REQUIREMENTS**

**A Preparations**

Before shoulder material is placed on any area, all snow and ice shall be removed therefrom; all grass, weeds, or other vegetation shall be close cut and removed; and the existing shoulder shall be bladed to a smooth surface and compacted over its full width by two passes of a roller over each strip the width of the roller. The roller may be a tamping roller as specified in 2123.3H or a pneumatic-tired roller with a mass (**weight**) of not less than 3600 kg/meter (**200 pounds/inch**) of roller width.

**B Placing Earth Material**

The shouldering material shall be placed, compacted, and finished to the required grade and cross-section in accordance with the embankment construction, quality compaction method, as specified in 2105.

**2123.2**

No materials shall be placed or stockpiled in such a manner as to restrict free surface drainage of the roadway.

Before operations are suspended each night, all material shall be struck off at least down to the elevation of the pavement or bituminous surfacing and sloped to drain.

**C Topsoil Covering**

Where topsoil covering is specified, the topsoil shall be furnished and placed in accordance with 2105.

**2120.4 METHOD OF MEASUREMENT**

**A Earth Shoulder Material**

Earth shoulder material will be measured by the volume (vehicular measure) of material furnished and placed.

**2120.5 BASIS OF PAYMENT**

Payment for the accepted quantity of earth shoulder material at the Contract price per unit of measure will be compensation in full for all costs of the preparatory work and for furnishing and placing the shoulder material as specified.

Payment for the earth shouldering will be made on the basis of the following schedule:

<b>Item No. Item</b>	<b>Unit</b>
2120.501 Earth Shoulder Material.....	cubic meter ( <b>cubic yard</b> )

**2123**

**Equipment Rental**

**2123.1 DESCRIPTION**

This work shall consist of furnishing laborers and of furnishing and operating equipment, in cases where the Contract provides that the work is to be performed as directed by the Engineer and at the Department's expense.

**2123.2 GENERAL REQUIREMENTS**

All equipment shall be in a mechanical condition such that it will operate in a manner satisfactory to the Engineer.

All equipment that operates on bituminous or concrete surfaces shall be equipped with rubber tires or smooth street plates.

Tractive equipment used to draw any other equipment shall be of a type that will not damage the work being performed and that has sufficient power to effectively operate the drawn equipment.

### 2123.3

#### 2123.3 SPECIFIC REQUIREMENTS

Equipment rented under this Specification shall meet the following specific requirements regarding type, size, capacity, power, or dimensions.

##### **A Motor Grader**

The motor grader shall be of the self-propelled type with pneumatic-tired wheels and power-operated controls and shall have a mass of not less than 8600 kg (**19,000 pounds**). It shall have a moldboard at least 3.6 m (**12 feet**) long with a suitable cutting edge and shall be equipped with a suitable scarifier.

##### **B Dozer**

The dozer may be of either the angle-dozer or bull-dozer type attached to a crawler-type tractor having at least 56 kw (75 horsepower) at the draw-bar and power operated controls. The dozer blade shall be not less than 2.3 m (**90 inches**) wide. Angle-dozers shall be adjustable to an angle of 90 degrees with the direction of travel of the tractor. The dozer and tractor will be considered as a single unit.

##### **C Scraper**

The scraper may be the carryall type mounted on pneumatic-tired wheels or the rotary type drawn by a tractor of suitable size. It shall have not less than the volumetric capacity indicated in the Proposal, which shall be construed to be the manufacturer's rated heaped capacity.

##### **D Dragline**

The dragline shall be of the full-revolving type, equipped with a bucket of at least the size specified in the Proposal, but in no case larger than that for which the machine is designed.

The 0.75 m<sup>3</sup> (**1 yd<sup>3</sup>**) dragline shall have at least a 13.7 m (**45 foot**) boom and a working radius of at least 10.6 m (**35 feet**).

The 1.9 m<sup>3</sup> (**2.5 yd<sup>3</sup>**) dragline shall have at least a 24.3 m (**80 foot**) boom and a working radius of at least 18.2 m (**60 feet**).

Any other size of dragline shall have the boom length and working radius specified in the Contract.

For swamp work, one set of mats shall be furnished for each dragline. Each mat shall have a length of not less than twice the distance between the outside edges of the crawler treads. The combined width of all the mats shall equal at least twice the bearing length of the crawler treads.

##### **E Power Shovel**

The power shovel shall be of the full-revolving crawler-type with a bucket of the size recommended by the manufacturer. The size of the shovel will be indicated in the Proposal by the capacity of the bucket.

**F Tractor**

The tractor shall be of the crawler type and shall have the specified power at the draw-bar as indicated in the Proposal. The power shall be measured in kilowatts (**horsepower**).

**G Pneumatic-Tired Roller**

The pneumatic-tired roller shall have a compacting width of 1.5 m (**5 foot**) or more and shall be so constructed that the gross mass can be varied, as directed by the Engineer, within the range of 1700-4400 kg/meter (**100-250 pounds/inch**) of rolling width. The arrangement of the tires shall be such that compaction will be obtained over the full compacting width with each pass of the roller.

The roller may be self propelled or provided with suitable tractive equipment, unless the Proposal specifies a certain type. If more than one roller is propelled by a single tractive unit, the combination will be counted as a single roller unit.

**H Tamping Roller**

For the purposes of this Specification, a tamping roller consists of two sections, each having a drum at least 1.2 m (**48 inches**) in diameter, a gross mass and number of pads as approved by the Engineer, and drawn by suitable tractive equipment.

**I Blank****J Steel-Wheeled Roller**

The steel-wheeled roller shall be self propelled and have a minimum total mass of 7.3 metric tons (**8 tons**), or as otherwise specified in the Contract. When vibratory rollers are used, they shall produce 45 kN per meter (**250 pounds/inch**) of width. The roller shall be capable of reversing without backlash and shall be equipped with spray attachments for moistening all rolls on both the front and back.

Unless otherwise specified in the Proposal, steel-wheeled rollers may be either the tandem type or the three wheeled type.

**K Truck**

The truck shall have a minimum manufacturer's rated capacity of at least 1.3 metric tons (**1.5 tons**) and shall have a volumetric capacity of not less than 3.8 m<sup>3</sup> (**5 cubic yards**). It shall be equipped with a power-operated hoist and a metal dump box of the end dump type. The rear axle of the truck shall be equipped with dual wheels and tires not less than 200 mm (**8 inches**) in width (manufacturer's designated size).

**L Rotary Tiller**

The rotary tiller shall be at least 1370 mm (**54 inches**) wide and adjustable for any depth up to 225 mm (**9 inches**), and shall be drawn by suitable tractive equipment.

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#### **M Front End Loader**

The front end loader shall consist of a crawler type or rubber-tired tractor, equipped with a power-operated loader having a bucket with at least the struck capacity specified in the Proposal. It shall be capable of excavating to a depth of at least 250 mm (**10 inches**) below the bottom of the treads (or tires) and loading the excavated material on the trucks used for hauling.

### **2123.4 METHOD OF MEASUREMENT**

#### **A Equipment Hours**

Rental of each unit of equipment will be measured by the number of hours of actual working time and necessary traveling time within the Project limits.

#### **B Common Laborer Hire**

Common laborer hire will be measured by the hours of actual working time and necessary traveling time within the Project limits.

### **2123.5 BASIS OF PAYMENT**

Payment for the use of any equipment at the Contract price per hour will be compensation in full for the use and operation of such equipment, including the operator or operators and any tractive equipment and other accessories required in connection with such use, subject only to these provisions for additional compensation in cases where the Contractor is obligated to pay overtime wages for work performed by order of the Engineer on Sundays, holidays, or during overtime periods.

Payment for laborers at the Contract price per hour will include compensation for the use of any hand tools used by such laborers, subject only to these provisions for additional compensation in cases where the Contractor is obligated to pay overtime wages for work performed by order of the Engineer on Sundays, holidays, or during overtime periods.

No compensation in addition to the Contract price per hour for equipment rental or common laborer hire will be made because of any overtime or work performed on Sundays or holidays except when such work is ordered by the Engineer to be performed during those times. If the Engineer orders the use of equipment or common laborers during overtime periods or on Sundays or holidays, compensation will be made in addition to the Contract price per hour for equipment rental or common laborer hire only for the increased wages for which the Contractor is obligated under the terms of wage agreements. Such additional compensation will be made by increasing the Contract price per hour for the equipment or common laborers used by an amount equal to the difference between the normal hourly wage for straight time work and the overtime hourly wage actually paid the laborers



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employed in operating the equipment or performing the labor, as determined from the Contractor's payroll.

Payment as provided above will include such supervision by the Contractor as may be necessary to accomplish the work in the manner directed by the Engineer, except that, if the Engineer considers that a full time foreman is necessary and so orders, payment for furnishing such a foreman will be as Extra Work on a Force Account basis.

Payment for equipment rental and common laborer hire will be made on the basis of the following schedule:

<b>Item No.</b>	<b>Item</b>	<b>Unit</b>
2123.501	Common Laborers .....	hour
2123.503	Motor Grader .....	hour
2123.506	__ m <sup>3</sup> ( <b>cubic yard</b> ) Dragline.....	hour
2123.507	__ m <sup>3</sup> ( <b>cubic yard</b> ) Shovel .....	hour
2123.508	__ m <sup>3</sup> ( <b>cubic yard</b> ) Scraper .....	hour
2123.509	Dozer .....	hour
2123.510	__ m <sup>3</sup> ( <b>cubic yard</b> ) Truck.....	hour
2123.511	__ kW ( <b>hp</b> ) Tractor.....	hour
2123.512	Rotary Tiller .....	hour
2123.514	__ m <sup>3</sup> ( <b>cubic yard</b> ) Front End Loader.....	hour
2123.521	Pneumatic-Tired Roller .....	hour
2123.522	Pneumatic-Tired Roller (Tractor Drawn) .....	hour
2123.523	Pneumatic-Tired Roller (Self Propelled) .....	hour
2123.524	Tamping Roller.....	hour
2123.525	__ metric ton ( <b>ton</b> ) Steel-Wheeled Roller.....	hour

**2130**

**Application of Water**

**2130.1 DESCRIPTION**

This work shall consist of furnishing and applying water for dust control within the Project limits as directed by the Engineer or stipulated in the Contract.

**2130.2 MATERIALS**

The water shall be furnished by the Contractor and it shall be reasonably clean.

**2130.3 CONSTRUCTION REQUIREMENTS**

**A Equipment**

Water supply tanks shall be equipped with distributing bars or other apparatus that will ensure uniform application of the water. Application

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of water on the road shall be with a self-propelled distributor of the pressure type, mounted on pneumatic-tired wheels. Pump capacity shall be sufficient to permit application of the whole load uniformly at any rate up to 940 L (**250 gallons**) per minute.

**B Application**

The water supply and equipment used shall be sufficient to apply the quantity required within the time interval necessary to secure optimum results and avoid unwarranted loss of water through evaporation, absorption, or drainage. The water shall be applied at such times and in such quantities as the Engineer approves.

**2130.4 METHOD OF MEASUREMENT**

Water applied for dust control within the Project limits, by direct order of the Engineer or when application is specified at the Department's expense, will be measured for payment by volume.

Deductions may be made for any water wasted through failure of the Contractor to coordinate the application of water with other operations as may be directed.

**2130.5 BASIS OF PAYMENT**

Payment for the accepted quantities of water at the Contract price per unit of measure will be compensation in full for all costs of furnishing, transporting, and applying the water as directed.

These provisions apply to water used for dust control within the Project limits as directed by the Engineer. These provisions do not apply to any sprinkling or other uses for water required in conjunction with the construction of concrete pavements; to any water used in the production or curing of concrete; to any water used to maintain plant life; to any water used in conjunction with compacting soil and aggregate; or to any water used for dust control on any Contractor selected haul roads, detours, or work sites outside of the Project limits; all costs of which will be incidental to the Contract items involved.

Water applied by order or approval of the Engineer for dust control will be paid for at a unit price of \$3 per cubic meter (**\$11 per 1000 gallons**) in the absence of the Contract bid item 2130.501.

Payment for the application of water will be made on the basis of the following schedule:

<b>Item No.</b>	<b>Item</b>	<b>Unit</b>
2130.501	Water .....	cubic meter ( <b>1000 gallons</b> )

**2131**

**Application of Calcium Chloride**

**2131.1 DESCRIPTION**

This work shall consist of furnishing and applying calcium chloride, either as a surface treatment or as an admixture, in conjunction with grading or the construction of an aggregate base or surface course, or as a surface application on the road.

**2131.2 MATERIALS**

**A Calcium Chloride, type as specified or permitted ..... 3911**

**B Water**

Water used for preparing solutions shall be reasonably clean and free of suspended matter.

**2131.3 CONSTRUCTION REQUIREMENTS**

**A Surface Application**

Calcium chloride in dry form shall be applied on the road with a spreader capable of distributing the material uniformly at the rate directed. Calcium chloride solutions shall be applied on the road with a distributor meeting the requirements of 2321.3C1.

Unless otherwise specified, application rates shall be as directed by the Engineer.

**B Admixture Application**

When used as an admixture, the calcium chloride may be mixed with the aggregate at the aggregate producing plant, applied on the road as a surface application and there mixed with the aggregate, or applied on the road in solution with the mixing water.

If the calcium chloride is added at the aggregate producing plant, it shall be introduced into the aggregate at a uniform rate and in the required proportions, by a separate conveyor or metering device approved by the Engineer.

**2131.4 METHOD OF MEASUREMENT**

In the case of bulk shipments of dry calcium chloride, the material of each type as delivered and used will be measured by the net railroad or truck mass. In the case of bag or drum shipments, the mass of the material as delivered and used will be computed from the bag or drum mass.

Calcium chloride solutions will be measured by volume as adjusted to 15°C (60° F). Tank volumes will be corrected for temperature by using the correction factors for asphalt emulsion as shown in the Mn/DOT Bituminous Manual. Conversion of shipping mass to volume will be on the basis of 1390 kg/ cubic meter (11.6 pound/gallon) in the case of solutions of 38 percent concentration.

**2131.4**

For application, measurement, and payment purposes, the percentage of anhydrous chloride in the various types of material as delivered will be assumed to be as follows:

<u>Material</u>	<u>Anhydrous Chloride Percentage by Mass</u>
Calcium Chloride, Type 1 .....	77%
Calcium Chloride, Type 2 .....	94%
Calcium Chloride Solution .....	38%

If the material as delivered does not conform to the above specified percentages, the application rates and pay quantities will be adjusted by the Engineer so as to make payment for equivalent quantities based on conversion factors established by the Department in accordance with the assumed percentages for each type.

In the event of unseasonably cold weather, which might cause crystallization in the 38 percent calcium chloride solution, a solution containing 35 percent anhydrous chloride may be furnished with the Engineer's approval, in which case conversion of shipping mass to volume will be on the basis of 1360 kg per cubic meter (**11.35 pounds/gallon**). For payment, the net volume of 35 percent solution will be converted to equivalent volume of 38 percent solution by multiplying by 0.921.

**2131.5 BASIS OF PAYMENT**

Payment for calcium chloride at the Contract price per unit of measure will be compensation in full for furnishing and applying the material as specified.

Application of water in conjunction with the use of dry calcium chloride will be paid for in accordance with 2130, as a separate item, only to the extent that water is used by order of the Engineer.

Payment for application of calcium chloride will be made on the basis of the following schedule:

<b>Item No.</b>	<b>Item</b>	<b>Unit</b>
2131.501	Calcium Chloride, Type __ .....	metric ton ( <b>ton</b> )
2131.502	Calcium Chloride Solution .....	cubic meter ( <b>gallons</b> )

**2201**

**Concrete Base**

**2201.1 DESCRIPTION**

This work shall consist of constructing a base course of Portland cement concrete, with or without reinforcement, on a prepared subgrade.

**2201.2 MATERIALS**

**A Concrete ..... 2461**

Mix designations shall be as given below for the method of placement to be used.

Manual Placement ..... Mix No. 3B42

Standard Machine Placement ..... Mix No. 3B32

Vibratory Machine Placement ..... Mix No. 3B22

In the event Class C aggregate is used meeting the requirements for CA-15 as given in 3137, the cement content required will not exceed the values given in 2461.3C.

**B Reinforcement Bars ..... 3301**

**C Dowel Bars ..... 3302**

**D Steel Fabric ..... 3303**

**E Blank**

**F Preformed Joint Filler ..... 3702**

**G Emulsified Asphalt ..... 3151**

**H Curing Paper ..... 3752**

**I Blank**

**J Plastic Sheeting ..... 3756**

**K Membrane Curing Compound ..... 3754**

**2201.3 CONSTRUCTION REQUIREMENTS**

Construction requirements shall be the same as those specified in 2301.3, Concrete Pavement, except as modified by the following:

**A Joint Construction**

When emulsified asphalt is used for curing and the joints are sawed, the sawing operations shall be completed within 24 hours after concrete placement.

When a widening strip is constructed adjacent to an existing pavement, a transverse joint shall be constructed opposite each old joint and, where the old joints are more than 9 m (**30 feet**) apart, additional joints shall be constructed approximately half-way between the old joints.

### 2201.3

#### **B Surface Finishing**

When a concrete base is constructed to widen an existing concrete pavement and the Plans show the top of the base at the same elevation as the existing pavement surface, the surface of the base shall conform to the pavement surface.

After the surface has been screeded, no additional surface finishing will be required except for a final brooming to roughen the surface and such other finishing as may be necessary to produce a surface conforming to the requirements specified hereinafter.

#### **C Integrant Curb**

Concrete for integrant curb shall be Mix No. 3A22, 3A32, or 3A42, depending on the slump requirements for the equipment used.

#### **D Concrete Curing**

The concrete base shall be cured by the use of curing paper or plastic sheeting as provided for in 2301.3M, or by the use of emulsified asphalt applied by means of power spraying equipment at a total rate that will provide a moisture-proof film over the entire surface of the base.

Within 2 hours after application of asphalt emulsion, a coating of whitewash made of hydrated lime and water shall be applied. The proportions used in the whitewash and the rate of application shall be such that a uniform color, not darker than uncoated concrete after curing, will be produced on the surface of the base. After September 15th, the use of the whitewash application may be discontinued with the consent of the Engineer.

#### **E Workmanship and Quality**

The workmanship and quality requirements of 2301.3P shall apply to concrete base construction except that: (1) the surface smoothness requirements set forth hereinafter shall apply in lieu of 2301.3P; (2) the permissible deviations in average thickness of the base shall be 6 mm (**0.25 inch**); and (3) the riding quality requirements of 2301.3P shall not apply.

After completion of the curing period, the Department will test the surface of the base for slope and grade uniformity. Except for any irregularities induced by grade requirements when the base is constructed adjacent to an existing concrete pavement or gutter, the surface of the base shall not vary more than from a 3 m (**10 foot**) straightedge.

Areas that are found to vary from the 3 m (**10 feet**) straightedge by more than 10 mm (**3/8 inch**) will not be excluded from the pay quantities, but in lieu of being removed and replaced acceptably, a deduction will be made from the moneys due the Contractor equal to the product of the defective area and: (1) \$1.25 per square meter (**\$1.00 per square yard**) for those areas where the maximum deviation is more than 10 mm (**3/8 inch**), but not more than 15 mm (**5/8 inch**), and (2)

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\$2.50 per square meter (**\$2.00 per square yard**) for those areas where the maximum deviation exceeds 15 mm (**5/8 inch**).

**2201.4 METHOD OF MEASUREMENT**

The methods of measurement will be the same as specified in 2301.4 with the substitution of the term "base" for "pavement."

**2201.5 BASIS OF PAYMENT BASIS OF PAYMENT**

The basis of payment will be the same as specified in 2301.5 except for substituting the term "base" for "pavement" and using the following schedule.

<b>Item No.</b>	<b>Item</b>	<b>Unit</b>
2201.501	Concrete Base.....	square meter ( <b>square yard</b> )
2201.502	Concrete Base, Standard Width .....	square meter ( <b>square yard</b> )
2201.503	Concrete Base, Irregular Width .....	square meter ( <b>square yard</b> )
2201.511	Structural Concrete.....	cubic meter ( <b>cubic yard</b> )
2201.521	Base Reinforcement, Type____	square meter ( <b>square yard</b> )
2201.529	Reinforcement Bars.....	kilogram ( <b>pound</b> )
2201.531	Expansion Joints, Design____	meter ( <b>linear foot</b> )
2201.536	Dowel Bar .....	each
2201.541	Integrant Curb, Design____	meter ( <b>linear foot</b> )

**2204**

**Bituminous Treated Base**

**2204.1 DESCRIPTION**

This work shall consist of constructing a bituminous treated base course on a prepared subgrade.

**2204.2 MATERIALS**

The Engineer may allow the Contractor to substitute a hot-plant mixed base course mixture conforming to 2331 or 2340 for the cold mixture.

**A Aggregate ..... 3138**

The class of aggregate to be used will be shown in the Plans or indicated in the Special Provisions. Gradation requirements for the specified class of aggregate shall be modified to the extent that not less than 3 percent nor more than 7 percent passes the 75µm (#200)sieve.

**B Bituminous Material..... 3151**

The bituminous material for the mixture shall conform to the requirements for one of the following kinds and grades, subject to any

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limitations imposed by the Plans or Special Provisions. If any options are permitted, the kind to be used shall be optional with the Contractor but the grade will be designated by the Engineer.

MC Liquid Asphalt.....MC-250, 800

RC Liquid Asphalt.....RC-250, 800

Emulsified Asphalts ..... SS-1, SS-1h, CSS-1, CSS-1h

**2204.3 CONSTRUCTION REQUIREMENTS**

**A General**

The Contractor shall mix the bituminous material and aggregate in a central plant and spread the mixture on the road by motor graders, bituminous pavers, or other approved equipment.

When the Engineer allows the Contractor to substitute a hot-plant mixed base course mixture for the cold mixture, the Contractor shall mix, spread, and roll the mixture accordance with 2331 except that compaction requirements shall be in accordance with the ordinary compaction method of 2331.3. The Engineer may require the Contractor to seal coat the finished surface of designated areas according to 2356.

**B Restrictions**

If emulsified asphalt is used in the mixture, the total moisture content of the aggregate and the emulsion shall, at the time the emulsion is added, be sufficient to ensure thorough distribution of the bituminous material in the mixture. If the addition of water is required, the water shall be applied to the aggregate or mixed with the emulsion prior to mixing the bituminous material with the aggregate.

If a bituminous material other than emulsified asphalt is used in the mixture, the aggregate shall not contain more than 4 percent of free moisture at the time the bituminous material is added.

Mixing shall be done only when the temperature of the aggregate is 1°C (33°F) or higher.

**C Mixing Operations**

The materials shall be mixed in a central mixing plant conforming to 2321.3C6 and, at the time the bituminous material is added to the aggregate, the aggregate shall conform to gradation uniformity specified in 2211.3C.

The bituminous material shall be applied to the aggregate at a rate designated by the Engineer within the range of 29 to 54 L per metric ton (0.35-0.65 gallons/100 pounds) of dry aggregate.

The temperature of the bituminous material at the time it is applied to the aggregate shall be as directed by the Engineer (with a tolerance of 5°C (10°F)), within the limits specified following.



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### Liquid Asphalt

MC-250, RC-250..... 60-80°C (**135-175<sup>0</sup> F**)

MC-800, RC-800..... 75-100°C (**165-210<sup>0</sup> F**)

### Emulsified Asphalt

SS-1, SS-1h, CSS-1, CSS-1h..... 10-70°C (**50-160<sup>0</sup> F**)

#### **D Spreading and Compacting**

The Contractor shall deposit, spread, and compact the mixture to the specified thickness and cross section without segregation. The Contractor shall only work on sections of such length as will meet the approval of the Engineer.

Prior to spreading the mixture for compaction, the volatile component of the mixture shall have been removed to a degree satisfactory to the Engineer.

The Contractor shall spread the mixture without segregation to produce the specified thickness and cross section.

The Contractor shall uniformly compact the full depth of each layer by the quality compaction method according to 2211.3C. For test purposes, a layer will be considered to be 75 mm (**3 inch**) in compacted thickness.

#### **E Fog Seal**

A fog seal shall be applied to the surface of the completed base at a rate not to exceed 0.5 L (**0.1 gallon**) per square meter (**square yard**), using a kind and grade approved by the Engineer.

#### **F Grade and Surface Requirements**

After compaction, the elevation of the finished surface of the base at any point of measurement shall not vary by more than 15 mm (**0.05 foot**) from the prescribed elevation for that point as determined from the grades staked by the Engineer and the cross sections shown in the Plans.

### **2204.4 METHOD OF MEASUREMENT**

The accepted quantity of bituminous mixture of each aggregate class will be measured separately by mass of the loads (including total fluid content) as hauled from the mixing plant.

The accepted quantities of bituminous material will be measured by volume. Bituminous material used for fog seal will be included for payment with the quantity incorporated in the mixtures.

### **2204.5 BASIS OF PAYMENT**

Payment for the accepted quantities of bituminous material and bituminous mixture at the Contract prices per unit of measure will be compensation in full for all costs of constructing the bituminous treated base as specified, exclusive of those costs that are to be compensated for separately under other Contract items.

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No direct compensation will be made for any water used in conjunction with the mixing and placing operations.

Payment for the bituminous treated base will be made on the basis of the following schedule:

<b>Item No.</b>	<b>Item</b>	<b>Unit</b>
2204.503	Bituminous Material for Mixture.....	liter ( <b>gallon</b> )
2204.507	Bituminous Mixture, Class ___Aggregate .	metric ton ( <b>ton</b> )

**2206**

**Soil-Cement Base**

**2206.1 DESCRIPTION**

This work shall consist of constructing a cement treated base course using Portland cement and soil as it exists in the roadbed or as furnished under the Contract.

**2206.2 MATERIALS**

<b>A</b>	<b>Portland Cement, Type I or Type IA .....</b>	<b>3101</b>
<b>B</b>	<b>Sand Cover .....</b>	<b>3149</b>
<b>C</b>	<b>Bituminous Material for Curing.....</b>	<b>3151</b>
	Liquid Asphalt.....	RC-70, RC-250
	Emulsified Asphalt.....	RS-1, RS-2, CRS-1, CRS-2

Unless otherwise restricted, the type and grade of bituminous material to be used (of those given above) shall be optional with the Contractor.

<b>D</b>	<b>Water .....</b>	<b>3906</b>
<b>E</b>	<b>Soil</b>	

Soil supplied by the Contractor may be any pit-run material of granular structure or of moderately plastic nature that does not contain organic matter in detrimental quantity, and that has been screened as necessary to remove all stones retained on a 75 mm (3") sieve.

**2206.3 CONSTRUCTION REQUIREMENTS**

**A General**

The soil-cement base may be constructed by the method where the soil, cement, and water are mixed on the roadbed by a machine, or by the method where the materials are mixed in a central mixing plant. However, mixing of the materials in a central mixing plant will be permitted only if the edges of the base are suitably confined during the placing and compacting operations.

Operations shall be so conducted that the mixing, compacting, and application of the curing material will be completed, over the full width of the section under construction, during daylight hours on the same day. The mixing may be done on portions of the width at one time,

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provided there is sufficient overlapping at the edges of the longitudinal strips to produce a mixture with a uniform cement content and thickness over the entire width.

Mixing, spreading and compacting operations shall only be performed when the air temperature is 5°C (40° F) or higher.

Any subgrade preparation required shall be performed in accordance with 2112.

#### **B Placing Soil**

##### **B1 Road Mix Method**

When the soil, cement, and water are mixed on the road, selected soil or aggregate shall be placed on the entire width of the roadbed as required, shaped approximately to the required grade and cross section, and compacted with a pneumatic-tired roller. Two passes of the roller over each strip the width of the roller will be required for each 75 mm (3 inches) thickness or fraction thereof.

##### **B2 Central Plant Mix Method**

Materials mixed in a central mixing plant shall be placed by means of a mechanical spreader. Portions of the width may be placed separately, provided the next adjacent strip is placed within 30 minutes. If more than one spreader is used to place the full width of the base, the spreaders shall move forward simultaneously.

#### **C Application of Cement**

The Contractor shall provide a record of the tare and gross mass of each truck load of cement when bulk cement is used. The Contractor may provide a truck platform scale within the limits of the Project, or the trucks may be weighed on an approved commercial scale located outside the Project limits. The scale shall be of sufficient length, width, and capacity to weigh the loaded truck in one operation. The scale shall be equipped with a digital recorder that will provide a record of the tare and gross mass.

When the trucks are weighed on the Contractor's scale on the Project, the cement record shall be submitted to the Engineer each day, together with a certified statement of the total mass of cement used in the work that day. When the trucks are weighed on an approved commercial scale, a certified weigh ticket shall be furnished with each load, the cement compartments shall be sealed at the point of origin, and the seal shall be broken only at the destination in the presence of the Engineer.

##### **C1 Road Mix Method**

The specified quantity of cement shall be deposited uniformly over the entire width of the base. The quantity of cement placed shall not vary by more than 0.3 percentage point from the planned percentage of cement.

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No equipment, except that used in spreading and mixing, will be allowed to pass over the freshly spread cement until it is mixed with the soil.

Cement shall be applied only to a section of such length that all subsequent operations can be carried out in accordance with this Specification. No cement shall be applied when the subgrade will not support the equipment without rutting or other deformation or when the percentage of moisture in the soil exceeds the allowable maximum moisture content of the soil-cement mixture.

#### C2 Central Plant Mix Method

The central mixing plant shall be equipped with a device to accurately meter the cement. In the case of a continuous mixing plant, the device shall be adjustable so that it can be synchronized with the soil conveyor belt. The cement silo and cement delivery chutes shall be equipped with air jets capable of maintaining a constant pressure. The cement shall be delivered to the mixer at a uniform rate in the specified proportion.

#### **D Mixing**

##### D1 Road Mix Method

The mixing machine may be of the type that:

- (a) Picks up loose soil for the full depth of the base and mixes the soil, cement, and water, all as a single operation; or
- (b) Loosens and pulverizes the soil in the roadbed for the full depth of the base and mixes the soil, cement, and water, all as a single operation.

Unless the Special Provisions specifically permit the use of a machine that does the mixing by a series of forward movements, the mixing shall be done by a single continuous forward movement of the machine.

Mixing operations on each section of the road shall be started within 1 hour after the cement was placed thereon.

Either as a part of the mixing operations or prior thereto, the soil shall be pulverized to the extent that all of the material will pass the 25-mm (**1 inch**) sieve and not less than 80 percent (by moist mass) will pass the 4.75-mm (**#4**) sieve, exclusive of stones or fragments of bituminous surfacing retained on those sieves. Any existing bituminous mat shall be pulverized to the extent that not less than 95 percent of the material will pass the 37.5-mm (**1-1/2 inch**) sieve, and shall be used as a part of the aggregate for the soil-cement base. Pulverizing shall not be done on any section of the road in which the base cannot be completed within 48 hours.

The soil, cement, and water shall be mixed for the full depth of the base at one time to provide a uniform mixture with uniform moisture content. Water required to be added shall be applied uniformly in the

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mixer. The mixing operation shall be such that, prior to the application of water, sufficient mixing of the soil and cement is done to prevent the formation of cement balls. The moisture content of the mixture at the conclusion of the mixing operations shall be not less than 80 percent nor more than 100 percent of optimum moisture, except that it shall be less than that which will cause the base to become unstable during the compacting and finishing operations.

### D2 Central Plant Mix Method

When introduced into the mixing plant, the soil shall be pulverized to the extent that all of the material will pass the 25 mm (**1 inch**) sieve, exclusive of stones. The soil shall be delivered to the mixer at a uniform rate in the required quantity.

The soil, cement, and water shall be mixed at one time to provide a uniform mixture with uniform moisture content. Water required to be added shall be applied uniformly in the mixer. The operation shall be such that, prior to the application of water, sufficient mixing of the soil and cement is done to prevent the formation of cement balls. When delivered to the roadbed, the moisture content of the mixture shall be not less than 80 percent nor more than 100 percent of optimum moisture, except that it shall be less than that which will cause the base to become unstable during the compacting and finishing operations.

The mixing plant shall be equipped with a device to accurately measure the quantity of water used, and it shall also be equipped with a device that will automatically stop the mixer when the aggregate conveyor belt is not delivering aggregate at the required rate or when the cement delivery chute is not delivering cement at the required rate.

### E Compaction

Compaction shall be obtained by the specified density method. The full thickness of each layer shall be compacted uniformly to at least 98 percent of maximum density. No individual test shall show less than that density. The maximum density of the soil-cement mixture will be determined in the field by the method prescribed in the Mn/DOT Grading and Base Manual, using representative samples of the moist soil-cement mixture. In the case of road mixed base, the samples will be obtained near the conclusion of moist mixing operations from the section of road being processed. In the case of central plant mixed base, the samples will be obtained immediately behind the spreader. The density of the completed base will be determined by the method prescribed in the Grading and Base Manual.

Just prior to beginning the compacting operations, the mixture shall be shaped approximately to the section shown in the Plans.

At the time the compacting is started, the mixture shall be in a loose condition for its full depth. To ensure this condition, all mixtures on each section of the base shall be loosened to the full depth at least once

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every 30 minutes from the time the mixing is completed until compacting is started on that section.

The compaction shall proceed continuously until about 25 mm (**1 inch**) of loose mixture remains on the surface, and shall be completed to that extent on each area of the base within 4 hours after the start of mixing operations on that area.

After the base (except approximately the top 25 mm (**1 inch**)) has been compacted, the surface shall be shaped to the required lines, grade, and cross section. The surface shall then be lightly scarified (by a nail drag or weeder) to produce a uniformly loose mulch approximately 25 mm (**1 inch**) thick. Water may be added as necessary to produce the required moisture content in the loose material.

This moisture content shall be maintained until the compaction is completed. The water required for this operation shall be applied with a distributor equipped with a pump and capable of applying the whole load uniformly up to a maximum of 940 L (**250 gallons**) per minute. The resulting surface shall be rolled in such a manner as to produce a smooth, closely knit surface, free of cracks, ridges, or loose material, conforming to the required lines, grade, and cross section. This rolling shall be supplemented by the use of a broom drag.

The compaction of the top 25 mm (**1 inch**) of the base on the full width of the section under construction shall be completed within 1 hour after the completion of the compaction of the lower portion of the base on that section. On any area of the base, the material in the top 25 mm (**1 inch**) shall be loosened at least every 30 minutes from the time the compaction of the lower portion of the base on that area is completed until compaction of the top 25 mm (**1 inch**) on that area is started.

When the base is placed with a spreader having automatic controls, with both longitudinal and transverse grade control achieved by means of an erected string line and capable of producing a base meeting the grade and surface requirements of 2206.3J1, those requirements pertaining to compaction of the upper 25 mm (**1 inch**) of the base, as specified above, shall not apply. In the event that it becomes necessary to add additional material to meet the specified tolerance requirements, the spreader shall be capable of loosening the previously placed material sufficiently to bond the additional material to the in-place base.

The compaction of any additional base material placed in this manner shall be completed within 1 hour after completion of the compaction of the lower portion of the base on that section.

During the final compaction operations, the Contractor shall check the surface of the base for conformance with the grade and surface requirements specified herein. Any area that does not conform to the requirements shall be corrected by trimming the excess material from the surface in a manner that will create the least possible disturbance to the remainder of the base. The excess material shall be disposed of

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immediately. The disturbed portion of the base recompact. Loose material shall not be left on the base. Filling low spots in the base with loose material will not be permitted.

#### **F Construction Joints**

No longitudinal construction joints will be permitted.

A vertical transverse construction joint shall be made at the end of each day's work, and at the end of the completed work whenever construction is halted for a period of 3 hours or more. Unless such construction joints are made by the use of headers, the end of the section placed shall (before operations are resumed) be cut back to a square joint and a firm section. The portion removed may be pulverized and reused as soil with additional cement added as directed by the Engineer, or it may be removed entirely and replaced with new soil, at no expense to the Department.

#### **G Protection and Curing**

Within 4 hours after the surface has been finished as specified above and during daylight hours on the same day, the base shall be fogged with water in a quantity sufficient to fill the voids in the surface.

The base shall then immediately be covered with a membrane of bituminous curing material applied at a rate designated by the Engineer, but not to exceed 0.9 L/ square meter (**0.2 gallons/square yard**). The temperature of the bituminous material at the time of application shall be as approved by the Engineer within the ranges of 30- 65°C (**90-150<sup>0</sup> F**) for emulsion and 50-80°C (**125-175<sup>0</sup> F**) for liquid asphalt. The application shall be made with a distributor of the type described in 2321.3C1. The surface shall then be uniformly covered with sand cover material, applied at a rate designated by the Engineer, but not to exceed 8 kg/ square meter (**15 pounds/square yard**).

The bituminous membrane shall be maintained intact, and the base shall be protected from freezing, for a period of not less than 7 days.

A portion of the completed base may be used for turning equipment used in constructing an adjoining section, provided such portion is covered with earth or earth and planking as may be necessary to prevent such equipment from marring the surface of the completed work. The earth or earth and planking shall be removed from the base within 7 days after its use is discontinued, and the surface of the base shall be thoroughly cleaned.

#### **H Shoulders**

Before the road is opened to traffic, the Contractor shall, without direct compensation therefor, reshape and recompact the shoulders with a pneumatic-tired roller having a mass of not less than 3600 kg/meter (**200 pounds/inch**) of overall rolling width. Four passes of the roller over each strip the width of the roller will be required. Any water ordered used by the Engineer in conjunction with this final shaping and

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compacting of the shoulders will be paid for in accordance with 2130. The shoulders shall be surfaced as required by the Contract.

#### **I Blank**

#### **J Workmanship**

Any portion of the base that is not constructed in accordance with the foregoing construction requirements and within the time limits specified or that does not conform to all of the following requirements will be subject to 1503.

##### **J1 Grade and Surface Requirements**

The finished surface of the base shall show no variations greater than 5 mm (**1/4 inch**) for a 3 m (**10 foot**) straightedge laid thereon parallel to the centerline.

The elevation of the finished surface of the base, at any point thereon, shall not vary by more than 25 mm (**1 inch**) from the prescribed elevation for that point, as determined from the grades staked by the Engineer and the cross sections shown in the Plans.

##### **J2 Thickness Requirement**

The thickness of the completed base will be checked at intervals not to exceed 100 m (**330 feet**). The average thickness of the base constructed on any 1 day shall not vary from the thickness shown in the Plans by more than 15 mm (**1/2 inch**). No individual test shall show a thickness varying from that shown in the Plans by more than 20 mm (**3/4 inch**).

#### **K Opening to Traffic**

No section of the base shall be opened to traffic (including the Contractor's equipment) before the expiration of the 7 days curing period hereinbefore specified.

### 2206.4 METHOD OF MEASUREMENT

#### **A Soil-Cement Base**

Soil-cement base of each specified thickness will be measured separately by area.

#### **B Cement**

Cement will be measured by the mass incorporated into the mixture.

#### **C Soil**

Soil obtained from outside the roadbed will be measured, as indicated in the Contract by the material deposited on the road. When the materials are mixed in a central mixing plant, the measurements will include the mass or volume of water and cement added to the soil at the mixing plant.



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**D Bituminous Curing Material**

Bituminous curing material will be measured by volume at 15°C (60° F).

**E Sand Cover**

Sand cover material will be measured, as indicated in the Contract of material acceptably placed.

**2206.5 BASIS OF PAYMENT**

Payment for the item of soil-cement base at the Contract price per unit of measure will be compensation in full for all costs of constructing the base as specified, exclusive of those costs that are compensated for separately under other Contract items.

Separate payment will be made for cement, bituminous curing material, sand cover material, and any soil required to be furnished by the Contractor.

Payment for soil-cement base will be made on the basis of the following schedule:

<b>Item No.</b>	<b>Item</b>	<b>Unit</b>
2206.501	Soil-Cement Base .....	square meter ( <b>square yard</b> )
2206.502	Cement.....	metric ton ( <b>ton</b> )
2206.506	Soil .....	metric ton ( <b>ton</b> )
2206.507	Soil (LV).....	cubic meter ( <b>cubic yard</b> )
2206.516	Bituminous Curing Material .....	liter ( <b>gallon</b> )
2206.521	Sand Cover .....	metric ton ( <b>ton</b> )
2206.522	Sand Cover (LV) .....	cubic meter ( <b>cubic yard</b> )

**2207**

**Bituminous Stabilized Subgrade**

**2207.1 DESCRIPTION**

This work shall consist of stabilizing, to a specified depth, the material in the upper portion of the subgrade by the addition of bituminous material.

**2207.2 MATERIALS**

**A Bituminous Material..... 3151**

The bituminous material for the mixture shall conform to the requirements for one of the following kinds and grades, subject to any limitations imposed by the Contract. If any options are permitted, the kind to be used shall be optional with the Contractor but the grade shall be as designated by the Engineer.

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Asphalt Cement ..... 200/300 penetration  
MC Liquid Asphalt..... MC-250, MC-800  
RC Liquid Asphalt..... RC-250, RC-800  
Emulsified Asphalt..... S-1, SS-1h, CSS-1, CSS-1h

**B Anti-Stripping Additive..... 3161**

If an additive is to be used, it may be added to the bituminous material either at the refinery or at the job site. The blending shall be done at a time and in a manner approved by the Engineer. When the additive is to be added on the job, the combined materials shall be mixed by not less than 5 complete circulations. No compensation in addition to the Contract prices will be made because of any additive that may be used.

**2207.3 CONSTRUCTION REQUIREMENTS**

**A General**

The construction requirements are based on methods of construction by which the bituminous material will be applied to and mixed with the aggregate on the road by road-mix methods.

**B Restrictions**

If emulsified asphalt is used in the mixture, the total moisture content of the aggregate and the emulsion shall, at the time the emulsion is applied, be sufficient to ensure satisfactory mixing. If the addition of water is required, the water shall be applied to the aggregate or mixed with the emulsion prior to mixing the bituminous material with the aggregate.

If asphalt cement is used in the mixture, the aggregate shall, at the time the asphalt cement is applied, contain sufficient moisture (in the Engineer's opinion) to ensure satisfactory mixing. Moisture control will be considered as incidental work, and no direct compensation will be made therefor.

If a liquid asphalt is used in the mixture, the aggregate shall not contain more than 2 percent of free moisture at the time the bituminous material is applied except that, if an anti-stripping additive is used, the aggregate may contain free moisture up to a maximum of 4 percent.

An anti-stripping additive may be used only with the consent of the Engineer.

If the method of mixing employed requires the bituminous material to be applied in a separate operation, the bituminous material shall be applied with distributors.

Except when asphalt cement is used in the mixture, application of bituminous material and mixing shall be done only during daylight hours and when the air temperature is 10°C (50° F) or higher, and the bituminous material shall be at least partially mixed with the aggregate before dark on the same day that it is applied.

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When asphalt cement is used in the mixture, the mixing shall be done only when the air temperature is 15°C (**60° F**) or higher, and the mixing shall be done by a machine that thoroughly mixes the asphalt cement with the aggregate in the subgrade to the specified depth in one continuous forward movement.

When the method of mixing employs equipment requiring the aggregate to be windrowed, the bituminous mixture shall be spread only during daylight hours and when the air temperature is 10°C (**50° F**) or higher. If compaction is obtained by the use of conventional rolling equipment, such mixtures shall be spread in layers approximately equal in thickness, but no single layer shall exceed 75 mm (**3 inches**) in compacted thickness. If compaction is obtained by vibratory or other special compacting equipment, the thickness of each layer may be increased to a maximum of 150 mm (**6 inches**). The mixture shall be kept in windrows during rains, and shall be free of surface moisture at the time of spreading and compacting.

The mixing, spreading, and rolling shall be conducted only on sections of such length as will meet the approval of the Engineer.

#### **C Equipment**

The equipment used shall conform to the applicable requirements of 2321.3C except that, when asphalt cement is specified as the bituminous material for the mixture, the mixing shall be done by a machine that meets the following requirements:

- (1) The machine shall be capable of thoroughly mixing the asphalt cement with the aggregate in the subgrade to the specified depth in one continuous forward movement.
- (2) The machine shall be equipped with a spray bar that distributes the bituminous material uniformly across the mixer at a predetermined accurately controlled rate.
- (3) The asphalt shall be applied to the aggregate at a spray bar pressure of not less than 200 kPa (**30 pounds/square inch**).

#### **D Application of Bituminous Material and Mixing**

If the mixing is done by a machine of the type required when asphalt cement is used in the mixture, each successive adjacent pass of the mixer shall overlap the previous pass sufficiently to prevent leaving any unmixed seams in the subgrade aggregate.

The bituminous material shall be applied to the aggregate at a rate per square meter (**square yard**) per 25 mm (**1 inch**) of thickness of stabilized thickness designated by the Engineer within the following limits:

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<b>Kind of <u>Bituminous Material</u></b>	<b>Quantity Required per Square meter (square yard) per <u>25 mm (Inch) of Thickness</u></b>
Liquid Asphalts .....	2-3 L ( <b>0.4-0.6 gallons</b> )
Emulsified Asphalts .....	1-3 L ( <b>0.2-0.7 gallons</b> )
Asphalt Cements .....	2-3 L ( <b>0.5-0.7 gallons</b> )

When the bituminous material is applied with distributors, it may be necessary to apply it in more than one application. After each application, mixing shall continue until a mixture of uniform color is produced.

All mixtures shall be mixed and aerated until the volatile component of the mixture has been removed to a degree satisfactory to the Engineer.

The temperature of the bituminous material at the time of application shall be as approved by the Engineer, within the limits specified below:

Liquid Asphalt	MC-250, RC-250	40-105°C ( <b>105-220<sup>0</sup> F</b> )
	MC-800, RC-800	55-125°C ( <b>135-255<sup>0</sup> F</b> )
Emulsified Asphalt	SS-1, SS-1h,	20-70°C ( <b>70-160<sup>0</sup> F</b> )
	CSS-1, CSS-1h	
Asphalt Cement		150-175°C ( <b>300-350<sup>0</sup> F</b> )

**E Spreading and Compacting**

Spreading, shaping, and compacting shall follow immediately after mixing. The mixture shall be spread without segregation to produce the specified thickness and cross sections.

When emulsified asphalt is used in the mixture, the total fluid content (emulsion plus water) of the mixture at the time of spreading and compacting shall be not more than 100 percent of optimum moisture.

The bituminous mixture shall be uniformly compacted for the full depth of each layer to a density not less than 100 percent of the density obtained when a sample of the mixture is compacted by the one point density compaction method described in the Mn/DOT Grading and Base Manual.

**F Fog Seal**

A fog seal shall be applied to the stabilized subgrade at a rate not to exceed 0.5 L /square meter ( **0.1 gallon/square yard**) of bituminous material, using a kind and grade approved by the Engineer.

2211.2

**G Thickness and Surface Requirements**

After compaction, the elevation of the finished surface of the bituminous stabilized subgrade at any point of measurement shall not vary by more than 15 mm (**0.05 foot**) from the prescribed elevation for that point, as determined from the grades staked by the Engineer and the cross sections shown in the Plans.

The variations in depth of the bituminous stabilization shall average within 15 mm (**1/2 inch**) of the planned depth on any day's operation. No individual test shall show a depth more than 20 mm (**3/4 inch**) less than the planned depth.

**2207.4 METHOD OF MEASUREMENT**

The accepted quantity of bituminous stabilized subgrade of each specified thickness will be measured separately by area, based on the planned width.

The accepted quantities of bituminous material will be measured by volume. Bituminous material used for fog seal will be included for payment with the quantity of bituminous material for mixture.

**2207.5 BASIS OF PAYMENT**

Payment for the accepted quantities of bituminous material and bituminous stabilized subgrade at the Contract prices per unit of measure will be compensation in full for all costs of constructing the bituminous stabilized subgrade as specified, exclusive of those costs that are to be compensated for separately under other Contract items.

No direct compensation will be made for any water used in conjunction with the mixing and placing operations.

Payment for the bituminous stabilized subgrade will be made on the basis of the following schedule:

<b>Item No.</b>	<b>Item</b>	<b>Unit</b>
2207.503	Bituminous Material for Mixture.....	liter ( <b>gallon</b> )
2207.512	Bituminous Stabilizer .....	
	Subgrade, ___ mm ( <b>inch</b> ) thick .....	
	.....square meter ( <b>square yard</b> )	

**2211**

**Aggregate Base**

**2211.1 DESCRIPTION**

This work shall consist of constructing one or more courses of aggregate base on a prepared subgrade.

**2211.2 MATERIALS**

<b>A</b>	<b>Aggregate</b> .....	<b>3138</b>
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## 2211.2

The class of aggregate to be used in each course will be shown in the contract. Gradation acceptance for Classes 1, 2, 3, 4, 5, 6 and 7 aggregates will be by the random sampling method in accordance with 2211.3F.

### 2211.3 CONSTRUCTION REQUIREMENTS

#### A General

Aggregate removed from below water shall be stockpiled and allowed to drain for at least 24 hours before being delivered on the road when its water content is such that, in the Engineer's opinion, it will cause saturation of the subgrade soils.

The base shall be constructed in layers not more than 75 mm (**3 inches**) in compacted thickness, except that each layer compacted with approved types of special compacting equipment may be increased to a maximum of 150 mm (**6 inches**)

. Vibratory rollers will be allowed for use on a performance basis in accordance with 1805.

Where successive courses are to be constructed with different classes of aggregate, the Engineer may allow the Contractor to construct any course in accordance with the material requirements for the next above course. However, the Engineer will make payment for the combined work on the basis that each course was constructed according to the Plans.

#### B Placing and Mixing

When the base is constructed in a single layer, aggregate shall not be deposited on the roadbed more than 3 km (**2 miles**) in advance of the completed portion of the base. When the base is constructed in more than one layer, the aggregate for one layer shall not be deposited more than 5 km (**3 miles**) in advance of the completed portion of the succeeding layer, except that a single class of aggregate may be placed and compacted for the entire length of the Project before another class of aggregate is placed thereon. At the time of depositing the aggregate on the road, the roadbed shall be so dry and compact that no rutting or displacement will occur. Aggregate shall be placed on public road approaches and private entrances in the quantities designated by the Engineer.

If so required by the Contract, calcium chloride shall be furnished and mixed with the aggregate in accordance with 2131. Water may be added to the aggregate during mixing operations in the quantity necessary to produce proper compaction.

Aggregate windrows shall be moved, as directed by the Engineer, to permit satisfactory maintenance and drying of the subgrade. Any material that becomes contaminated after placement shall be removed and replaced, or corrected and retested.

When any surfacing is included in the same Contract as the aggregate base, the Contractor shall conduct operations in such a

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manner that, before suspending operations for the winter, all base aggregate deposited on the roadbed shall be covered with the initial surface course or otherwise protected in a manner approved by the Engineer. A bituminous penetration prime coat is not considered to be a surface course.

### **C Spreading and Compacting**

At the time of spreading the base material for compaction, the aggregate shall be so uniformly mixed that it will meet specified gradation requirements, based on the results of gradation tests run on aggregate samples obtained after mixing and prior to compaction.

The material for each layer shall be spread and compacted to the required cross section and density before placing aggregate thereon for a succeeding layer. The surface of each layer shall be maintained, with uniform texture and firmly keyed particles, until the next layer required by the Contract is placed thereon or until the completed base is accepted if no other construction is required thereon.

Compaction shall be obtained by the:

- (1) Specified density method,
- (2) Quality compaction method, or
- (3) Penetration index method

whichever method is prescribed for the particular course. Compaction by the specified density method will be required on all base courses except those that are otherwise designated in the contract for compaction by either the quality compaction or penetration index method. If Class 7 is specified or substituted for another class of aggregate, then densification shall only be obtained by the quality compaction method or the penetration index method.

#### **C1 Specified Density Method**

The full thickness of each layer shall be compacted to not less than 100 percent of maximum density. For test purposes, a layer will be considered to be 75 mm (**3 inches**) in compacted thickness. At the time of compaction, the moisture content of the base material shall be not less than 65 percent of optimum moisture.

The Engineer will make tests to determine the actual field density of the compacted base. The field density, optimum moisture, and maximum density will be determined in the field by methods described in the Mn/DOT Grading and Base Manual.

#### **C2 Quality Compaction Method**

Each layer shall be compacted until there is no further evidence of consolidation using a steel-wheeled roller or pneumatic-tired roller meeting 2123 unless the use of vibratory or other special compaction equipment is approved by the Engineer.

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Water shall be applied to the base material during the mixing, spreading, and compacting operations when and in the quantities the Engineer considers necessary for proper compaction.

#### C3 Penetration Index Method

The full thickness of each layer of class 5, 6 or 7 shall be compacted to achieve a penetration index value less than or equal to 10 mm (**0.4 inch**) per blow, as determined by a Mn/DOT standard dynamic cone penetrometer (DCP) device. For test purposes, a layer will be considered to be 75 mm (**3 inch**) in compacted thickness but a testing layer can be increased in thickness to a maximum of 150 mm (**6 inch**) if compacted in one lift by a vibratory roller. At least two passing dynamic cone penetrometer tests shall be conducted at selected sites within each 800 m<sup>3</sup> (**1000 cubic yard**) (CV) of constructed base course.

If a test fails to meet the specified requirements, the material represented by the test shall be recompacted and will be retested for density compliance.

All aggregates prescribed to be tested under the Penetration Index Method 2211.3C3 must be tested and approved within 24 hours of placement and final compaction. Beyond the 24 hour limit, the same aggregate can only be accepted by the Specified Density Method 2211.3C1.

Water shall be applied to the base material during the mixing, spreading and compacting operations when and in the quantities the Engineer considers necessary for proper compaction.

#### C3a Determination of Penetration Index Value

The penetration index value will be determined using a Mn/DOT cone penetrometer (DCP) device. The basic test method can be found in the Mn/DOT User Guide to the Dynamic Cone Penetrometer and the detailed test methods and procedures for base and shouldering aggregate are available from the Grading and Base Office, Maplewood.

### **D Workmanship and Quality**

The Contractor shall construct each base course in conformity with the cross-sectional dimensions shown in the Plans and the staked grades. When the final layer of base has been completed, and at the time any additional construction is to be placed thereon, the finished surface of the base shall not vary more than 15 mm (**0.05 foot**) from the elevation prescribed for that point as determined from the staked grades and the typical sections shown in the Plans. When the base is placed adjacent to a pavement, the elevation of the finished surface of the base shall be referenced to the edge of the pavement.

When fine grading operations are required on the finished base prior to constructing pavement thereon, the surface elevation tolerance shall be met at the time of completing the fine grading. Any excess



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material deposited on the shoulders as a result of those operations, that is contaminated to the extent that it does not meet the Specification requirements for use in the aggregate shouldering, will be deducted from the pay quantities.

**E Aggregate in Stockpiles**

When the Proposal contains an item for stockpile aggregate, the Contractor shall, in addition to the aggregate required for the base construction, produce, deliver, and stockpile aggregate of the class specified at the designated sites as directed by the Engineer.

**F Random Sampling Gradation Acceptance Method**

The following provisions shall apply to the use of Class 1, 2, 3, 4, 5, 6 and 7 aggregates:

**F1 Gradation Control**

The Contractor and/or aggregate producer shall be responsible for maintaining a gradation control program in accordance with the random sampling acceptance method described in the Grading and Base manual.

The Contractor will be permitted to proceed with and complete the base construction on the basis of the Contractor’s Certification (on Form 24346 furnished by the Engineer) that the material supplied and used conforms to the appropriate specification requirements. The Contractor shall assume full responsibility for the production and placement of uniform and acceptable materials.

**F2 Acceptance Testing**

Aggregate gradation compliance will be determined in accordance with following table:

**Table 2211-A, Acceptance Testing Schedule<sup>(a)</sup>**

Quantity <sup>(k)</sup> Metric tons <sup>(b)</sup> <b>Tons<sup>(b)</sup></b>	No. Lots <sup>(c)</sup>	No. Samples <sup>(d)(e)</sup> or No. Sublots/Lot <sup>(f)</sup>	Payment Acceptance Schedule
less than 500	N/A	use Form 2415 or 2403 (small qty.)	Table 2211-C
≥500 but less than 4,000	N/A	1/1000 metric tons <sup>(g)</sup> ( <b>tons</b> ) <sup>(g)</sup>	Table 2211-C
≥4,000 but less than 10,000	1 <sup>(h)(i)</sup>	4 <sup>(i)</sup>	Table 2211-B

(a) In accordance with 1503, Conformity with Plans and Specifications, it is the intent of these specifications that materials and workmanship shall be uniform in character and shall conform to the prescribed target value or to the middle portion of the

### 2211.3

tolerance range. The purpose of the tolerance range is to accommodate occasional minor variations from the median zone. The production and processing of the materials and the performance of the work shall be so controlled that the material or workmanship will not be of borderline quality.

- (b) Or equivalent in cubic meters loose volume or cubic meters compacted volume:

1 metric ton =  $0.6\text{m}^3$  (**1 ton = 0.7 cubic yard**) (LV) or

1 metric ton =  $0.46\text{m}^3$  (**1 ton = 0.55 cubic yard**) (CV).

- (c) The use of any one kind or class of material from more than one source is prohibited without permission of the engineer according to 1601. If the contractor changes sources (with Mn/DOT's approval), a new lot consisting of four sublots will be established provided that the quantity equals or exceeds 4000 metric tons (**tons**). When a material source is changed prior to completing a lot, the remainder of the 4 samples will be taken from the previously placed materials, provided that the quantity equals or exceeds 4000 metric tons (**tons**). However, if the quantity placed is less than 4000 metric tons (**tons**), acceptance testing will be used on one test per thousand metric tons (**thousand tons**).
- (d) Samples for gradation testing will be taken randomly by the Engineer prior to compaction, in accordance with the random sampling method described in the Grading and Base Manual.
- (e) Classes 1, 2 and 7, Shoulder Surfacing Aggregate, may be sampled from the stockpile for testing and acceptance, in accordance with 3138.3.
- (f) Each lot will be divided into four sublots which are approximately equal in quantity.
- (g) Each individual sample will be analyzed separately for payment.
- (h) Each lot shall consist of a maximum of approximately 10000 metric tons (**tons**) of material, although lesser sized lots may occur due to construction constraints.
- (i) Each lot will be analyzed separately for payment.
- (j) One gradation sample will be taken from each subplot and tested. The results obtained from the four samples will be averaged for payments to the nearest one-tenth of one percent for the specified sieves.
- (k) Quantities shown are the same for both metric and English units.

The Engineer will have each sample tested in the field by a Mn/DOT Certified Technician or submit them to the District laboratory for testing. A delay of at least 3 working days is anticipated before laboratory test results are available but a maximum of 8 working hours delay is anticipated for field gradations.

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The individual test results or subplot averages, which are based on Table 2211-A, Acceptance Testing Schedule, shall be compared with tolerances shown in Tables 2211-B or 2211-C, Aggregate Base Payment Schedules. Acceptance for non-complying material shall be made in accordance with the respective tables. To qualify for full payment the Contractor may correct, at no cost to the Department, any lot of non-compliance material where acceptance is based on the lot criteria (greater than 4000 metric tons (**ton**)) and/or the quantity of material represented by a failing test where acceptance is based on the individual sample criteria.

When corrective action is required for acceptance of the work, in accordance with Tables 2211-B and 2211-C, the Contractor shall perform the corrective work at no cost to the Department. The Contractor shall remove the unacceptable material and replace it with acceptable material, or correct the unacceptable material on the road. In lieu of replacement or correction, the Engineer may allow (in the best interest of the Department) the Contractor to accept a price reduction instead of corrective action.

Upon completion of any corrective work required for full payment, whether it is by blending, mixing, adding and/or replacing material, the corrected material will be sampled and tested for acceptance. The entire lot shall be retested, in accordance with Table 2211-A, when the acceptance is based on the lot criteria; otherwise, retesting will be based on one sample per thousand metric tons (**thousand tons**).

**Table 2211-B  
AGGREGATE BASE PAYMENT SCHEDULE  
(4 Sublots/4 Samples)**

<u>% Passing Outside Specified limits *</u>		
All Sieves, except		
<u>75 <math>\mu</math>m (#200) Sieve</u>	<u>75 <math>\mu</math>m (#200) Sieve</u>	<u>Acceptance Method</u>
0.1-1.0	0.1-0.3	5.0% Price Reduction
1.1-2.0	0.4-0.6	15.0% Price Reduction
>2.0	>0.6	Corrective Action Req'd.
* Based on average of 4 tests		
Price reductions for more than one failing sieve size shall be cumulative. The compensation due to the Contractor for the quantity of material represented by the failing test results shall be reduced by the sum of the respective percentages.		

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**Table 2211-C  
AGGREGATE BASE PAYMENT SCHEDULE  
(Individual Test)**

<u>% Passing Outside Specified limits *</u>		
<u>75 <math>\mu</math>m (#200) Sieve</u>	<u>75 <math>\mu</math>m (#200) Sieve</u>	<u>Acceptance Method**</u>
0.1-1.0	0.1-1.0	Substantial Compliance
1.1-2.0	1.1-1.5	5.0% Price Reduction
2.1-3.0	1.6-2.5	15.0% Price Reduction .
>3.0	>2.5	Corrective Action Reqd.

\* Based on individual sample test results.  
\*\* To be applied to occasional failure. If the material consistently fails to meet specification requirements, it will be subject to price reduction as determined by the Engineer.  
Price reductions for more than one failing sieve size shall be cumulative. The compensation due to the Contractor for the quantity of material represented by the failing test results shall be reduced by the sum of the respective percentages; however, the reduction will not exceed 50 percent.

**2211.4 METHOD OF MEASUREMENT**

The Engineer will measure aggregate base according to 1901 and as specified in the Contract, by mass or volume. No deductions will be made for the mass or volume of water and admixtures.

**A Aggregate Base**

Aggregate base of each class will be measured as indicated by:

- (1) Mass,
- (2) Loose volume (LV),
- (3) Compacted volume (CV), or
- (4) Stockpile volume (SV).

Where variables or placement conditions make it impractical to determine the volume of placed material, the base material will be measured by mass or by loose volume (LV). The mass so measured will be converted to equivalent compacted volume on the basis of

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2160 kg/m<sup>3</sup> (135 pounds/cubic foot) of compacted base. Vehicular measure will be converted to compacted volume by methods determined by the Engineer.

**B Stockpile Aggregate**

Aggregate of each class placed in stockpiles will be measured as indicated by:

- (1) Mass,
- (2) Loose volume (LV), or
- (3) Stockpiling volume (SV)

**2211.5 BASIS OF PAYMENT**

Payment for the accepted quantities of aggregate base of each class at the Contract prices per unit of measure will be compensation in full for all costs of furnishing the materials and constructing the base as specified, except that separate payment will be made for any admixtures that may be specified.

No direct compensation will be made for water used in conjunction with the mixing, placing, and compacting operations.

Payment for the accepted quantities of stockpile aggregate of each class at the Contract prices per unit of measure will be compensation in full for all costs of furnishing and delivering the material as specified.

Payment will be made under items selected from the following schedule:

<b>Item No.</b>	<b>Item</b>	<b>Unit</b>
2211.501	Aggregate Base, Class _____ .....	metric ton ( <b>ton</b> )
2211.502	Aggregate Base (LV), Class _____ .....	cubic meter ( <b>cubic yard</b> )
2211.503	Aggregate Base (CV), Class _____ .....	cubic meter ( <b>cubic yard</b> )
2211.505	Stockpile Aggregate, Class _____ .....	metric ton ( <b>ton</b> )
2211.506	Stockpile Aggregate (LV), Class _____ .....	cubic meter ( <b>cubic yard</b> )
2211.507	Stockpile Aggregate (SV), Class _____ .....	cubic meter ( <b>cubic yard</b> )

NOTE: See 2105.4C and insert the words "in Stockpile" or "from Stockpile" if appropriate.

2221

**2221**

**Aggregate Shouldering**

**2221.1 DESCRIPTION**

This work shall consist of constructing one or more courses of aggregate on shoulders adjacent to concrete or bituminous pavements.

**2221.2 MATERIALS**

**A Aggregate ..... 3138**

The class of aggregate to be used in each course will be shown in the contract.

Gradation acceptance for Classes 1,2, 3, 4, 5, 6, and 7 will be by the random sampling method in accordance with 2211.3F. The Engineer may elect to sample Classes 1, 2 and 7 shoulder surfacing aggregate from the stockpile. The stockpile sampling and testing will be performed by Mn/DOT project personnel at the rate of one field gradation test per 1000 metric ton (**ton**). Acceptance will be in accordance with the provisions of 3138.3.

**2221.3 CONSTRUCTION REQUIREMENTS**

Construction requirements for the aggregate shouldering shall be the same as those specified in 2211.3 for aggregate base, except that surfacing aggregate may not be substituted for lower courses.

**A Subgrade Preparation**

The existing shoulders, or that part of the subgrade on which the shouldering is to be placed, shall be shaped and compacted to the required grades and cross sections as given for the bottom of the shouldering, provided, however, that removal of excess material will not be required if it meets the Specification requirements for the shouldering aggregate. Contaminated material shall be removed and disposed of as directed.

The Contractor may place excess aggregate from the roadbed base construction operations on the shoulder when:

- (1) The Engineer accepts the aggregate for use in shouldering.
- (2) The Contractor shapes and compacts the shoulder to a uniform grade and cross-section, permitting placement of the remaining shoulder aggregate at a relatively constant spread, so far as this can be accomplished without loading and hauling materials.

When placing aggregate shouldering on an existing shoulder, the preparation of the existing shoulder shall be as directed by the Engineer. Removal of vegetation and the shaping and compacting of the shoulder subgrade shall be incidental work for which no direct compensation will be made. Removal of excess materials from the existing shoulders will be paid for as Extra Work in the absence of specific Contract items therefore, but only to the extent that the Engineer orders the excess

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material to be loaded and hauled away from the immediate shoulder area.

### **B Placing and Mixing**

The aggregate shall not be deposited or mixed on the adjoining concrete pavement or bituminous wearing course surface. Any material spilled on the pavement surface shall be removed by sweeping.

At the time of depositing the aggregate on the shoulders, the subgrade shall be so dry and compact that no rutting or displacement will occur.

In conjunction with the placement of shoulder aggregate, additional material shall be placed on private entrances and road approaches as the Engineer directs.

The Contractor may place and compact the shoulder aggregate the same day that the bituminous base or surfacing is placed, if the bituminous is not damaged by this operation.

### **C Spreading and Compacting**

When Class 1, 2 or 7 aggregates are used for shouldering, compaction shall be obtained by the quality compaction method.

### **D Construction Under Traffic**

The Contractor shall protect the traffic from drop-off conditions when traffic is carried during construction.

The Contractor shall protect against any drop-off of 40 mm (**2 inches**) or greater from the traveled lane to the adjacent shoulder by bringing the shoulder flush with the traveled lane using a portion of the planned shoulder aggregate. The Engineer may approve the temporary use of existing shoulder material or allow the Contractor to protect the traffic by other measures. This protection requirement applies:

- (1) Prior to construction on the traveled lane.
- (2) Prior to shut down of daily operations.

Placement of the planned shoulder aggregate other than in the final stage will be based on a slope as directed by the Engineer. The final construction of the shoulder shall be in accordance with the typical section shown in the Plan.

## **2221.4 METHOD OF MEASUREMENT**

Aggregate shouldering of each class specified will be measured by the same methods as prescribed in 2211.4.

## **2221.5 BASIS OF PAYMENT**

Payment for the accepted quantities of aggregate shouldering of each class at the Contract prices per unit of measure will be compensation in full for all costs of furnishing the materials and constructing the shouldering as specified, except that separate payment will be made for any admixtures that may be specified.

**2221.5**

No direct compensation will be made for water used in conjunction with the mixing, placing, and compacting operations.

Except as otherwise provided for in the Contract, all costs incurred in preparing and maintaining the shoulder subgrade shall be compensated for as a part of work required in 2112 or 1514.

Payment will be as follows:

<b>Item No.</b>	<b>Item</b>	<b>Unit</b>
2221.501	Aggregate Shouldering, Class ____ .....	metric ton ( <b>ton</b> )
2221.502	Aggregate Shouldering (LV), Class ____ .....	..... cubic meter ( <b>cubic yard</b> )
2221.503	Aggregate Shouldering (CV), Class ____ .....	..... cubic meter ( <b>cubic yard</b> )
2221.505	Stockpile Aggregate, Class ____ .....	metric ton ( <b>ton</b> )
2221.506	Stockpile Aggregate (LV), Class ____ .....	..... cubic meter ( <b>cubic yard</b> )
2221.507	Stockpile Aggregate (SV), Class ____ .....	..... cubic meter ( <b>cubic yard</b> )

NOTE: See 2105.4C and insert the words "in Stockpile" or "from Stockpile" if appropriate.

**2231**

**Base Reconditioning**

**2231.1 DESCRIPTION**

This work shall consist of reconditioning the existing base prior to construction of bituminous overlay or surfacing courses. It shall include the reconditioning of old pavements and all types of base courses other than an untreated aggregate base.

This work does not include the removal and replacement of pavement structure items to full depth, which may be necessary to remove unstable foundation material or facilitate other subsurface construction.

**2231.2 MATERIALS**

**A Bituminous Patching Mixture**

Bituminous patching mixture shall be the same material as will be used in the initial bituminous surfacing course that is to be constructed on the reconditioned base.

**B Mixture for Joints and Cracks**

Mixture for joints and cracks shall consist of a prepared mix containing fine aggregate and bituminous material conforming to the following:



2231.3

<b>Aggregate Gradation</b>	<b>Percent by Mass</b>
Passing 12.5-mm (½ inch) sieve .....	100
Passing 2.00-mm (# 10) sieve.....	20-70
Passing 75-µm (# 200) sieve .....	1-10

Maximum shale content of the aggregate shall not exceed 6 percent.

<b>Bituminous Material</b>	<b>Percent by Mass</b>
Asphalt Cement .....	5.0-7.0

The Engineer will designate the kind and grade of bituminous material to be used. The bituminous material used shall meet 3151.

Mixing operations shall be conducted as approved by the Engineer.

**C Joint and Crack Filler** (As specified in the Plans or Special Provisions)

**2231.3 CONSTRUCTION REQUIREMENTS**

**A General**

Where so indicated in the Plans or ordered by the Engineer, the existing base or pavement shall be removed and replaced in accordance with other provisions of the Contract.

**B Surface Repair**

Surface repairs shall be made as directed by the Engineer, so as to produce a satisfactory base on which to construct the pavement provided for in the Contract. All loose, unstable, or deteriorated portions of the existing base or pavement shall be removed to the extent that a stable surface will be achieved upon completion of the patching operations. All waste or surplus material shall be disposed of to the satisfaction of the Engineer.

All holes and depressions shall be filled with bituminous patching mixture in layers of a thickness approved by the Engineer. Compaction shall be obtained with mechanical tampers in areas not accessible to conventional rolling equipment. Specified density requirements will not apply.

**C Joint Repair**

Existing joints and cracks in concrete pavement that are more than 6 mm (1/4 inch) shall be cleaned and refilled as specified herein, if and to the extent that the required material is provided for as a Contract item.

Joints and cracks more than 6 mm (1/4 inch) but not more than 20 mm (3/4 inch) in width shall be cleaned of old filler material and foreign matter to a depth of at least 20 mm (3/4 inch), after which they are to be filled with joint and crack filler material.

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Joints and cracks more than 20 mm (**3/4 inch**) in width shall be cleaned of old filler material and foreign matter to a depth of at least 25 mm (**1 inch**), after which they are to be refilled with mixture for joints and cracks. The material shall be thoroughly tamped into place.

**2231.4 METHOD OF MEASUREMENT**

The accepted quantities of bituminous patching mixture, mixture for joints and cracks, and joint and crack filler, as furnished and placed, will each be measured separately by the mass or by the LV of material, as indicated in the Proposal.

**2231.5 BASIS OF PAYMENT**

Payment for the accepted quantities of bituminous patching mixture, mixture for joints and cracks, and joint and crack filler, at the appropriate Contract price per unit of material furnished and placed, will be compensation in full for all costs of removal and disposal of the existing deteriorated materials, and for all costs of furnishing and placing the patching or filler materials as specified.

Removal of a concrete base or pavement to full depth and width between existing joints, or by sawing, shall be accomplished as Extra Work in the absence of an item covering its removal under the provisions of 2104.

Payment for base reconditioning will be made on the basis of the following schedule:

<b>Item No. Item</b>	<b>Unit</b>
2231.501 Bituminous Patching Mixture.....	metric ton ( <b>ton</b> )
2231.502 Bituminous Patching Mixture.....	cubic meter ( <b>cubic yard</b> )
2231.505 Mixture for Joints and Cracks.....	.....
.....	kilogram ( <b>pound</b> )
2231.507 Joint and Crack Filler .....	kilogram ( <b>pound</b> )

**2232**

**Mill Pavement Surface**

**2232.1 DESCRIPTION**

This work shall consist of improving the profile, cross slope, and surface texture of an existing pavement surface by machine (cold) milling preparatory to placement of another course thereon.

**2232.2 BLANK**

**2232.3 CONSTRUCTION REQUIREMENTS**

**A Equipment**

Pavement milling shall be accomplished with a power operated, self-propelled cold milling machine capable of removing concrete and bituminous surface material as necessary to produce the required profile, cross slope, and surface texture uniformly across the pavement

### 2232.3

surface. The machine shall also be equipped with means to control dust and other particulate matter created by the cutting action.

The machine shall be equipped to accurately and automatically establish profile grades along each edge of the machine, within plus or minus 3 mm (**1/8 inch**), by referencing from the existing pavement by means of a ski or matching shoe, or from an independent grade control. The machine shall be controlled by an automatic system for controlling grade, elevation, and cross slope at a given rate.

#### **B Operations**

The pavement surface shall be milled to the depth, width, grade, and cross slope as shown in the Plans or as otherwise directed by the Engineer. Machine speeds shall be varied to produce the desired surface texture grid pattern. Milling shall be performed without excessive tearing or gouging of the underlying material.

The pavement milling operations shall be referenced from an independent grade control in those areas where the Engineer considers such control is essential. The control shall be established and maintained by the Contractor in a manner and in such position as the Engineer approves.

Milling operations shall be conducted so that the entire pavement width is milled to a flush surface at the end of each work period, whenever the pavement is open to traffic. In case of uncompleted operations resulting in a vertical or near vertical longitudinal cutting face, it shall be the Contractor's responsibility to minimize the hazardous effects to traffic by resloping the longitudinal face to provide a suitable taper, by constructing a temporary bituminous taper, or by otherwise providing the necessary protective measures, as approved by the Engineer. Transverse cutting faces shall be tapered at the end of each working period where traffic is permitted. To further provide for traffic, the Contractor shall also construct temporary bituminous tapers at intersecting streets, around utility appurtenances, and at all appropriate entrances during the milling operations, as ordered by the Engineer.

The Contractor shall construct the temporary milled tapers and furnish, place, and remove temporary bituminous tapers as incidental work for which no direct compensation will be made.

In areas inaccessible to the milling machine, the work shall be accomplished by other equipment or methods acceptable to the Engineer.

The surfacing removed in conjunction with the milling operations may be recycled for use on the Project in accordance with the applicable Specifications, or disposed of outside of the Right of Way as specified in 2104.3.

After the milling operations are completed to the planned depth, the milled area shall be cleaned by sweeping or vacuuming with equipment

**2232.3**

approved by the Engineer. Such cleaning shall be performed to the satisfaction of the Engineer.

Debris resulting from milling and cleaning operations shall be disposed of outside of the Right of Way as specified in 2104.3, except as otherwise authorized by the Engineer.

Milling at previously patched areas shall be performed to the required depth below the pavement surface existing prior to the previous patch being placed, and not from the surface of the patch.

The Contractor shall take care to avoid disturbing or damaging any existing drainage or utility structures on the Project. Any damage resulting from the Contractor's operations shall be repaired by the Contractor at no expense to the Department.

**2232.4 METHOD OF MEASUREMENT**

Pavement milling will be measured by the area of each type of surface removed. Measurements will be of those areas milled as specified, based on actual finished dimensions of the work.

**2232.5 BASIS OF PAYMENT**

Payment for pavement milling at the appropriate Contract price per unit of measure will be compensation in full for all costs of performing the work as specified, including, but not limited to, traffic safety, cleanup, and disposal operations.

Payment for pavement milling will be made on the basis of the following schedule:

<b>Item No.</b>	<b>Item</b>	<b>Unit</b>
2232.501	Mill Bituminous Surface.....	square meter ( <b>square yard</b> )
2232.502	Mill Concrete Pavement .....	
	Surface.....	square meter ( <b>square yard</b> )

2301

Concrete Pavement

2301.1 DESCRIPTION

This work shall consist of constructing Portland cement concrete pavement on a prepared subgrade. The pavement will be designated by type, as being either reinforced or nonreinforced.

2301.2 MATERIALS

A Concrete ..... 2461

Mix designations shall be as given below for the method of placement to be used.

Manual Placement..... Mix No. 3A41

Standard Machine Placement..... Mix No. 3A31

Vibratory Machine Placement..... Mix No. 3A21

Class D aggregate within a single fraction (CA-1, CA-2, CA-3, or CA-5) will not be permitted except in bridge approach panels.

A1 Coarse Aggregate Fraction of the Coarse Aggregate

The coarse aggregate fraction of the coarse aggregate (CA-1, CA-2, or CA-3) for concrete pavement shall meet one of the following requirements:

- (a) Class A aggregate,
- (b) Class B carbonate with an absorption value of less than 1.75 percent when tested in accordance with the test procedure on file in the Materials Laboratory, or
- (c) Class C aggregate with less than 30 percent of the particles by mass (**weight**) of carbonate origin.

A2 Fine Aggregate Fraction of the Coarse Aggregate

The fine aggregate fraction of the coarse aggregate (CA-5) shall meet one of the above (a), (b), or (c) requirements or Class R material may be used.

A3 Class R as the Coarse Aggregate

For 100 percent Class R coarse aggregate concrete mixes, the mix designations shall be as given below for the method of placement to be used.

Manual Placement..... Mix No. 3A40R

Standard Machine Placement..... Mix No. 3A30R

Vibratory Machine Placement..... Mix No. 3A20R

A4 All Class R Aggregate

The Contractor may use Class R aggregate with A2 or A3 above in concrete pavement upon receiving written approval from the Engineer. Such approval will be given only if the Concrete Engineer can adequately trace the source of the original coarse aggregate

**2301.2**

and subsequently determines that source to be satisfactory for the use intended.

<b>B</b>	<b>Reinforcement Bars</b> .....	<b>3301</b>
<b>C</b>	<b>Dowel Bars</b> .....	<b>3302</b>
<b>D</b>	<b>Steel Fabric</b> .....	<b>3303</b>
<b>E</b>	<b>Blank</b>	
<b>F</b>	<b>Concrete Joint Sealers,</b>	
F1	Hot-Poured, Crumb Rubber Type .....	3719
F2	Hot-poured, Low Modulus Type .....	3720
F3	Preformed Type .....	3721
F4	Hot-poured, Elastic Type .....	3723
F5	Hot-poured, Elastic Type .....	3725
<b>G</b>	<b>Preformed Joint Filler</b> .....	<b>3702</b>
<b>H</b>	<b>Curing Materials</b>	
H1	Waterproof Curing Paper.....	3752
H2	Plastic Curing Blankets .....	3756
H3	Membrane Curing Compound .....	3754
H4	Extreme Service Membrane Curing Compound.....	3755
<b>I</b>	<b>Blank</b>	
<b>J</b>	<b>Form Coating Material</b> .....	<b>3902</b>

**2301.3 CONSTRUCTION REQUIREMENTS**

Unless otherwise prohibited by the Special Provisions, the use of the "Slip Form" method of construction will be permitted as an alternative procedure to the construction method employing fixed forms as provided for herein, in which case references to the use of fixed side forms or to the use of equipment designed to ride on fixed forms shall not apply.

**A General**

**A1 Operation and Supervision**

Construction operations shall not be started until the Engineer has determined that all equipment, tools, inspection facilities, preliminary testing, and accessories necessary for the phases of work being undertaken at the time are on the work site and meet the Specification requirements as to design, capacity, and mechanical condition.

The Contractor shall have in the Project organization a separate foreman, subforeman, or designated worker in charge of each phase of the work requiring direct supervision, who is authorized to receive instructions and orders in the absence of the general foreman or superintendent. Major phases of the work requiring this direct supervision shall be as follows:

### 2301.3

- (a) Aggregate producing plant, if operated as a part of the Contract.
- (b) Concrete batching and mixing plant.
- (c) Subgrade preparation and fine grading.
- (d) Form setting.
- (e) Concrete placing.
- (f) Finishing and curing.
- (g) Joint sealing and cleanup.

The Contractor should also have available a manufacturer's manual that explains the operation and adjustments of the major pieces of power operated equipment to be used.

#### A2 Special Plant Lab – Office Requirements for (QC/QA) Projects Only

The following special requirements apply for concrete paving projects where materials acceptance is based on quality control performed by the Contractor and the quality assurance performed by the Agency (QC/QA):

A separate combination Plant Lab-Office shall be furnished for use during the concrete paving operation. This combination Plant Lab – Office shall be shared equally by the Concrete Paving Contractor QC technicians and the Agency QA technicians. This combination Plant Lab – Office supplied by the Concrete Paving Contractor shall be considered incidental and shall meet the requirements of Mn/DOT 1604.

The combination Plant Lab – Office will be constructed and equipped to all provisions of Mn/DOT 2031.3A except as modified below:

- a. Minimum total floor area, based on exterior dimensions, will not be less than 21 square meters (**224 square feet**).
- b. Minimum Plant Lab floor area, based on exterior dimensions, will not be less than 13.5 square meters (**144 square feet**).
- c. Minimum Plant Office floor area, based on exterior dimensions, will not be less than 7.5 square meters (**80 square feet**).
- d. Plant Lab and Plant Office areas will be separated by a wall to effectively isolate the Plant Lab from the Plant Office.

In addition to the requirements set forth above, each combination Plant Lab – Office will be equipped to meet all the provisions of Mn/DOT 2031.3B1 (Field Office Furnishings) and Mn/DOT 2031.3B2 (Field Laboratory Furnishings) except as modified below:

- a. Plant Office Furnishings
  - 1. Two (2) desks with minimum total exterior dimensions of 0.75 m by 1.50 meters (**30 x 60 inches**). One each for the Agency and Contractor.

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2. Sufficient desk chairs to utilize all desks and provide seating for at least two additional persons.
3. Two (2) file cabinets with two or more file drawers. One each for the Agency and Contractor.
4. The Contractor shall provide a working telephone and working fax machine. The Contractor shall provide local and long distance telephone service in the Plant office only for the duration of concrete paving operations. The Contractor shall pay for the telephone installation, the basic monthly phone service charges and the eventual removal of the telephone. Payment for local telephone service will be considered incidental for which no direct payment will be made. The Contractor shall bill Mn/DOT for long distance phone charges by sending an invoice and a copy of the long distance charges, provided said charges were not incurred by the Contractor, his employees, his subcontractors, or suppliers.

#### b. Plant Laboratory Furnishings

1. One sturdily built workbench or countertop with minimum dimensions of 0.75 x 3.65 m (**30 x 144 inches**) to be shared equally between the contractor and agency.
2. Shelf space above workbench or countertop or at other convenient locations, totaling a minimum of 2.5 m (**8 linear feet**) length by (0.20 m (**8 inches**) minimum width).
3. Electronic balances/scales for all materials testing.

In addition to the requirements set forth above, the combination Plant Lab – Office will meet requirements of Mn/DOT 2031.3C. Type D service will be provided with the exception that toilet and lavatory facilities are not required.

Concrete paving operations will not be permitted to begin until the combination Plant Lab – Plant Office meets all requirements herein.

#### A3 Equipment Restrictions

Equipment, other than sawing equipment, shall not operate on the new pavement slab until the joints have been sealed. Equipment operated on a slab shall be designed, equipped, and operated so as not to cause damage. Should any damage result, the operations shall be suspended until corrective action has been taken. In no case shall the equipment wheels or tracks be operated within 100 mm (**4 inches**) of the slab edge.

The Contractor shall not operate paving or other heavy equipment on a new pavement slab until the concrete has attained an age of 7 days or until it has a minimum flexural strength of 3450 kPa (**500 psi**), and then only when authorized by the Engineer. The



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concrete test specimens shall be cast, cured, and tested as prescribed in the Mn/DOT Concrete Manual. When such paving operations are authorized, the following conditions shall be complied with:

- (a) Before moving on and off the pavement, a ramp of compacted earth or other suitable material of sufficient strength and elevation shall be constructed to prevent undue stress in the pavement slab.
- (b) The paving equipment shall operate on protective mats consisting of wood strips, belting, or other suitable material to prevent damage to the pavement surface and joints. The pavement surface shall be swept free of debris prior to placing the protective mats.

#### A4 Integrant Curb

Integrant curb is a curb that is constructed monolithically with the pavement.

#### A5 Terminal Headers

Terminal headers of the length directed by the Engineer shall be constructed where necessary to protect the ends of new pavement.

#### A6 High Early Strength Sections

Where so indicated in the Plans or directed by the Engineer, a section of pavement shall be constructed of high early strength concrete at important road crossings, intersections, driveway entrances, or other locations where early use of the pavement may be required to accommodate traffic.

Because of the accelerated rate of hardening of high early strength concrete, the Contractor shall take such extra precautions as necessary to ensure satisfactory finishing of these sections.

#### A7 Closed Period for New Pavement

New pavement shall not be opened to use by any traffic until the joints have been sealed.

Newly constructed pavement may be opened to use by light vehicles (axle loads of 2700 kg (6000 pounds) or less) 72 hours after the concrete has been placed.

New pavement shall be closed to use by general public traffic for 12 days or until the concrete has developed a flexural strength of 3100 kPa (**450 psi**), whichever is the shorter. When the opening of new pavement to traffic is to be determined by flexural strength, the test specimens shall be cast and tested as prescribed in 2461.4A5. The test specimens shall be cured in the same manner and under the same conditions as the pavement represented.

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#### **B Subgrade Preparations**

The aggregate base construction and subgrade preparations, as provided for in 2211 and 2112 respectively, shall be completed in sufficient time to permit all tests and measurements to be completed prior to the fine grading operation. The subgrade shall then be fine graded to the required shape and grade to ensure construction of pavement meeting the specified thickness and cross section. Fine grading shall be accomplished with a template planer or other suitable machine capable of producing the necessary finish. Fine grading operations shall be completed at least 3 hours in advance of concrete placement, except on crossovers and other such small areas as the Engineer exempts.

If the slipform method of construction is used, the base course from out to out of the paver treads shall be accurately fine graded to the required elevation by an approved fine grading machine mounted on crawler treads. Base construction shall be completed and the required subgrade density obtained to a width at least 0.3 m (**1 foot**) beyond the outside edges of the paver treads before the fine grading is performed. The aggregate base shall have sufficient stability and firmness to support the fine grading equipment and slipform paver without any serious distortion of the alignment or grade line.

Following the fine grading operations, the subgrade shall be recompacted as necessary to produce a firm smooth subgrade. Water shall be added as necessary during the recompacting operations, and the subgrade shall be maintained in a moist condition until placement of the concrete. The subgrade shall be rechecked with a suitable device prior to placing the concrete, if paving equipment or hauling equipment has been operating thereon. The Engineer may recheck the density of the base after completion of fine grading operations. Any disturbed material shall be recompacted.

Within 24 hours after paving or upon form removal, the Contractor shall shape the shoulders in such a manner and to such an extent that surface water will drain away from the pavement and off the shoulders. The Contractor shall maintain the shoulders in that condition.

#### **C Form Placement and Removal**

##### **C1 Form Sections**

Regardless of type or design, forms shall have a height at least equal to the edge thickness of the pavement and shall have a strength and rigidity such that, when they are set in place and braced, they will withstand the mass (**weight**) and action of passing equipment without springing, settlement, or lateral displacement. Individual form sections shall be connected by methods that will secure the effect of a continuous form.

Form sections shall be not less than 3 m (**10 feet**) long except that wood forms may be 2.4 m (**8 feet**) or more in length. Approved flexible

### 2301.3

or curved forms of proper radius shall be used on curves having a radius of 45 m (**150 feet**) or less, except that, on curves having a radius greater than 30 m (**100 feet**), straight forms not over 3 m (**10 feet**) in length may be used when power operated strike-off and finishing equipment is used. The finished face of all curbing shall be constructed and finished to a line closely conforming to the Plan curvature and location. Straight forms longer than 3 m (**10 feet**) shall not be used on any curved line unless specifically authorized by the Engineer.

The top surfaces of all forms shall be smooth and free of localized indentations and deformities, and shall show no deviations greater than 3 mm (**1/8 inch**) from a straight edge having a length equal to the form section. The faces of straight forms shall show no deviations greater than 13 mm (**0.5 inch**) from a 3 m (**10 foot**) straight edge.

Integrant curb forms shall conform to the applicable requirements for paving forms and shall be equipped with clamps or other satisfactory means to ensure their support and alignment.

#### C2 Form Setting

The Contractor shall set the forms to the proper alignment and grade for a distance equal to at least 3 hours of paving time ahead of the paver, except when less than that quantity of paving remains to be done.

The foundation upon which the forms will be set shall be compacted in accordance with 2301.3B. The forms shall have a firm and uniform bearing over their whole base area; shall be tightly joined and securely staked; and shall be clean and free of accumulations of hardened concrete. The contact faces of the forms shall be coated with a chemical release agent conforming to 3902 prior to placing the concrete against them.

In the event of rain, the forms shall be removed and reset as necessary to permit drainage and comply with the above requirements.

#### C3 Keyway Forms

Keyway forms that are attached to the side forms may be cut off not more than 75 mm (**3 inches**) from each end of the form section length. All keyway forms for fixed form paving shall be manufactured to the Plan dimensions.

#### C4 Removal of Forms

Side forms for pavement and back forms on integrant curb shall not be removed earlier than 12 hours after the concrete has been placed, except that the Engineer may authorize earlier removal based on the procedure to be used.

Forms shall be removed in a manner that exerts no apparent shock or strain on the pavement or curb and under satisfactory conditions of visibility (such as natural daylight), as determined by the Engineer.

### 2301.3

#### **D Batch Hauling**

Dry batches shall be hauled in approved trucks that are compartmentalized to keep individual batches separate from one another. Also a cement compartment shall keep the cement separate from the other batch ingredients and free from wind loss.

Wet batches shall be hauled in trucks that are mortar tight and capable of complete discharge of the concrete. The trucks shall be equipped with vibrators to aid in such discharge. Dump type trucks shall not dump concrete directly on the grade unless approved by the Engineer, and such approval will only be granted when the dimensions of the work make other methods impractical.

Any truck operations on the base will be subject to 2301.3B.

#### **E Placing Metal Reinforcement**

All metal reinforcement shall be clean when used. The forms shall be of the type, style, and dimensions shown in the Plans, unless otherwise approved.

Metal reinforcement shall be placed at the locations shown in the Plans and in accordance with the following:

##### **E1 Steel Fabric**

Steel fabric reinforcement shall conform to the wire size, spacing, and arrangement, and to the unit dimensions shown in the Plans. Those requirements shall be considered to be the minimum. Alternate configurations may be approved by the Engineer, provided that equal or greater steel percentages are maintained.

All main line pavement constructed by standard or vibratory machine placement methods shall be constructed in a single layer of concrete. This will require appropriate equipment for depressing the steel fabric reinforcement to the specified location.

The tie bar steel required for LIT joints shall be placed by an approved mechanical device attached to the spreader or paver. Such device shall space and depress the tie bar steel to the desired depth and location.

Steel fabric reinforcement used in other locations shall be placed in the pavement by either one of two methods:

- (a) The concrete may be placed in two layers, in which case the steel fabric shall be laid on top of the first layer of concrete after it has been spread and consolidated as hereinafter specified; or
- (b) The concrete may be placed in a single layer and the steel fabric depressed into place, provided the job performance of the method and equipment used places the fabric within the specified elevation range in the pavement and provided the procedure does not unduly segregate the concrete materials.

For two-layer construction, the first layer shall be struck off with a mechanical spreader or with a strike-off board, timber, or metal plate of

### 2301.3

proper shape, the elevation of which is controlled by supports that ride on the forms or adjacent concrete. Surface consolidation of the first layer of concrete in this case is optional with the Contractor except that along the forms and adjacent to structures the concrete in the first layer shall be consolidated by vibration during or after the strike-off and before placing the steel fabric reinforcement.

Placement of the second layer of concrete shall follow within 30 minutes of placement of the first layer; however, existing conditions may necessitate placement of the second layer within a shorter time interval.

#### E2 Bar Reinforcement

All bar reinforcement except dowel bars will be classified as Reinforcement Bars. Reinforcement bars include, but are not limited to, joint ties and construction headers.

All reinforcement bars shall be epoxy coated in accordance with 3301.

Bar reinforcement of greater section area than that specified in the Plans may be used at the Contractor's option, but the spacing between the individual members shall not exceed the spacing shown in the Plans for the type of reinforcement and bar size specified.

Unless otherwise shown in the Plans, splices in reinforcement bars shall not be less than 40 diameters and the overlapped ends shall be securely tied with wire. All reinforcement bars shall be placed on chairs or by appropriate equipment for depressing the bars to the specified location.

#### E3 Dowel Bars

The Contractor shall:

- (a) Furnish dowel bar assemblies that are fabricated in single units for the appropriate lanes. Use not more than two assembled sections in any one joint for ramps, loops, and tapered sections.
- (b) Secure the dowel bar assemblies so movement does not occur while concrete is being placed.
- (c) Remove assembly ties and other similar materials that are parallel to the dowel bars so that there is at least a clearance of 100 mm (**4 inches**) from the anticipated joint centerline to ensure proper joint movement.
- (d) Blank
- (e) Coat the free ends of the epoxy coated dowel bars:
  - (1) With a thin uniform coating of an approved form coating material meeting 3902,
  - (2) For a minimum of one-half of the dowel length plus 50 mm (**2 inches**), and
  - (3) Within 1 hour of covering with concrete.

### 2301.3

- (f) Mark the location of all doweled contraction joints in order to ensure accurate placement of the weakened plane of the joint during subsequent operations.

#### **F       Batching and Mixing**

The Contractor shall batch and mix the concrete, and perform all related operations in accordance with 2461 and the following additional requirements.

##### F1       General

The Contractor shall check measuring equipment before paving operations are started and at any other time when there is evidence of improper operation. The batching and mixing of concrete shall not start until proper operations are ensured. The Engineer may suspend paving when improper operations are observed.

The air entraining agent shall be agitated in order to ensure homogeneous concentrations. The air entrainment container shall have a volume of at least 1 m<sup>3</sup> (**300 gallons**) or as otherwise approved by the Engineer.

When mixing operations are first started on the Project, the mixer timing device shall be set to produce an operating timed cycle of 75 seconds for all single drum mixers and 55 seconds for all dual drum mixers. This cycle shall remain in effect until the mechanical operating constants of the mixer can be accurately determined. The Engineer will then make such modifications in the cycle as may be necessary to conform to 2461.4C.

Batching and mixing operations shall be suspended whenever satisfactory finishing and curing of the pavement cannot be carried on properly.

##### F2       Cement Cutoff and Yield

The Contractor shall make positive cement cutoffs, except when the proportioning is performed in a commercial ready-mix plant and the batch is delivered to the construction site in revolving drum agitator type trucks. The positive cement cutoffs shall be made in accordance with the following provisions:

- (a) A cement cutoff shall be made when approximately 250 metric tons (**500,000 pounds**) of cement have been used and again prior to the use of 1000 metric tons (**2,000,000 pounds**). Thereafter, a cement cutoff shall be made at least every 1500 metric tons (**3,000,000 pounds**) or once a week, whichever provides the longer time interval between cutoffs.
- (b) When bulk cement is delivered directly to the cement batching plant in railroad cars or sealed transport trucks, the Contractor shall deliver to the Engineer copies of the freight bills the same day they are received from the transporting company.

### 2301.3

- (c) When bulk cement is delivered to the cement batching plant in unweighed or unsealed trucks, the Contractor shall provide a platform scale at the cement batching plant of sufficient length, width, and capacity to weigh the loaded truck. The scale shall be equipped with a digital recorder that will provide a digital record of the tare and gross mass (**weight**) of each load of cement. This record shall be submitted to the Engineer each day together with a certified statement of the total mass (**weight**) of cement delivered that day.
- (d) The Contractor shall advise the Engineer of the method and schedule of cement unloading. The unloading of cement shall not begin until the Engineer approves the operation.

Individual cutoffs shall not show an underrun in cement usage exceeding 1.5 percent of the quantity specified, nor shall the final cutoff show an overall underrun exceeding 1.0 percent. If either one or both of these limitations are exceeded, the concrete represented thereby will not be paid for at the Contract unit bid prices. Unless the Engineer determines that the pavement is so deficient in cement content as to constitute unacceptable work, the defective concrete will be paid for at an adjusted unit price having the same ratio to the Contract unit price as the quantity of cement used has to the quantity of cement required. The quantity required will be the specified quantity less the allowable underrun. In case both tolerances are exceeded, the price adjustment will not be applied to both conditions, but only to the one that produces the greatest payment deduction.

#### F3 Basic Scale Requirements

The Contractor shall inspect, test, and calibrate the scales according to 1901 and the Mn/DOT Concrete Manual, after being set up. The initial spot check for accuracy and sensitivity shall be made before starting production operations. A copy of the inspection certificate shall be furnished to the Engineer.

The beams and dials of weighing mechanisms shall be completely enclosed in weatherproof cases and provided with transparent openings to permit observation and reading of the beams and dials. Provisions shall be made for opening and locking the front of the case. The main poise on each weighing beam shall have one or more V projections that recede into matching niches on the weigh beam. Both the main and secondary poises shall be provided with clamping devices to prevent their movement on the beam during weighing operations.

All beam scales shall be equipped with an over and under indicator that will show the beam in balance at zero load and at any beam setting. The indicator shall have an over and under travel equal to not more than 5 percent of the beam capacity.

#### F4 Cement Batching

### 2301.3

The Contractor shall:

- (a) Weigh bulk cement within a tolerance of 1 percent.
- (b) Submit the cement records to the Engineer.

#### F4a Interlocking Device

The Contractor shall furnish an interlocking devices when the quantity of concrete to be produced and placed is more than 750 m<sup>3</sup> (**1000 cubic yards**).

The cutoff gates for cement batching shall be automatic and shall be controlled by the scale mechanism. The hopper inlet mechanism of the cement batching equipment shall be interlocked with the discharge gate to prevent opening the hopper inlet gate while the discharge gate is open. The hopper discharge mechanism shall be interlocked with the scale mechanism to prevent:

- (1) Opening the discharge gate during filling until the full quantity of the cement is in the hopper and the scale is balanced.
- (2) Opening the discharge gate if the quantity of cement in the hopper is out of range of the specified tolerance.
- (3) Closing the discharge gate until the cement is entirely discharged from the hopper and the scale is back in zero balance.

#### F4b Cement Scale and Cement Recorder

The Contractor shall equip the cement scale with an automatic cement recorder that will record the mass of cement in each batch for Projects if:

- (1) Paving operations require more than 750 m<sup>3</sup> (**1000 cubic yards**) of concrete, or
- (2) Concrete is furnished by a ready-mix concrete plant for a single Project requiring a total volume of more than 1500 m<sup>3</sup> (**2000 cubic yards**) of concrete.

The automatic cement recorder shall be graphic, digital, or photographic, and shall meet the requirements shown in the Mn/DOT Concrete Manual. It shall register both empty balance and total mass (**weight**) of each batch. The recorder shall be located and housed to protect against dust, moisture, and vibration. The housing shall be capable of being locked and, unless the recorder is photographic, the batch mass (**weight**) shall be observable without unlocking.

The cement scale may be equipped with manual controls for emergency use in the event of trouble with the automatic controls. In the event of trouble with the automatic controls, manual weighing will be permitted for a period not to exceed 5 days, provided the cement recorder is in proper working order.

In the cement batching operation, the Contractor will be permitted to override the automatic controls infrequently for periods not exceeding 15 minutes duration, provided the cement recorder is in



proper working order. In the event of trouble with the cement recorder, the cement batching operation will be permitted to continue for a period not to exceed 1 working day, provided the automatic controls are in proper working order and the batching is performed automatically. The Contractor may substitute a photographic recorder if the malfunctioning recorder cannot be repaired within the 1 working day. The Contractor shall immediately cease batching operations if the substitute recorder is not fully operational.

#### F5 Aggregate Batching

The Contractor may either provide for weighing each fraction of aggregate on a separate scale, or for cumulative weighing of part or all of the aggregate fractions on a single dial or multiple beam scale. Each weighing unit shall include a:

- (a) Visible springless dial that will indicate the scale load at all stages of the weighing operation from zero to full scale capacity, or
- (b) Tare beam connected to an over and under indicator that will show the scale in balance at zero load and at balance for every beam setting.

For multiple weighing on a single dial scale, the delivery tolerance shall be 1 percent of the full scale for a total mass (**weight**) over 50 percent of scale capacity and 0.5 percent of the full scale for a total mass (**weight**) less than 50 percent of scale capacity. On individual weighing of aggregate fractions, the delivery tolerance shall be 0.5 percent of the full scale for each fraction.

When the quantity of concrete to be produced and placed exceeds 750 m<sup>3</sup> (**1000 cubic feet**), the hopper inlet mechanism of the aggregate scales shall be interlocked with the discharge gate to prevent opening either gate while the other gate is open.

Aggregate beam scales shall be equipped with under and over load lights that are controlled by microswitches or direct contacts. Lights shall be mounted on each beam for single weigh hoppers and on the upper tare beam for cumulative weighing. Cumulative weighing dial scales shall be equipped with an overload light for total load only, and the dial shall be at least 450 mm (**18 inches**) in diameter.

For beam and for dial scales, a dual set of lights shall be provided with one set mounted inside the inspector's field laboratory and the other set mounted on the aggregate hopper. Power supply for the lights shall be from a power line or a portable power plant. Weighing batches with inoperative light signal systems will not be permitted beyond 24 hours.

The above requirements for overload lights will be waived at commercial ready-mix concrete plants and at any other plant equipped with batching recorders meeting the requirements in the Mn/DOT Concrete Manual.

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#### F6 Fly Ash Batching

The batching of fly ash shall conform to 2301.3F4 with the exception that no recorder will be required and the scale delivery tolerance shall be no greater than 2.5 kg (**5 pounds**).

#### G Placing Concrete

The Contractor shall sprinkle the subgrade as necessary to provide a moisture content in the upper 75 mm (**3 inches**) of the subgrade (at the time of concrete placement) such that there will not be excessive absorption of water from the concrete into the subgrade soil.

The concrete shall be deposited so as to form a continuous mass requiring a minimum of rehandling or redistribution and of sufficient depth to provide the necessary excess for subsequent finishing operations. The concrete shall not be dumped or discharged directly upon or against a joint assembly in any manner that will cause its displacement.

Premixed concrete may be hauled to the placement site in dump trucks, subject to 2301.3D.

The concrete along header joints shall be consolidated by internal vibration prior to final finishing.

Manhole and catch basin frames or rings shall be set to the required elevation during the paving operations except where they straddle a construction joint, in which case a rectangular section shall be "boxed out" in that part of the pavement that is placed first. The sides of the boxed out area shall be not more than 0.3 m (**1 foot**) outside the base of the casting and they shall be formed to provide keyed joints.

Should placement of concrete be temporarily suspended, the placement operations shall be resumed in such manner that will not result in a cold joint or honeycombing. If the suspension period exceeds 90 minutes, a standard header joint shall be constructed.

#### H Fixed-Form Construction

In all cases the concrete shall be struck-off as soon as practicable after it has been deposited on the subgrade, after which it shall be screeded twice. Manual placement methods will be permitted only when the dimensions of the work make the use of standard power-operated equipment impractical or as a temporary measure in cases when the power-operated equipment breaks down. Self-propelled, power-operated finishing equipment will not be required on pavements less than 3 m (**10 feet**) in width nor when there is less than 2500 m<sup>2</sup> (**3000 square yards**) of pavement to be placed.

#### H1 Vibratory Machine Placement

The following requirements shall apply to fixed-form pavement construction using concrete designed for vibratory machine placement:

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#### H1a Strike-off and Screeding

The Contractor shall use sufficient strike-off and screeding equipment to keep pace with the placement of concrete.

The Contractor shall provide at least one mechanical spreader equipped with a reciprocating screed at least 300 mm (**12 inches**) wide and with full width vibratory equipment, plus one standard finishing machine. A mechanical spreader shall be a unit designed for the sole purpose of spreading and consolidating the concrete between the side forms to a uniform cross section.

There shall be an initial strike-off, followed by a first and second screeding operation. The machine used for these operations shall carry a proper excess of concrete or mortar ahead of and along the full length of the screeds and vibrators, and the operations shall be conducted in a manner that will not displace or damage joint assemblies. Excess water and laitance brought to the surface by these operations shall be wasted over the forms.

Power-operated finishing machines shall be equipped with either a single reciprocating screed not less than 500 mm (**12 inches**) wide or with two reciprocating screeds, one of which shall be at least 300 mm (**20 inches**) wide.

The second screeding movement shall be carried forward for a distance of not less than 30 m (**100 feet**) at a time, except that, if the rate of paving progress is less than 30 m (**100 feet**) per hour, the distance shall be equal to 1 hour's paving progress. If the forward progress is such that the second screeding operation cannot be performed properly, the rate of concrete placement shall be reduced or additional screeding equipment shall be used.

#### H1b Portable Vibrator Operation

Concrete adjacent to side forms and fixed structures shall be consolidated by means of portable vibrators or by "fins" attached to full width vibratory equipment. The portable vibrator shall operate at a speed of not less than 60 Hz (**3600 VPM**). While in operation, the vibrator head shall not be permitted to come in contact with the subgrade. In the event of failure of the vibrator, and if no replacement unit is available, the concrete in these areas may be consolidated by means of hand spading for the remainder of the day.

#### H1c Full-Width Vibrator Operation

Full-width vibrators shall operate between 60 (**3600 VPM**) and 100 Hz (**6000 VPM**) in the concrete and between 70 (**4150 VPM**) and 115 Hz (**6900 VPM**) when checked in air. The vibrators may be either of the surface or internal vibration type. The vibrator impulses shall be delivered directly to the concrete and the intensity of vibration shall be sufficient to consolidate the concrete mass thoroughly and uniformly throughout its entire depth and width.

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The rate of progress of the vibratory equipment and the duration of the application shall be so regulated that the concrete is fully but not excessively vibrated. Excessive vibration, as indicated by segregation or undesirable water gain in the upper zone of the segregation or undesirable water gain in the upper zone of the pavement, will not be permitted. The operation of vibrators shall be suspended when the forward progress is interrupted.

If the vibratory equipment temporarily fails or if its use is discontinued, the work may continue by using the standard machine placement method of consolidation, provided the concrete mixture is redesigned for that method. Any increase in concrete or cement costs resulting from such change shall be borne by the Contractor.

#### H1d Pan Finishing

Except as otherwise provided hereinafter, all concrete that has been consolidated and screeded with power-operated machines shall be further smoothed by a pan-type float finisher. The pan-type finishing unit shall include two reciprocating screeds and the pan float. The second screed board and the pan float shall be suspended from the frame of the unit near the mid-span of the wheel base. The pan float shall not be supported by or permitted to ride on the side forms. The screeds on the pan-type finisher will be considered as performing the second screeding operation. The pan-type finishing machine shall be operated in the forward direction only, without stops or reversals, except in case of emergency.

The use of power-operated pan floats will not be permitted on areas of pavement where the crown or elevation must be adjusted or warped to meet that of an intersecting pavement, or where the number, size, or location of manholes or other appurtenances will interfere with or delay the operation of the float. In such cases, the surface shall be finished with metal-shod long-handled floats.

#### H2 Standard Machine Placement

The concrete shall be designed for standard machine placement. The operations and equipment shall be the same as those specified for the vibratory machine method of placement, except as modified hereinafter.

There shall be at least one mechanical spreader and one standard finishing machine. On single lane construction and on widening lanes, the floating may be performed either with manual or power operated floats. Mechanical spreaders will not be required on pavements constructed 6 m (**19 feet**) or less in width.

Full width vibratory equipment will not be required. No consolidation of the concrete will be required, other than that obtained through operation of the finishing machine, and except as provided for concrete consolidation by means of the portable vibrator according to 2301.3H.

### H3 Manual Placement

The concrete shall be designed for manual placement, and the manually operated screeds shall be operated over each section of the pavement so constructed as many times as necessary to produce a surface conforming to the Plan crown and gradient of the pavement.

Manually operated screeds shall be steel-shod and be equipped with vibrators, pull rods, and handles. They shall be shaped as required by the nature of the work.

#### I Blank

#### J Slipform Construction

The concrete shall be designed for vibratory machine placement when the slipform method of construction is to be used, and the concrete shall be placed with an approved slipform paver designed to spread, consolidate, screed, and float finish the freshly placed concrete in such manner that a minimum of hand finishing will be necessary to provide a dense and homogenous pavement in conformance with the Contract. The slipform paver shall have (as one of its components) a non-oscillating extrusion plate with an adjustable angle of entry.

Consolidation shall be accomplished with vibrating tubes or arms working in the concrete or with a vibrating screed or pan operating on the surface of the concrete. Vibrators shall operate at the frequencies listed for full-width vibrators in 2301.3H. Internal vibrators should be spaced at 600 mm (**24 inches**) intervals maximum for slipform machine speeds of less than 5 m (**16 feet**) per minute and at 450 mm (**18 inch**) maximum intervals for speeds of 5 m (**16 feet**) per minute or greater. The outer vibrators shall operate at a distance of 150 to 225 mm (**6 -9 inches**) from the edge of concrete.

The concrete shall be maintained at a uniform consistency, as will produce no appreciable edge slump or irregular edge alignment. Consistency requirements will be modified as necessary. Edge slump in excess of 5 mm (**1/8 inch**) will not be allowed.

The slipform paving operations for mixing, delivering, spreading, and extruding the concrete shall be coordinated to provide uniform progress of the paver. If, for any reason, it is necessary to stop the forward movement of the paver, the vibratory and tamping elements shall also be stopped immediately.

When specified for automatic grade control, the paver shall be so equipped. These automatic controls shall be capable of maintaining the proper elevation at both sides of the paver by controlling the elevation of one side and controlling the crown, or by controlling the elevation of each side independently. The grade reference shall be achieved by means of an erected string line.

Erected string line control shall consist of a tightly stretched wire or string, offset from and parallel to the pavement edge on one or both

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sides, and set parallel to the established grade for the pavement surface. The Contractor shall set this control reference and shall support the line at intervals as close as necessary to maintain the established grade and alignment. The control line shall be set sufficiently in advance of paving to avoid delays.

#### **K Joint Construction**

Unless otherwise indicated in the Plans, all joints shall be perpendicular to the subgrade. Dowel bars shall be placed parallel to the subgrade and parallel to the centerline of the pavement.

Contraction joints shall be spaced at the intervals shown in the Plans except that, adjacent to header joints, reinforced panels, railroad grade crossings, and the free ends of pavement, the spacing shall be shortened as necessary to provide panel lengths not varying more than 10 percent from the specified length.

Initial joint sawing shall be approximately 3 mm (**1/8 inch**) wide and to the full joint depth. The initial sawing shall be accomplished as soon as the condition of the concrete will permit without raveling and before random cracking occurs. The sequence of initial sawing shall be at the Contractor's option. Widening of the joints to full width shall not be performed until the concrete is at least 24 hours old and shall be delayed longer when the sawing causes raveling of the concrete.

When formed joints are constructed, the inserts shall be installed after the final screeding and the inserts may either be vibrated into place or installed in a groove formed by vibrating into the concrete a cutter bar of the same size and shape as the insert. The tops of inserts shall be placed as close to the pavement surface as the finishing operations will permit. The inserts shall be of approved shape and lengths, and when joined shall extend across the pavement to within 15 mm (**0.5 inch**) from the side forms. Any depressions or ridges of displaced concrete caused by installing the inserts shall be immediately filled or removed by hand finishing to provide a smooth surface across the joint. All inserts used in forming joints shall remain in place until after expiration

of the minimum curing period unless permission is obtained from the Engineer for earlier removal.

The location of each transverse joint shall be marked in a manner satisfactory to the Engineer, prior to placement of the concrete and, in the case of joints that are to be sawed, the markings shall be transferred to the fresh concrete as soon as the final finishing operations have been completed. Water under nozzle pressure shall be used to remove the sawing residue from each joint and the pavement surface immediately after completing the sawing of that joint.

Preformed joint filler material for expansion joints shall be staked in place in order to maintain its proper position during concrete placement. The filler material shall have a metal shield on the top edge

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to protect the material and maintain proper alignment. The shield shall be removed after completion of the longitudinal floating over the joint and while the concrete is still plastic.

Transverse joints constructed in the pavement shall be extended through the integrant curb.

When placing concrete adjacent to in-place concrete pavement joints, protect all ends of transverse joints to the satisfaction of the Engineer to prevent concrete mortar from infiltrating into the existing joints and causing compression spalls.

#### **L Surface Finishing**

After the concrete has been consolidated, screeded, and floated, the pavement surface shall be given a final finish texture. This final finish shall be obtained by drawing a carpet drag longitudinally along the pavement before the concrete has attained its initial set. The drag shall be mounted on a bridge. The dimensions of the drag shall be the width of the concrete placed by a longitudinal length having sufficient surface contact to produce a texture satisfactory to the Engineer.

The carpeting for the carpet drag shall be an artificial grass type having a molded polyethylene pile face with a blade length of 15 to 25 mm (**5/8 - 1 inch**) and a total minimum mass of 2.35 kg/square meter (**weight of 70 ounce/square yard**). The backing shall be of a strong, durable material not subject to rot, that shall be adequately bonded to the facing to withstand use as specified.

In addition to and immediately following the carpet drag, provide the pavement surface with a transverse metal-tine texture. This operation requires a mechanized device providing a randomized spacing of 16-26 mm (**approximately 5/8 - 1 inch**). The required tine width is 2-3 mm (**approximately 1/12 - 1/8 inch**) and the required tine depth is 3-8 mm (**approximately 1/8 - 5/16 inch**) with care not to dislodge coarse aggregate particles. Manual methods for achieving similar result may be used on ramps and other locations approved by the Engineer. Other texturing equipment may be approved for use provided an equivalent texture is obtained.

The above specified metal-tine texturing will not be required on such subsidiary paving areas as cross-overs and parking lanes as the Engineer exempts, or on certain restricted speed limit areas (under 55 km/h (**35 miles per hour**)) as specifically exempted in the Contract or by the Engineer.

#### **M Concrete Curing and Protection**

The Contractor shall:

- (1) Cure and protect the concrete by the blanket curing method or one of the membrane curing methods.
- (2) Cure the entire pavement surface and edges as soon as surface conditions permit after the finishing operations.

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- (3) Continue curing and protecting the concrete for at least 72 hours.
- (4) Place the curing media on the pavement edges within 30 minutes after removal of the forms when side forms are used.
- (5) Extend the minimum curing period to 96 hours when fly ash or Portland-pozzolan cement substitutions are used.
- (6) Use the extreme service membrane curing method after September 15 north of the 46 degree parallel, after October 1 south of the 46 degree parallel, and before April 15.
- (7) Provide sufficient curing blankets as described in 2301.3M1 to readily protect the concrete from rain and cold temperature when the membrane curing method is used.

#### M1 Blanket Curing Method

The pavement surfaces shall be covered with waterproof paper or plastic sheeting as soon as possible (without marring the pavement) after completion of the finishing operations.

The curing blankets shall be in such a condition and shall be so placed as to provide an airtight and moisture proof covering that will prevent loss of water vapor from the underlying pavement during the curing period. When placed, the adjoining blankets shall overlap at least 0.5 m (**18 inches**). This lap shall be secured with a windrow of earth to form a closed joint, and each blanket shall have a windrow of earth along the edges of the pavement to hold the blanket in place. Additional mounds of earth shall be placed at random over the blanket to prevent displacement or billowing of the blankets by the wind. After removal of forms, the extra width provided in the blankets or the stringer strips shall be folded down over the sides of the pavement and be secured by a continuous windrow of earth as a seal. Plowing of this windrow into place will not be permitted.

#### M2 Membrane and Extreme Service Membrane Curing Method

The exposed surfaces of the concrete shall be coated with membrane curing compound immediately after the last texturing operation. The only exception is when the concrete must be protected from adverse weather conditions and the Contractor elects to do this by placing plastic sheeting over the concrete; the curing membrane must then be applied immediately after the sheeting is removed. The compound shall be applied with an approved fully-automatic spraying machine, at the minimum rate of one liter per 4 m<sup>2</sup> per liter (**150 square feet/gallon**) of surface area. Hand operated spray equipment may be used for applying the compound on pavement edges and irregular shaped surfaces.

Before being placed in the spray equipment, the compound shall be thoroughly mixed in the shipping containers by the use of compressed air, or by other approved means. All emulsion type cures shall be



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protected from freezing while in storage on the job site and while in the spray equipment.

The equipment shall be operated in a manner that will direct the membrane compound to the surface from two different lateral directions. When a single set of nozzles is mounted on a bar that extends longitudinally over the pavement, the compound shall be applied in two passes of the nozzles over the surface, one in each direction. When two sets of nozzles are mounted on two transverse lines over the pavement in a staggered manner and the membrane compound from either set of nozzles will uniformly cover the pavement surface, application may be accomplished in one pass of the unit. If used, the spray bar drive system shall operate independently of the wheels or track drive system. The equipment shall also include a storage tank with an agitator, a filter system, check valve nozzles, and a shield to control loss of material by wind action.

Should any spot check indicate a deficiency in material usage appreciably below the specified minimum rate, the surface area in question shall be resprayed or shall be covered with curing blankets. Also, should the membrane film become damaged at any time within the required curing period, the damaged areas shall be repaired immediately by respraying.

#### **N Joint Sealing**

The Contractor shall not seal joints until they have been inspected and approved by the Engineer. At the time they are sealed, the concrete shall be surface dry and the joints shall be thoroughly cleaned of all debris, dirt, dust, and other foreign matter, including accumulations of concrete. Just before the joints are sealed, the Contractor shall clean the joints with a jet of compressed air under pressure of not less than 580 kPa (**85 pounds/square inch**). The Contractor shall seal integral or tied curb joints with the same joint sealer as used to seal the pavement joints.

Where Plans and Specifications call for polymeric joint sealants (silicones, etc.) or preformed elastomeric joint sealants in the transverse joints, 3723 sealant shall be used in longitudinal joints and expansion joints. Where Plans and Specifications require 3725 sealant in transverse joints, 3725 sealant shall also be used in longitudinal and expansion joints to avoid potential confusion caused by different specification hot-pour sealers (3723, 3725) on the job site.

If the type of sealant for transverse joints is not specified elsewhere in the Contract, the Contractor shall select an approved moisture cured polymeric sealant from the list of approved products on file at Mn/DOT's concrete office.

The handling and placing of joint sealer material shall be performed in accordance with the following provisions:

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#### N1 Hot Poured Sealers

Hot poured sealers shall be heated in a double-boiler type kettle or melter having the space between inner and outer shells filled with oil or other heat transfer medium. The heating equipment shall include automatic temperature control, mechanical agitation, and recirculating pump provisions. Since some materials are subject to damage by overheating, reheating, or prolonged heating, proper care and equipment shall be used as recommended by the manufacturer of the sealer material.

Prior to final compressed air cleaning, the joint walls shall be lightly sandblasted.

The ambient temperature of the pavement shall be above 4°C (39°F) during application of the sealer.

#### N3 Polymeric Sealers

Polymeric sealers shall be installed according to manufactures recommendations.

Joints shall be filled in a neat, workmanlike manner and in conformance with the tolerances shown in the Plans. The use of a backup material or bond-breaker in the bottom of the joint will be required to control the depth of sealant, achieve the desired shape of the sealant, and support the sealant against indentation and sag. The backup and bond-breaker materials shall be compatible with the sealer. Any joints filled above permissible level shall be corrected by removing and replacing the sealer at no expense to the Department.

As the joint filling operations progress, the sealant surface shall be dusted with talc or be covered with single layer paper tissue to prevent small incompressible particles (stone pebbles and chips) from bonding to the exposed tacky surface.

Heating and filling operations shall be coordinated so that no more sealer material is melted than can be used the same day. Once the sealer material has been heated to application temperature it shall be so maintained until it is placed. The sealer material shall be placed within 4 hours after the initial heating to the application temperature.

#### N2 Preformed Sealers

The seals shall be furnished in one continuous length for each joint, except that:

- (a) In contraction joints, butt splices will be permitted at longitudinal joints, and
- (b) In expansion joints, one butt splice per lane width will be permitted, provided the splice is made by factory methods that have been approved by the Materials Engineer.

In its final position in the joint, the upper corners of the preformed seals shall be below the pavement surface as shown in the Plans, and the walls of the seal shall not fold over at the top of the joint.

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Stretching of the sealer material in the installation process shall not exceed 5 percent of the joint length.

Wherever an expansion joint abuts aggregate or bituminous surfaced shoulders, the ends of the expansion joint shall be sealed in the same manner as the top portion of the joint. A wedge-shaped section shall be removed from the bottom part of the seal where it makes a right angle turn from the top to the side of the joint. The seal shall extend to the bottom of the pavement. No shouldering shall be placed in the areas of the expansion joints until the vertical joint ends have been so sealed.

**O Blank**

**P Workmanship and Quality**

**P1 Surface Requirements**

After completion of the curing period and prior to the opening of the roadway to traffic, the Contractor shall test the pavement surface for surface smoothness and ride quality. See 2301.3P1c to determine if ride quality is required.

The Contractor shall furnish a properly calibrated, 7.62 m (**25 foot**) wheel base, California type, computerized profilograph and competent operator certified by the industry in its' operation to measure pavement surface deviations in the longitudinal direction. The computer shall smooth the profile using a third-order Butterworth filter with a cutoff wavelength of 0.6096 m (**2.0 feet**). The computer shall generate a profile index using a 5.08 mm (**0.2 inch**) blanking band and shall use a 7.62 mm (**0.3 inch**) bump threshold to identify "must grind" locations. In lieu of a computerized profilograph, the Contractor may furnish a computerized analysis of the trace provided the above requirements are met.

Operate the profilograph in accordance with the manufacturer's instructions and at a speed no greater than a normal walk. To determine the profile index for mainline pavement, irregular pavement and ramps, make one pass at the midpoint between the wheel paths in each lane.

Make runs continuous and stop approximately 30 m (**100 feet**) prior to a construction header. Evaluate construction headers for smoothness on the next subsequent pass. Evaluate for smoothness all terminal headers that tie into existing pavement and the existing portland cement concrete pavement existing approximately 15 m (**50 feet**) adjacent to the terminal header. Bridge approach panels and bridge surfaces are exempt from these requirements, however, paving start-up areas are not exempt. Lift the test wheel and clearly label the profilogram to mark the beginning and end of each trace, each equation and each 152.4 m marker (**500 feet**). Completely label each trace to show the Project number, stationing, lane, wheel pass, date paved, date tested and the operator's name. Make runs within 48 hours of pavement placement.

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Turn over the profile index (California Test Method 526 on file) test results and the trace to the Engineer within 48 hours of each run. This data is also used for ride quality determination when required.

The Engineer may test the entire Project length by an independent source. If the Engineer determines that the Contractor's certified test results are inaccurate, the Contractor is charged for this work at a rate of \$500 per lane 1.6093 km (**1 mile**), with a minimum charge of \$1000.

The Contractor shall remove all pavement areas represented by high points having deviations of 7.62 mm (**0.3 inches**) or more in 7.62 m (**25 feet**) in the longitudinal direction, or 7.62 mm (**0.3 inches**) in 0.9144 m (**3 feet**) transverse direction using an approved texture planing grinding device consisting of multiple diamond blades. In the longitudinal direction, determine deviations according to California Test Method 526. In the transverse direction, determine deviations using a 0.9144 m (**3 foot**) straight edge. After removing all individual deviations of 7.62 mm (**0.3 inches**) or more, surface test and provide necessary additional corrective work to achieve the required surface smoothness or riding quality.

NOTE: Deviations between 7.62 mm (**0.3 inches**) and 10.16 mm (**0.4 inches**) may remain in place if the ride is satisfactory in the judgement of the Engineer.

All costs relative to Contractor providing the profilograph and the appropriate profile index and traces are included in the unit bid price for 2301.502, Concrete Pavement, Standard Width and Item 2301.503, Concrete Pavement, Irregular Width.

#### P1cRiding Quality

The Engineer shall determine the final ride quality based on the results of the California profilograph data provided under 2301.31b as modified herein. Paving Projects less than 0.8 km (**0.5 mile**) in continuous length in a 7.2 m (**24 foot**) wide standard roadway width and those portions of a paving project where the posted vehicle speed is anticipated to be less than 68 km/hr (**42 mph**), as determined by the Engineer are exempted from these riding quality requirements. The occurrence of bridges shall not interrupt the continuity determination, but the bridge surface and approach panels are not included in the ride quality determination. All pavements within 75 m (**250 feet**) of a terminal header that is not adjacent to a paved surface are exempt.

- (1) Each lane is divided into 0.1609 km (**0.1 mile**) sections and tested by the California profilograph.
- (2) Remaining subsections shorter than 0.1609 km (**0.1 mile**) is tested according to (1) above, but is prorated for equivalency in the riding quality.

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- (3) Sections or subsections not excluded, which have riding quality greater than 63.13 mm/km (**4 inches/mile**) but less than or equal to 94.70 mm/km (**6 inches/mile**) as measured by the California profilograph are accepted at the unit bid price.
- (4) Sections or subsections not excluded, which have riding quality greater than 94.70 mm/km (**6 inches/mile**) but less than or equal to 126.26 mm/km (**8 inches/mile**) as measured by the California profilograph are accepted at the unit bid price less a payment deduction determined according to the following formula:

$$y = \frac{2x^2}{16} - 2x + 7 \quad (x = \text{PI calculated in inches/miles})$$

$$y = 0.0006x^2 - 0.15156x + 8.372 \quad x = \text{PI calculated in mm/km}$$

Where y = price reduction in dollars.  
Where x = profile index PI.

Sections or subsections that have a profile index greater than 126.26 mm/km (**8 inches/mile**) will require removal and replacement or texture planing to a profile index of 94.70 mm/km (**6 inches/mile**) or less at the Contractor's option. Sections or subsections that have a profile index greater than 94.70 mm/km (**6 inches/mile**) may be texture planed to eliminate payment reductions. Planing to provide a bonus is not acceptable.

- (5) Sections or subsections not excluded, which exhibit an exceptional riding quality less than 63.13 mm/km (**4 inches/mile**), when tested by the California profilograph, are paid at the unit bid price plus a bonus according to the following formula:

$$y = ((4.0 - x) \times \$0.28) \text{ for PI calculated in inches/mile}$$

$$x = ((63.1 - x) \times \$0.0212) \text{ for PI calculated in mm/km}$$

Where y = bonus in dollars per 0.8361 m<sup>2</sup> (**square yard**)

Where x = profile index in 15.78 mm/km (**inches/ mile**)

The ride quality determination by the California profilograph Method requires that the profilograph is computerized to assimilate and store pavement profile data or that the Contractor provides a computerized evaluation of the profilogram trace for a non-computerized profilograph. All mainline pavement except those sections exempt above, are subject to (1), (2) and (3) above except as modified below and the following:

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For easy review by the Engineer, the Contractor shall provide a profile index test summary report including the station, length, m<sup>2</sup> (**square yards**) represented, and price adjustment for each 0.1609 km (**0.1 mile**) section. Adjacent lane results are reported in an adjacent column on the summary report.

No section or subsection will receive a riding quality bonus if more than 5 per cent of the section or subsection is corrected by surface texture planing. Texture planed areas of sections are not eligible for incentive bonuses.

#### P2 Thickness Requirements

The finished pavement thickness will conform to the thickness shown in the Plans or as modified, in writing, by the Engineer. Modifications by the Engineer will be considered as being the plan thickness. Prior to the final acceptance of the work, the Contractor will core the pavement, as marked by the Department, for use as test specimens to verify the pavement thickness.

Coring will not begin until the new pavement has attained an age of 7 days or until control beams have attained a flexural strength of 3450 kPa (**500 pounds/square inch**). The Contractor will be responsible for filling the core holes with 3U18 concrete or another concrete mix approved by the Engineer. The Contractor will be responsible for all traffic control related to coring. All unacceptable cores and cores taken to delineate deficient pavement as outlined in 2301.3P2 or 2301.3P3 will be at the Contractor's expense. Coring will be in accordance with the following procedure:

The Engineer will calculate the number of cores required and their location using a random number procedure. The number of cores required will be calculated as follows:

- (a) On each Project (and on each roadbed of a divided highway), main line pavement of each width, thickness and type will be divided into a series of 1500 meter (**5,000 foot**) sections and one fractional section (or one fractional section if the total length is less than 1500 meter (**5,000 feet**)), beginning at the point nearest the end of the Project shown in the Plans as the Beginning of the Project. Each loop and each ramp at each grade separation will be considered as a separate fractional section.
- (b) One random core will be drilled from each 300 meter (**1,000 foot**) increment in each traffic lane of each 1500 meter (**5,000 foot**) section. In each fractional section over 150 meter (**500 feet**) in length, random cores will be drilled at the minimum rate of one core per 300 meter (**1,000 feet**) of traffic lane, but not less than a total of three cores.

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- (c) Selective cores may be taken as the Engineer directs, in addition to the random core program described above, but they will not be considered or used in computing the average thickness of acceptable pavement sections.

The Engineer will mark core locations on pavement and make any necessary location adjustments.

The Contractor will cut 100 mm (**4 inch**) nominal diameter cores at marked locations, other size cores will not be accepted. The cores will then be laid next to their holes in a curing condition (e.g., wrapped in wet burlap).

NOTE: If the age of the concrete pavement is older than 28 days, the cores will not be required to be stored in a curing condition. The Contractor will take precautions to ensure the quality of the cores. Cores that are out of round, have ridges, not perpendicular, etc. will not be accepted.

The Engineer will field measure the core thickness and verify (Field ID Number) the cores. Exploratory cores will be taken if the field measurements show any thin pavement, as described herein.

The contractor, accompanied by the Engineer, will pick up the cores and store them, in a curing condition (water tank, 15-25° C (**60-80°F**)) if necessary, at the Department's field office.

The Contractor, accompanied by the Engineer, will transport the cores to the MN/DOT's Office of Materials and Road Research in a manner that will ensure their integrity. Examples of this would be to transport the cores in a bed of wet sand or to band the cores in a pyramid shape on a pallet, wet down and cover with plastic.

The contractor will be responsible for supplying all materials required for ensuring the integrity of the cores.

The pavement thickness will be determined by measuring the length of the cores in accordance with the procedure on file at the Office of M&RR. This procedure provides for obtaining the average length of the core in one operation by the use of nine probes that are interconnected in a hydraulic linkage. The core length will be recorded to the nearest millimeter (**0.05 inch**).

Whenever any core shows a length deficiency of more than 10 mm (**0.50 inch**) from the planned thickness, exploratory cores will be taken. The first exploratory cores at any location will be taken 5 meters (**10 feet**) on each side of the deficient core location and at the same distance from the pavement centerline, and one will be taken in the adjacent traffic lane if it was placed in the same operation. If the length of each one of the first exploratory cores is equal to or greater than the plan thickness of the pavement minus 10 mm (**0.50 inch**), no additional cores will be taken in that location. If any or all of these cores are not within such limitations, additional exploratory cores will be taken at intervals of 5 to 10 m (**10-25 feet**), as directed by the Engineer, at the same distance from the pavement centerline in the same lane as the

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original core. The coring will proceed in the direction of the deficiency until cores of satisfactory length are obtained.

Wherever the cores show a thickness deficiency greater than 10 mm (**0.50 inch**), the pavement will be considered to be defective. The defective pavement area will be considered as the entire area surrounding the deficient core (or cores) within a traffic lane and between acceptable cores. The remaining areas in an increment where the cores show a thickness deficiency no greater than 10 mm (**0.50 inch**) will be considered as acceptable pavement.

Where the cores are deficient in length by more than 10 mm (**0.50 inch**) and the concrete also has an air content less than 3.0 percent, the Contractor will remove and replace the defective pavement.

Where the cores are found to be deficient in length by more than 10 mm (**0.50 inch**) and the pavement represented by those cores is not required to be removed and replaced for other deficiencies, the Contractor may at his option either remove and replace the defective pavement or leave it in place in consideration of the payment deductions provided for herein, with the exception that the Engineer may order the removal and replacement of any pavement that is deficient in thickness by more than 25 mm (**1 inch**), in which case the following deductions will not apply.

Where the cores show a thickness deficiency exceeding 10 mm (**0.50 inch**), but less than 25 mm (**1 inch**), the pavement represented by those cores will not be excluded from the pay quantities; however, a deduction will be made from the moneys due the Contractor equal to the product of the defective areas and \$25.00 per square meter (\$20.00 per square yard). Pavement represented by cores showing a thickness deficiency of 25 mm (**1 inch**) or more will be excluded from all payments plus a deduction will be made from the moneys due the Contractor equal to the product of the defective areas and \$25.00 per square meter (**\$20.00 per square yard**). These deductions will be assessed in lieu of removing and replacing the areas of pavement which are deficient in thickness.

All acceptable random core lengths (not over 10 mm (**0.50 inch**) thickness deficiency) in each increment of a section or fractional section will be used to compute the average pavement thickness in each increment, except that where the length of any core exceeds the Plan thickness by more than 5 mm (**0.30 inch**), that core length will be limited to the Plan thickness plus 5 mm (**0.30 inch**). The average pavement thickness for each section or fractional section will be computed as the summation of the average thicknesses of the individual increments in the section or fractional section divided by the number of increments.

Whenever the average thickness of the acceptable pavement in a particular section or fractional section of the mainline pavement is found to be less than the Plan thickness by more than 3 mm (**0.10 inch**)



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or when the average thickness of the acceptable pavement in a fractional section of a Loop or Ramp is found to be less than the Plan thickness by more than 5 mm (**0.25 inch**), the acceptable pavement in that section or fractional section (excluding any areas of defective pavement whether or not they have been removed and replaced acceptably) will be paid for at the Contract bid price, less a payment deduction determined in accordance with the following schedule:

**TABLE 2301-3  
DEDUCTIONS FOR THICKNESS DEFICIENCY**

Thickness Deficiency Exceeding the Permissible Deviations	Deduction Per Square meter ( <b>square yard</b> ) of Payment
2 mm and below ( <b>0.01 to 0.08 inch</b> , Incl.)	\$0.20
Over 2 mm to 4 mm ( <b>0.08 to 0.16 inch</b> , Incl.)	0.40
Over 4 mm to 6 mm ( <b>0.16 to 0.24 inch</b> , Incl.)	0.60
Over 6 mm to 8 mm ( <b>0.24 to 0.32 inch</b> , Incl.)	0.80
Over 8 mm to 10 mm ( <b>0.33 to 0.40 inch</b> , Incl.)	1.00

3 mm (**0.10 inch**) for Mainline Pavement

5 mm (**0.25 inch**) for Ramp or Loop Pavement, and for all Concrete Base

**P3 Reinforcing Steel Placement Requirements**

All steel reinforcement shall be placed at the locations shown in the Plans, within the placement tolerances provided.

The final position of all pavement reinforcement will be determined to the extent possible from the cores taken from the pavement for thickness and strength determinations. The depth of the steel reinforcement below the pavement surface in each core will be considered to be the average depth of all exposed steel members on the vertical surface of the core. Where two layers of steel reinforcement are evident in the core, each layer will be considered separately. All measurements will be made from the pavement surface of the core to the center of the cross section of the exposed steel members or, if the member has been dislodged, to the center of the groove remaining on the vertical surface of the core.

If no testing is performed, or if the testing performed does not indicate the depth of the reinforcement, the steel reinforcement will be considered to be in compliance with the vertical location requirements.

When measurements indicate that the vertical location of the steel reinforcement does not comply with the requirements, an additional investigation may be made to delineate the area in which the steel

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reinforcement is not within the specified limits for vertical location. When cores are used to delineate this area, they will be taken at 15 m (**50 foot**) intervals, and the limits of the noncompliance shall be the distance between acceptable cores minus 15 m (**50 feet**). The minimum noncompliance area shall be 15 m (**50 feet**) times the lane width.

In each pavement area where the vertical location of the steel reinforcement does not comply with the requirements, the pavement reinforcement so placed will be considered to be unacceptable work and will not be measured for payment. If the reinforcement is found to be less than 50 mm (**2 inches**) from the pavement surface, an additional deduction will be made from the moneys due the Contractor equal to the product of the defective area times \$6 per square meter (**\$5 per square yard**). If the reinforcement is found to be within 40 mm (**1-1/2 inches**) of the pavement surface, the nonconforming area shall be removed and replaced.

### 2301.4 METHOD OF MEASUREMENT

Concrete pavement construction will be measured in terms of the several items of work as provided for herein, with all measurements being subject to adjustment as provided for in 2301.3P.

#### A Concrete Pavement

Concrete pavement will be measured by area based on the specified dimensions, including the area covered by integrant curb, and the area thus obtained will represent the surface area of the pavement as constructed. Irregular width pavement will be measured and paid for separately, if so indicated in the item name, but the pavement of every thickness and type will be included under the same item.

Included in the standard width measurement will be all uniform width pavement constructed in multiples of the normal traffic lane width as shown in the Plans. Irregular width pavement will include all tapers, irregular shapes, and nonstandard widths such as on ramps, loops, and connections that are not of a width equal to one or more traffic lanes.

#### B Structural Concrete

Structural Concrete will be measured by volume based on the Plan thicknesses and the computed areas of concrete pavement. High early strength concrete sections will be measured separately only when and to the extent that separate compensation is provided therefor. Otherwise, the volumes of all pavement will be included in a single pay item, without regard to grade or strength of concrete or the type, width, and thickness of pavement.

#### C Pavement Reinforcement

Pavement reinforcement will be measured by area of pavement constructed with metal reinforcement. Areas will be measured separately by type of reinforcement as shown in the Plans, without regard to the number of layers used, and with no allowance for laps, splices, waste, and supporting devices.

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### **D Expansion Joints**

Expansion joints of each design designation, as detailed in the Plans, will be measured separately by length along the joint line.

### **E Reinforcement Bars**

Reinforcement bars will be measured by mass (**weight**) prior to coating with epoxy, in accordance with 2472.4A. No measurement will be made under this item of those bars that are paid for as pavement reinforcement.

### **F Integrant Curb**

Integrant curb of each design will be measured separately by length.

### **G Dowel Bars**

Dowel bars will be measured by the actual number of individual dowels placed. No measurement will be made under this item for dowels that are paid for as a part of expansion joint construction.

### **H Bridge Approach Panels**

When the Proposal contains an item (or items) for construction of bridge approach panels, their construction will be measured and paid for separately as complete in place items. Measurements will be as indicated in the Proposal, either by the number of complete panels of each design, or by the total area of all panels of the same basic design. In the absence of such items, the panel construction will be measured for payment under the several items provided for pavement construction.

### **I Blank**

### **J Concrete Coring**

The Engineer will measure the number of cores designated in the Contract or ordered by the Engineer that are acceptably taken, identified, and delivered as required.

## **2301.5 BASIS OF PAYMENT**

Payment for concrete pavement under 2301.501, 2301.502, or 2301.503, at the Contract bid prices per unit of measure will be compensation in full for all costs of constructing the pavement as specified, exclusive of those costs that are compensated for separately under other Contract items. The bid price includes all costs of fine grading, forming, spreading, screeding, finishing, curing, and protecting (the concrete, together with any other costs incidental to the pavement construction that are not covered by other items.

Payment for extreme service membrane cure required in 2301.3M will be provided at the rate of \$0.25 per square meter (**\$0.225 per square yard**) of concrete pavement placed requiring this type of cure. This payment will be compensation in full for furnishing, storing, and placing this material.

Payment for structural concrete at the Contract price per unit of measure will be compensation in full for all costs of producing, delivering, and depositing the concrete as specified, including all costs

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of the batch materials, mixing operations, and other incidentals involved in furnishing concrete for the work, except as otherwise provided by the following:

- a) Normal Mixes Above Minimum Cement Contents: Compensation of invoice plus 15 percent will be made for any additional cement required in the production of standard strength concrete above the minimum mass (**weight**) specified. The additional quantity is the difference between the design mass (**weight**) of cement per batch and the minimum mass (**weight**) specified in 2461.3C, or such higher minimum as stipulated.
- (b) High Early Concrete Mixes - Contractor's Decision: Compensation of invoice plus 15 percent will be made for the 30 percent additional cement used in the production of high early strength concrete that is furnished and placed at the discretion of the Contractor with the Engineer's approval, beyond the Contract requirements and without the Engineer's order.
- (c) High Early Concrete Mixes - Separate Pay Item: No extra compensation will be provided for the additional cement required in the production of high early strength concrete furnished as a separate pay item.
- (d) High Early Concrete Mixes - Engineer's Ordered: In absence of a separate pay item for high early strength concrete, compensation will be provided in the amount of 20 percent above the Contract cubic meter (**yard**) price for standard strength concrete for the quantity ordered by the Engineer. The Contractor will also receive compensation for additional cement when the total cementitious exceeds 130% of the minimum cement content for the concrete mixture designation involved at a rate of invoice plus 15 percent. The Contractor shall also be compensated for the difference in cost of substituting cement for fly ash at the rate of the differences of the increased invoice costs plus 15 percent.
- (e) Cement Substitution: Compensation of invoice plus 15 percent will be made for the additional fly ash used with the 4 for 3 fly ash substitution requirements of 2461.3D(6) and (7). Payment will be based on the design batch volumes excluding waste. The minimum cement content will be computed as 85 percent of the minimum shown under 2461.3C and the minimum fly ash content will be computed as 15 percent of the minimum shown under 2461.3C.

Any amount of cement or fly ash above the minimums will be paid for as per items (a) through (e) above.

Payment for pavement reinforcement of each type specified at the Contract prices per unit of measure of pavement in which the reinforcement is placed will be compensation in full for all costs of furnishing and placing the metal reinforcement as specified, including all costs of tie wires, supporting devices, splicing, intermediate strike-off, and any other operations or materials incidental to furnishing and placing the reinforcement.

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Payment for expansion joints of each design designation at the Contract price per unit of measure will be compensation in full for all costs of constructing the joints complete in place as detailed in the Plans, including the furnishing and placing of all required materials such as dowel bar assemblies, filler, and sealer materials.

Payment for dowel bars and reinforcement bars at the Contract prices will be compensation in full for all costs of furnishing and placing the materials as specified. No payment will be made under these items for those quantities that are compensated for on a complete unit basis as a part of other Contract items.

Payment for integrant curb at the Contract price per unit of measure for each design specified will be compensation in full for all costs of furnishing and placing the concrete, forming and finishing the curb, protecting and curing the concrete, and any other costs incidental to the completed curb.

Payment for construction of bridge approach panels at the Contract price per each panel complete in place, or at the Contract price per unit of measure for all panels, will be compensation in full for all costs of constructing the bridge approach panels as detailed in the Plans, including the costs of furnishing and placing concrete and steel, construction of integrant curb, terminal headers, concrete sills, protecting and curing the concrete, and other incidental work not specifically included for payment under other Contract items.

The Department will pay the Contract unit price for each measured core. The Contractor shall accept this payment as compensation in full for all costs of material, labor, and equipment necessary to take the cores, deliver the cores as directed, fill core holes, provide traffic control, and provide other incidentals to the concrete coring.

Payment for concrete pavement construction will be made on the basis of the following schedule:

<b>Item No.</b>	<b>Item</b>	<b>Unit</b>
2301.501	Concrete Pavement.....	square meter <b>(square yard)</b>
2301.502	Concrete Pavement, Standard Width.....	square meter <b>(square yard)</b>
2301.503	Concrete Pavement, Irregular Width .....	square meter <b>(square yard)</b>
2301.511	Structural Concrete.....	<b>cubic meter (cubic yard)</b>
2301.513	Structural Concrete, HE (High Early Strength).....	<b>cubic meter (cubic yard)</b>
2301.521	Pavement Reinforcement, Type.....	square meter <b>(square yard)</b>
2301.529	Reinforcement Bars (Epoxy Coated).....	kilogram <b>(pound)</b>
2301.531	Expansion Joints, Design.....	meter <b>(linear foot)</b>

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2301.538 Dowel Bar.....	each
2301.541 Integrant Curb, Design__ .....	meter ( <b>linear feet</b> )
2301.545 Concrete Coring .....	each
2301.551 Bridge Approach Panel.....	each
2301.553 Bridge Approach Panels .....	square meter ( <b>square yard</b> )

**2321**

**Road-Mixed Bituminous Surface**

**2321.1DESCRIPTION**

This work shall consist of constructing one or more courses of road-mixed bituminous surfacing on a prepared base.

Subject to approval of the Engineer, hot plant mixtures conforming to 2331 may be substituted for the cold mixture provided for herein, in which case the mixing, spreading, and rolling shall be done in accordance with 2331, with compaction being in conformance with the ordinary compaction method as described therein

**2321.2 MATERIALS**

**A Aggregate**

The aggregate shall conform to 3139 mixture Type 31 B, with the exception that the aggregate for any course other than a wearing course may consist of Class 5 aggregate conforming to 3138 and the following modifications:

- (1) Not less than 1 percent nor more than 7 percent of the aggregate shall pass the 75 µm (# 200) sieve.
- (2) Within the specified gradation limits, the aggregate shall be uniform at the time of mixing.

If so requested by the Engineer, to determine quality and mixture proportions, representative production samples of the aggregate to be used in the production of wearing course mixture shall be submitted to the Materials Laboratory at least 15 days in advance of starting the wearing course mixture production.

**B Bituminous Material..... 3151**

The bituminous material for the mixture shall conform to the requirements for one of the following kinds and grades, subject to any limitations imposed by the Contract. If any options are permitted, the kind to be used shall be optional with the Contractor, but the grade shall be as designated by the Engineer.

MC Liquid Asphalt.....	MC-250, 800
SC Liquid Asphalt .....	SC-250, 800
Emulsified Asphalt.....	SS-1, SS-1h, CSS-1h, CSS-1

**C Anti-Stripping Additive..... 3161**

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If any additive is to be used, it may be added to the bituminous material at either the refinery or the job site. The blending shall be performed at a time and in a manner approved by the Engineer. When the additive is to be added on the job, the combined materials shall be mixed by not less than five complete circulations. No compensation in addition to the Contract prices will be made because of any additive that may be used.

#### 2321.3 CONSTRUCTION REQUIREMENTS

##### A General

These requirements provide for the construction of a base course, a leveling course, a binder course, and a wearing course, or any combination thereof, and are based on methods of construction by which the bituminous material is applied to and mixed with the aggregate by road-mixing methods or in a central mixing plant.

##### B Restrictions

Bituminous materials and mixtures shall not be applied to or placed on an untreated subgrade at any time when the moisture content of the top 75 mm (**3 inch**) of the subgrade is more than 65 percent of optimum moisture.

If emulsified asphalt is used for the mixture, the aggregate shall, at the time the emulsion is applied, contain sufficient moisture to ensure satisfactory mixing. (Note: This may require the addition of water.) If any other bituminous materials are used for the mixture, the aggregate shall not contain more than 2 percent of free moisture at the time the bituminous material is applied.

An anti-stripping additive may be used only with the consent of the Engineer. In this case, the aggregate may contain free moisture up to a maximum of 4 percent.

If mixing is performed on the road by blade-mix methods, the bituminous material shall be applied with distributors.

If the blade-mix method is employed, bituminous material shall be applied and mixing performed only during daylight hours and when the air temperature is 10°C (**50° F**) or higher if the blade mix method is employed. The bituminous material shall be at least partially mixed with the aggregate before dark on the same day that it is applied.

If the mixing is performed by traveling plant or central mixing plant, it shall be performed when the air temperature is 4°C (**40° F**) or higher.

Spreading and compacting shall be performed only during daylight hours and when the air temperature is 10°C (**50° F**) or higher.

All mixtures shall be kept in windrows during rains and shall be free of surface moisture at the time of spreading and rolling operations.

The operations of depositing aggregates on the road, mixing aggregate with bituminous material, and spreading and rolling the

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mixture shall be conducted only on sections of such length as will meet the approval of the Engineer.

Each course shall be compacted and cured to such a degree that it will not be displaced or otherwise damaged before another course is placed thereon.

In general, no work within the roadbed will be permitted in the spring until seasonal load restrictions on roads in the vicinity have been removed. However, work within the roadbed may be permitted before that time if, in the opinion of the Engineer, it can be conducted without damage to the subgrade.

#### **C Equipment**

##### **C1 Distributor**

The distributor shall be so designed, equipped, maintained, and operated that bituminous material at even heat may be applied uniformly on variable widths of surface up to 4.5 m (**15 feet**) at readily determined and controlled rates up to 9.0 L (**2.0 gallons**) per square meter (**square yard**), with uniform pressure, and with an allowable variation from any specified rate not to exceed 0.1 L (**0.02 gallon**) per square meter (**square yard**). Distributor equipment shall include a tachometer, pressure gauges, accurate volume measuring devices or calibrated tank, and a thermometer for measuring temperatures of tank contents. Distributors shall be equipped with a power unit for the pump and full circulation spray bars adjustable laterally and vertically.

##### **C2 Pneumatic-Tired Rollers**

Pneumatic-tired rollers shall have a mass of not less than 3600 kg per meter (**200 pounds/linear inch**) of rolling width. "Wobbly wheeled" rollers will not be permitted.

##### **C3 Steel-Wheeled Rollers**

Steel-wheeled rollers shall be of the self-propelled and have a minimum total mass of 7.3 metric tons (**8 tons**), or as otherwise specified in the Contract. When vibratory rollers are used, they shall produce 45 kN per meter (**250 pounds/linear inch**) of width. The roller shall be capable of reversing without backlash and shall be equipped with spray attachments for moistening all rollers on both sets of wheels.

##### **C4 Motor Graders**

Motor graders shall be of the self-powered type, mounted on pneumatic tires. They shall be equipped with a blade not less than 3 m (**10 feet**) long and shall have a wheel base of not less than 4.5 m (**15 feet**). Motor graders used for the final layout and finishing of the surface shall be equipped with smooth pneumatic tires.

##### **C5 Traveling Mixing Plants**

The traveling plant shall be self-propelled and capable of maintaining a uniform rate of travel while mixing. It shall be mounted on pneumatic-tired wheels or smooth tread crawler tracks of such size that



the underlying road surface will not be rutted or damaged when the plant is loaded to capacity. The plant shall be so designed and constructed that it will pick up all of the aggregate cleanly from the road without damaging the underlying road surface.

The traveling plant shall be capable of constantly measuring the bituminous material accurately, mixing it thoroughly with the aggregate, and depositing the mixture in a uniform windrow.

The traveling plant shall be equipped with sufficient valves and a stub pipe in the bitumen line between the pump and the spray bar to facilitate calibration of the output of the pump. They shall also be equipped with temperature and metering devices that will determine accurately the temperature and quantity of bituminous material being applied to the aggregate.

#### C6 Central Mixing Plants

When heating of the aggregate is not required, central mixing plants may be of any type that will produce a bituminous mixture conforming to the mix requirements of this Specification. However, as minimum requirements, the plant shall be equipped with temperature and metering devices that will determine accurately the temperature and quantity of bituminous material being applied to the aggregate. Feeding of the aggregate and bituminous materials into the mixer shall be synchronized by interlocking mechanical means or other positive method approved by the Engineer.

#### D Treatment of the Surface

##### D1 Prime Coat

If so indicated in the Plans or directed by the Engineer, a bituminous prime coat shall be applied to the prepared base in accordance with 2358 prior to placement of the first course of bituminous mixture.

##### D2 Tack Coat

A bituminous tack coat shall be applied to existing bituminous or concrete surfaces and to the surface of each course constructed other than the final course, with the application being done in accordance with 2357 prior to placement of the next course thereon.

#### E Depositing and Mixing Aggregate with Bituminous Material

After satisfactory absorption of the prime coat, if used, the required quantity of new aggregate shall be deposited on the road. The new aggregate and float aggregate, if used, shall be thoroughly mixed and then bladed into a single windrow of uniform cross section for measurement and adjustment as directed by the Engineer.

If the mixing is performed by the road-mix method or by a traveling plant that depends on a uniform forward speed to measure the aggregate windrow, a windrow proportioner (evener) shall immediately precede the mixing operations. The windrow shall be evened or shaped until all measured cross-sections taken at 30 m (100 foot) intervals are not less

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than 95 percent or more than 105 percent of the average of all measured cross sections for the portion of the windrow involved.

If, on any portion of the Project, the base course is required to carry traffic during the interim period between its completion and the construction of the next course thereon, the bitumen content of the mixture for the base course on that section of the roadbed may be increased, at the option and direction of the Engineer, beyond the maximum limits provided above, but not to exceed the maximum application rate for wearing course mixtures.

The bituminous material shall be applied to the aggregate at a total rate designated by the Engineer, within the following limits:

**TABLE 2321-1  
BITUMINOUS APPLICATION RATE**

Kind of Bituminous Material	Rate in Liters per Metric Ton (Gallons/ton) of Dry Aggregate	
	Base, Leveling Binder Courses	Wearing Course
SC	---	42 to 58 (10 to 14)
MC	33 to 46 (8 to 11)	42 to 58 (10 to 14)
SS, CSS	42 to 58 (10 to 14)	50 to 75 (12 to 18)

If the method of mixing employs equipment requiring the bituminous material to be applied in a separate operation, no single application of bituminous material shall be applied to the aggregate in a quantity exceeding 2.3 L per square meter (0.5 gallons/square yard). The number and rate of applications shall be as directed by the Engineer. After each application, the bituminous material and aggregate shall be mixed sufficiently to produce a mixture of uniform color and, after the last application, the mixing shall continue until all particles of the aggregate are thoroughly coated and the mixture is free from fat or lean spots, balls, and uncoated particles.

The temperature of the bituminous material at the time of application shall be as approved by the Engineer, within the limits specified below:

**TABLE 2321-2  
TEMPERATURE OF BITUMINOUS MATERIAL**

Liquid Asphalt	MC-250, SC-250	40-105°C (105-220°F)
	MC-800, SC-800	60-125°C (135-255°F)
Emulsified Asphalt	SS-1, SS-1h,	20 to 70°C(70 to 160°F)
	CSS-1, CSS-1h	20-70°C(70-160°F)

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During the application of bituminous material, the changing of speed or the shifting of gears will not be permitted.

#### **F Spreading**

Before spreading the mixture, aeration by manipulation will be required until the mixture has become tacky and free of surface moisture to a degree satisfactory to the Engineer.

The bituminous mixture shall be spread without segregation to produce a layer of uniform thickness and the specified cross section.

The contact surface of curbs, concrete pavements, or other fixed structures shall be painted with a thin uniform coat of liquid bituminous material just before any bituminous mixture is placed against them.

After final compaction, all bituminous surfaces adjacent to gutters, manholes, pavement headers, or other fixed structures shall be slightly higher (but not to exceed 6 mm (**1/4 inch**)) than the surface of such structures.

#### **G Rolling**

Rolling shall begin at the time the mixture is being spread and continue until after the mixture has been shaped to the required cross-section.

Each course shall be thoroughly and uniformly compacted for its full thickness with pneumatic-tired rollers traveling at speeds not to exceed 8 km/h (**5 miles per hour**). The final rolling on the last course constructed under the Contract shall be performed with steel wheeled rollers traveling at speeds not to exceed 5 km/h (**3 miles per hour**). The rolling shall begin at the lower edge of the course and progress toward the upper edge or centerline. Each pass of the roller shall overlap the preceding pass by at least half the width of the roller and shall terminate at least 1 m (**3 feet**) in advance of or to the rear of the termination of the preceding pass.

The entire surface shall be rolled until there is no further compaction and until all roller marks are eliminated. Rolling shall be discontinued whenever it begins to produce excessive crushing or pulverizing of the aggregate or displacement of the mixture. In places inaccessible to the roller, compaction equal to that obtained with rollers shall be secured by means of mechanical tampers.

As necessary to prevent adhesion of the mixture to the roller wheels, the contact surfaces of the wheels shall be kept properly moistened, using water or a water solution containing small quantities of detergent or other approved material.

During the final spreading and compacting operations on each course, the Contractor shall check the thickness and surface for conformance with the thickness and surface requirements specified in 2321.3H. Any area that does not conform may be corrected by

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loosening the compacted surface, adding more mixture or reshaping the mixture, and recompacting. Lean, fat, or segregated areas shall be removed and replaced with new material. All corrections shall be made at no expense to the Department.

#### **H Thickness and Surface Requirements**

After compaction, the finished surface of any course shall show no variation greater than 6 mm (**1/4 inch**) from the edge of a 3 m (**10 foot**) straightedge laid thereon parallel to the centerline.

After compaction, the alignment of the outside edges of any course shall be such that the distance between the edge and the established centerline shall not vary more than 75 mm (**3 inches**) from the distance shown in the Plans for that course.

After compaction, no portion of any course other than a leveling course shall vary from the thickness shown in the Plans for that course by more than 13 mm (**0.5 inch**). No individual test shall show a thickness deficiency of more than 13 mm (**0.5 inch**). On any area where tests show a thickness in excess of the Plan thickness plus 13 mm (**0.5 inch**), the Department reserves the right to exclude from the final pay quantities the materials used in the excess mixture, above that required to construct the course in that area to a thickness equal to the Plan thickness plus 13 mm (**0.5 inch**).

#### **I Blank**

#### **J Seal Coat**

When specified in the Contract or ordered by the Engineer, designated areas of the finished surface shall be given a light bituminous seal coat in accordance with 2356.

If the Contract does not provide for application of a seal coat with cover aggregate, or if weather conditions at the time the seal coat would be applied in the normal sequence of operations do not permit its application at the time, the Contractor shall apply a fog seal if the Engineer so directs, using bituminous material of any kind and grade approved by the Engineer. Slow curing liquid asphalt will not be approved for use as fog seal material. The time and rate of application shall be as directed by the Engineer, with the rate of application not to exceed 0.5 L per square meter (**0.1 gallon/square yard**).

#### **K Aggregate in Stockpiles**

When the Contract contains an item for stockpile aggregate, the Contractor shall, in addition to the aggregate required for the bituminous surfacing, produce and deliver aggregate of the class specified to the Department at the designated sites. Delivery shall be made when and as approved by the Engineer. Construction of stockpiles shall be as directed by the Engineer.

**2321.4 METHOD OF MEASUREMENT**

**A Aggregate**

Aggregate will be measured, as indicated in the Proposal, by mass or LV of material deposited on the road. When mixing is performed in a hot-mix plant, the measured weights will include the weight of the bituminous material incorporated into the mixture.

**B Bituminous Material**

Bituminous materials will be measured by volume. Bituminous material used for fog seal will be measured and included for payment with the measured quantity of bituminous material for mixture.

**C Stockpile Aggregate**

Stockpile aggregate of each class specified will be measured as indicated in the Proposal, by mass or LV of material delivered in stockpiles.

**2321.5 BASIS OF PAYMENT**

Payment for the accepted quantities of aggregate and bituminous material incorporated in the mixture at the Contract prices per unit of measure will be compensation in full for all costs of constructing the bituminous surfacing as specified.

Payment for stockpile aggregate of each class specified, at the Contract prices per unit of measure, will be compensation in full for all costs of producing and delivering the material to the Department at the designated sites, including all costs of constructing the stockpiles as specified.

Payment for the road-mixed bituminous surface will be made on the basis of the following schedule:

<b>Item No.</b>	<b>Item</b>	<b>Unit</b>
2321.503	Bituminous Material for Mixture.....	liter ( <b>gallon</b> )
2321.506	Aggregate .....	metric ton ( <b>ton</b> )
2321.507	Aggregate .....	cubic meter ( <b>cubic yard</b> )
2321.511	Stockpile Aggregate, Class_____	metric ton ( <b>ton</b> )
2321.513	Stockpile Aggregate, Class_____	cubic meter ( <b>cubic yard</b> )