

TABLE OF CONTENTS

DIVISION 3	1
SECTION 3.1	1
EXCAVATION	1
3.1.1 GENERAL	1
3.1.1.1 Description	1
3.1.1.2 Related Work Specified Elsewhere	2
3.1.1.3 Dimensional Tolerances	2
3.1.1.4 Submittals and Records	2
3.1.1.5 Safety of Excavation Work	3
3.1.1.6 Work Scheduling	4
3.1.1.7 Work Site Conditions	4
3.1.1.8 Rectification of Unsatisfactory Excavation	4
3.1.1.9 Underground Utilities	5
3.1.1.10 Royalties for Excavated Materials	5
3.1.1.11 Use and Disposal of Excavated Materials	5
3.1.1.12 Site Restitution and Disposal of Temporary Works	5
3.1.2 EXCAVATION PROCEDURE	6
3.1.2.1 General Procedures	6
3.1.2.2 Preparation of Pavement and Shoulder Sub grades	7
3.1.2.3 Excavation for Structures and Pipes	7
3.1.2.6 Cofferdams	9
3.1.2.7 Preservation of Channels	10
3.1.2.8 Excavation for Borrow Materials	10
3.1.2.9 Excavation on Existing Asphalt Pavement Materials	11
3.1.3 MEASUREMENT AND PAYMENT	11
3.1.3.1 Excavation Excluded from Measurement	11
3.1.3.2 Measurement of Excavation for Payment	12
3.1.3.3 Measurement of Cofferdam and Dewatering	13
3.1.3.4 Basis of Payment	13
SECTION 3.2	15
FILL	15
3.2.1 GENERAL	15
3.2.1.1 Description	15
3.2.1.2 Related Work Specified Elsewhere	15
3.2.1.3 Dimensional Tolerance	16
3.2.1.4 Reference Standards	16
3.2.1.5 Submittals	16
3.2.1.6 Work Schedule	17
3.2.1.7 Site Conditions	17
3.2.1.8 Rectification of Unsatisfactory or Unstable Fill	17
3.2.1.9 Restitution of the Work Following Testing	18
3.2.1.10 Weather Limitation	18
3.2.1.11 Control of Traffic	18
3.2.2 MATERIALS	18
3.2.2.1 Material Sources	18
3.2.2.2 Common Embankment	18
3.2.2.3 Selected Embankment	19
3.2.2.4 Granular Selected Embankment for Swampy Areas	19
3.2.3 PLACING AND COMPACTING FILL	19

3.2.3.1	Site Preparation.....	19
3.2.3.2	Placing Fill.....	20
3.2.3.3	Compaction of Fill.....	21
3.2.3.4	Preparation of Sub grade on Fill.....	22
3.2.4	QUALITY ASSURANCE.....	22
3.2.4.1	Material Quality Control.....	22
3.2.4.2	Compaction Requirements for Earth Fill.....	22
3.2.4.3	Compaction Criteria for Rock Fill.....	23
3.2.4.4	Compaction Trial.....	23
3.2.5	MEASUREMENT AND PAYMENT.....	23
3.2.5.1	Measurement of Fill.....	23
3.2.5.2	Basis of Payment.....	24
SECTION 3.3		25
GRADE PREPARATION (corrections required)		25
3.3.1	GENERAL.....	25
3.3.1.1	Description.....	25
3.3.1.2	Related Work Specified Elsewhere.....	25
3.3.1.3	Dimensional Tolerances.....	25
3.3.1.4	Reference Standards.....	25
3.3.1.5	Submittals.....	26
3.3.1.6	Work Scheduling.....	26
3.3.1.7	Site Condition.....	26
3.3.1.8	Rectification of Unsatisfactory Grade Preparation.....	26
3.3.1.9	Restitution of the Work following Testing.....	26
3.3.1.10	Control of Traffic.....	27
3.3.2	MATERIALS.....	27
3.3.3	EXECUTION OF GRADE PREPARATION.....	27
3.3.3.1	Site Preparation.....	27
3.3.3.2	Compaction of Sub grade.....	27
3.3.3.3	Subgrade bearing capacity in cut.....	27
3.3.4	MEASUREMENT AND PAYMENT.....	27
3.3.4.1	Measurement for Payment.....	27
3.3.4.2	Basis of Payment.....	28
SECTION 3.4		29
CLEARING, GRUBBING AND TREE REMOVAL		29
3.4.1	GENERAL.....	29
3.4.1.1	Description.....	29
3.4.1.2	Related Work Specified Elsewhere.....	29
3.4.1.3	Submittals and Records.....	29
3.4.1.4	Safety of Work.....	29
3.4.1.5	Work Scheduling.....	29
3.4.1.6	Work Site Condition.....	30
3.4.2	CONSTRUCTION.....	30
3.4.2.1	Clearing and Grubbing.....	30
3.4.2.2	Removal of Top Soil.....	30
3.4.2.3	Tree Removal.....	31
3.4.3	MEASUREMENT AND PAYMENT.....	31
3.4.3.1	Measurement for Clearing and Grubbing.....	31
3.4.3.2	Measurement for Tree Removal.....	31
3.4.3.3	Basis of Payment.....	31

DIVISION 3 EARTHWORKS

SECTION 3.1 EXCAVATION

3.1.1 GENERAL

3.1.1.1 Description

- (a) This work shall consist of the excavation, handling, disposal or stockpiling of earth or rock or other material from the roadway or adjacent thereto as necessary for the satisfactory execution of the work of this Contract.
- (b) The work is generally required for the excavation of cuttings, the formation of trenches or foundations for pipes, culverts, drains or other structures, for stabilization works and the removal of landslides, for borrow of construction materials or disposal of waste materials, for excavation on existing asphalt pavement materials and for generally shaping the site in accordance with these Specifications and in reasonably close conformity with the lines, grades and cross-sections shown on the drawings or as directed by the Engineer.
- (c) [The work required for the removal of unsuitable material and topsoil will be covered by Section 3.4 of these Specifications.](#)
- (d) Except for payment purposes, the provisions of this section apply to all excavation work carried out in connection with the Contract, and all excavation shall be considered to be one of either:
 - (i) Common Excavation
 - (ii) Rock Excavation
 - (iii) Structure Excavation
 - (iv) Excavation of Existing Asphalt Pavement Materials
- (e) Common Excavation shall consist all excavation which is not classified as Rock Excavation, Structure Excavation, Borrow Excavation or Excavation of Existing Asphalt Pavement Materials.
- (f) Rock Excavation shall consist of the excavation of boulders 1 cubic metre in volume or greater and all rock or other hard material which, in the opinion of the Engineer, it is not practical to excavate without the use of pneumatic tools or drilling and blasting. It shall not include material which in opinion of Engineer, can be loosened by a single tine hydraulic ripper drawn by a tractor unit with a weight of 15 tonnes and a net rating of 180 HP.
- (g) Structure Excavation shall consist of the excavation of any material encountered, in the limit work as specified herein or as shown on Drawings, that is made for Structures. Any excavation defined as Common or Rock Excavation or Excavation of Existing asphalt Pavement Materials shall not be Structure Excavation.
- (h) Structure Excavation shall be limited to excavation for the footing or foundation of bridges or culverts, of concrete retaining walls, wing walls, and other structures not otherwise provided for in these Specifications.

- (i) Structural Excavation shall include backfilling with suitable material accepted by Engineer, disposing of surplus material, all necessary draining, pumping, bailing, sheeting, shoring, the construction of cribs and cofferdams and their subsequent removal.
- (j) Excavation of Existing Asphalt Pavement Materials shall consist of excavation and disposal of existing asphalt pavement materials with or without Cold Milling Machine, where indicated on Drawings or as directed by the Engineer.
- (k) The salvage and reuse of all excavated materials are subject to the prior approval of the Engineer before such materials shall be considered as suitable for processing and recycling to the other works.

3.1.1.2 Related Work Specified Elsewhere

- (a) Transportation and Handling : Section 1.5
- (b) Traffic Management and Safety : Section 1.8
- (c) Field Engineering : Section 1.9
- (d) Materials and Storage : Section 1.11
- (e) Environmental Safeguards : Section 1.17
- (f) Ditches and Waterways : Section 2.1
- (g) Culverts and Concrete Drains : Section 2.3
- (h) Porous Drainage : Section 2.4
- (i) Fill : Section 3.2
- (j) Grade Preparation : Section 3.3
- (k) Concrete : Section 7.1
- (l) Stone Masonry : Section 7.9
- (m) Demolition of Existing Structures : Section 7.15
- (n) Reinstatement of Existing Pavement : Section 8.1
- (o) Reinstatement of Shoulders on Sealed Roads : Section 8.2
- (p) Maintenance of Adjacent Roads and Bridges : Section 10.2

3.1.1.3 Dimensional Tolerances

- (a) Finished grade lines and formations after excavation excluding excavation of existing asphalt pavement materials shall not vary from those specified by more than 2 cm higher or 3 cm lower at any point, and 1 cm higher or lower at any point for excavation of existing asphalt pavement materials.
- (b) Finished cut slope surfaces shall not vary from the specified profile line by more than 10 centimetres in earth or 20 cm in rock, unavoidable overbreak in rock excluded.
- (c) Finished excavated soil or rock surfaces which are exposed to surface run-off water shall be sufficiently smooth and uniform and have sufficient slope to ensure the free drainage of the surface with no pounding.

3.1.1.4 Submittals and Records

- (a) For any excavation work to be paid under this Section, the Contractor shall either accept the Contract detail cross-section drawings or shall submit to the Engineer prior to commencing the work, detailed corrections to the cross-section drawings showing the existing ground before any clearing and grubbing operations, or any excavation have been carried out.

- (b) The Contractor shall submit to the Engineer detailed drawings of all temporary structures he proposes or is directed to use, such as shoring, bracing, cofferdams and cut-off walls, and shall obtain the Engineer's approval of such drawings before carrying out the excavation work intended to be protected by the proposed structures.
- (c) After each excavation for a subgrade, formation or foundation is completed, the Contractor shall notify the Engineer to that effect, and no bedding or other material shall be placed until the Engineer has approved the depth of excavation and the character and soundness of the foundation material, as provided under Article 3.1.2.
- (d) A register of explosion plan and all explosives used, showing locations and amounts shall be kept by the Contractor for checking by the Engineer.
- (e) The contractor shall submit to the Engineer in writing the locations, conditions and quantities of any existing asphalt pavement that shall be milled, or excavated. No milling shall be carried out in an area until the Engineer has approved or amended the submission. Measurement records shall be prepared jointly with the Engineer after the existing asphalt pavement has been completely milled or excavated.

3.1.1.5 Safety of Excavation Work

- (a) The Contractor shall bear full responsibility for ensuring the safety of workmen carrying out excavation work and of the general public.
- (b) During excavation work, stable interim excavation slopes capable of supporting adjacent works, structures or machinery shall be maintained at all times, and adequate shoring and bracing shall be installed when the excavated faces may otherwise be unstable. Where necessary, the Contractor shall underpin or otherwise support adjacent structures which otherwise may become unstable or be damaged by the excavation work.

To ensure the stable excavation slope and safety of workmen carrying out excavation work, for the excavation of more than 5 metres depth, the terraces shall be implemented with minimum terrace width of 1 metre or as directed by the Engineer.

- (c) Heavy equipment for earth moving, compacting or other purposes shall not be permitted to stand or operate closer than 1.5 m from the edge of open trenches or foundation excavations unless the pipes or structures have already been installed and covered with the compacted backfill.
- (d) Cofferdams, cut-off walls or other means of excluding water from excavations shall be properly designed and sufficiently strong to withstand the pressure imposed by hydrostatic, hydraulic and earth pressures.
- (e) At all times while workmen or others are within excavations below ground level, 1.5 metres or more the Contractor shall maintain a safety inspector at the site whose only duties will be to monitor safety. At all times first aid supplies shall be available at the actual site of the excavation work.
- (f) Explosives required for rock excavation shall be stored, handled, and used with the utmost caution and strictly in accordance with the statutory government regulations. The Contractor shall be responsible for the prevention of any unauthorized issue or improper use of any explosive and shall ensure that the handling of explosives shall be entrusted only to experienced responsible persons.

- (g) All open excavations shall be adequately signed and barricaded to prevent workmen or others accidentally falling into them, and any open excavation in the road carriageway or shoulder areas shall in addition be marked at night with white painted drums (or similar) and red or amber lighted lamps, to the satisfaction of the Engineer.
- (h) The provisions of Section 1.8, Traffic Management and Safety shall apply to all excavation work within the Right of Way.

3.1.1.6 Work Scheduling

- (a) The extent of any excavation opened in any one operation shall be limited consistent with maintaining the excavated surfaces in a sound condition, having regard to the effects of drying out, soaking by rain and disturbance by subsequent work operations.
- (b) Trenching or other excavation across the roadway shall be carried out using half width construction so that the road is maintained open to traffic at all times,
- (c) If traffic on the road has to be interrupted because of blasting or other work operations, the Contractor shall obtain prior approval of his schedule for such interruption from the proper authorities as well as from the Engineer.
- (d) Unless otherwise instructed by the Engineer, any excavation on existing asphalt pavement shall be covered with hot asphaltic mixtures on the same day so that the road is able to be opened for traffic.

3.1.1.7 Work Site Conditions

- (a) All excavation shall be maintained free of water and the Contractor shall provide all necessary materials, equipment and labor for dewatering (pumping), diverting waterways and the construction of temporary drains, cut off walls and cofferdams. Stand by pumps shall be maintained on site at all times to ensure no interruption in the continuity of dewatering procedures.
- (b) When Work is being carried out in existing drains or other areas where seepage water or soil may be polluted, the Contractor shall at all times maintain at the actual site of work a supply of water of potable quality for use by the workmen for washing, together with an adequate supply of soap and disinfectant.

3.1.1.8 Rectification of Unsatisfactory Excavation

- (a) Excavation work which does not meet the tolerance criterion given in Article 3.1.1.3 above shall be rectified by the Contractor as follows:
 - (i) Excess material shall be removed by further excavation.
 - (ii) Areas which have been over excavated, or areas of over breakage or slumping, shall be backfilled with Select Embankment or Aggregate Base as directed by the Engineer.
 - (iii) Areas of existing asphalt pavement which have been over-excavated more than the designated dimension and depth shall be backfilled with suitable materials at least to the original condition of existing pavement and to the designated dimension and depth.

3.1.1.9 Underground Utilities

- (a) The Contractor shall be responsible for obtaining any existing information on the existence and location of existing underground utilities and for obtaining and paying for any necessary permits or other authorization, and for temporary or permanent relocations necessary to carry out the excavations required by the Contract.
- (b) The Contractor shall be responsible for the care and protection of any serviceable underground piping, cables, conduit, or other subsurface lines or structures that may be encountered and for repairing any damage caused to them by his operations.

3.1.1.10 Royalties for Excavated Materials

When Selected Embankment or Aggregate Base, aggregates for asphalt or concrete or any other materials are obtained by borrow excavation outside the highway right of way, the Contractor shall make all necessary arrangements for payment of fees and royalties to landowners and authorities for permission to excavate and haul the materials.

3.1.1.11 Use and Disposal of Excavated Materials

- (a) All suitable material excavated within the limits and scope of the project shall whenever possible be used in the most effective manner for the formation of embankments or for backfill.
- (b) Excavated material containing highly organic soils, peat, large amounts of roots or other vegetable matter and compressive or saturated soils which in the opinion of the Engineer could not be adequately compacted or would prevent compaction of overlying materials or would be responsible for any undesirable settlement or failure, shall be classified as unsuitable for use as fill in the permanent works.
- (c) Any excavated material surplus to fill requirements, or any material not approved by the Engineer to be suitable as fill shall be disposed of and leveled in thin layers by the Contractor outside the Right of Way as directed by the Engineer.
- (d) The Contractor shall be responsible for all arrangements and costs for the disposal of surplus or unsuitable materials, including disposal of materials resulting from over excavation as prescribed in Article 3.1.1.8.(ii) and (iii) and also including hauling of the excavated materials. and obtaining the consent of the owner or tenant of the land where the disposal is made.
- (e) Surplus material from structural excavation, whether or not temporarily allowed to be placed within a stream area, shall be disposed of finally in such a manner as not to obstruct the stream or otherwise impair the efficiency or appearance of the structure. No excavated material shall be deposited at any time so as to endanger the partly finished structure.

3.1.1.12 Site Restitution and Disposal of Temporary Works

- (a) Unless otherwise directed by the Engineer, all temporary structures such as cofferdams or shoring and bracing shall be removed by the Contractor after the completion of the permanent structure or other work for which the excavation has been carried out. Removal shall be effected in such a manner so as not to disturb or mar the finished structure or formation.

- (b) Materials recovered from such temporary works remain the property of the Contractor or may, if approved as suitable by the Engineer, be incorporated into the permanent works and paid for under the relevant pay items entered in the Bill of Quantities.
- (c) Any excavated materials temporarily allowed to be placed within a waterway shall be disposed of finally in such a manner as not to obstruct the waterway.
- (d) All borrow pits or quarries used by the Contractor shall be left in a trim and tidy condition with stable sides and slopes, and adequate drainage and waterways.

3.1.2 EXCAVATION PROCEDURE

3.1.2.1 General Procedures

- (a) Excavation shall be carried out to the grades lines and elevations specified on the drawings or indicated by the Engineer and shall involve the removal of all materials of whatever nature encountered, including soil, rock, brick, stone, concrete, masonry, peat, organic matter and existing asphalt paving materials.
- (b) Excavation work shall be performed with the minimum possible disturbance to the material below and beyond the prescribed limits of excavation.

Where the material exposed on the formation line or subgrade or foundation level is loose or soft or mucky or otherwise unsuitable in the opinion of the Engineer, the material shall be thoroughly compacted or shall be removed and replaced with suitable fill, as directed by the Engineer.

- (c) Where rock, hardpan or other unyielding material is encountered on the formation line for lined ditches, at subgrade level for pavements and shoulders, or on the bottom of pipe trenches or structure foundation excavation, the material shall be over-excavated 0.15 m to a firm smooth uniform surface. No pinnacles of rock shall be left protruding from the exposed surfaces and all broken rock of greater diameter than 0.15 m shall be removed. The specified excavation profile shall be achieved by backfilling with compacted fill material approved by the Engineer.
- (d) Blasting as a means of rock removal shall only be used if, in the opinion of the Engineer, it is not practical to excavate with the use of pneumatic tools or a single tine hydraulic ripper. The Engineer may prohibit blasting and order the rock to be excavated by other means. if, in his opinion, blasting would be dangerous to persons or adjacent structures. or is being carried out in a reckless manner.
- (e) Where directed by the Engineer, the Contractor shall provide heavy mesh blasting mats for the protection of persons, property and the work during the excavation. If found necessary, blasting shall be restricted to times prescribed by the Engineer.
- (f) Excavation of rock shall be so conducted, whether by blasting or otherwise, so that the sides of the cut shall be left in a safe condition and as regular as practicable. Loose, overhanging rock that may become unstable or poses any other danger to the works or to people shall be removed, whether it occurs in new rock cuts or existing old ones.
- (g) It is in any case understood that, during the execution of excavations, the Contractor shall take steps on his own initiative to ensure the natural drainage of the water

flowing on the surface of the ground, in order to prevent it running into the excavations that have been opened.

3.1.2.2 Preparation of Pavement and Shoulder Subgrades

The provisions of Section 3.3, Grade Preparation shall apply as well as the provisions of this Section.

3.1.2.3 Excavation for Structures and Pipes

- (a) Trenches for pipes, culverts or concrete drains, and excavations for the foundations of bridges and other structures, shall be of sufficient size to enable the placing of structures or structure footings of the full width and length shown and the proper installation of materials, inspection of work and tamping of backfill under and around the placed work.
- (b) Where culvert or other trenches are to be excavated in new embankment fill, the embankment is to be constructed to the required level for a distance each side of the trench location of not less than 5 times the trench width; after which the trench shall be excavated with sides as nearly vertical as soil conditions will permit.
- (c) All rock or other hard foundation material exposed in bridge foundations shall be cleaned of all loose material and cut to a firm surface, either level, stepped, or serrated as directed by the Engineer. All seams or crevices shall be cleaned out and grouted. All loose and disintegrated rock and thin strata shall be removed. When the footing is to rest on material other than rock, excavation to the final foundation level for structure footings shall not be carried out until just before the footing is to be placed.
- (d) When foundation piles are used, the excavation of each pit shall be completed before the piles are driven and any placing of foundation fill shall be done after the piles are driven. After the driving is completed, all loose and displaced material shall be removed, leaving a smooth, solid bed to receive the footing.

3.1.2.4 Excavation of Cuttings

- (a) Care shall be taken not to over excavate. The method of excavation and trimming shall be approved by the Engineer. Batter profile boards shall be set before excavation of any section at 50 metre intervals at the top of all cut batters showing the design batter position and slope. The batter profile boards shall be maintained until the excavation works are complete and until the Engineer has inspected and approved the work.
- (b) Earth cuts shall preferably be trimmed by a grader equipped with a tilting blade or by an excavator. The work shall be supervised at all times by a foreman or assistant who shall ensure close compliance with the correct line indicated by the batter profile boards. All necessary measures shall be taken during and immediately after completion of the excavation, to prevent damage of the cut face. Such measures may include provision of catch drains, down slope drains, sodding or other measures.
- (c) Rock faces shall be pre split by close drilling and blasting when so approved or instructed by the Engineer.

- (d) All cut faces shall be cleaned of any loose material that might become a hazard after completion of the work. Rock faces or rock outcrops shall be cleaned manually when deemed necessary by the Engineer.
- (e) When unexpected ground conditions are encountered at any location that may cause instability of the cut face, necessary measures shall be taken to ensure stability. Necessary changes shall be agreed prior to further excavation. All changes shall be subject to the prior instruction or approval of the Engineer.

3.1.2.5 Excavation of Soft Soil, Expansive Soil or Intermediate Strength Subgrade Other Than Peat

Soft soil is defined as any soil having an insitu CBR of less than 2%. Intermediate strength sub grade is defined as any sub grade having a compacted CBR equal or higher than 2% but less than the design value stated in the Drawings or less than 6% if no value is stated. Expansive soil is defined as soil having a Potential Swell measured by Test exceeding 2.5%.

When soft, expansive or low strength soils are exposed at sub grade in cuttings, or when soft or expansive soil occurs below embankments the following additional treatment is required:

- (a) Soft soil shall be either:
 - i. Compacted to a bearing capacity greater than 2% insitu or
 - ii. stabilized or
 - iii. removed entirely or
 - iv. shall be excavated below subgrade to the depth shown on the drawings or otherwise to the depth given by Table 3.1.2.1 and 3.1.2.2. The excavation depth and subgrade improvement treatment shall be verified or amended by the Engineer, based on a site trial.

Table 3.1.2.1 Subgrade Improvement for Intermediate Strength Subgrades (CBR 2 – 5) and capping layer platforms

Existing ground after compaction	Lifetime traffic ESA (subgrade failure criteria)	Design Subgrade CBR		
		4	5	6
		Selected Embankment subgrade improvement thickness D_{se} (cm)		
2 – 3 (includes top-of-capping) D_{se2}	$10^5 - < 10^6$	20	25	30
	$10^6 - < 10^7$	25	30	35
	$10^7 - 10^8$	30	35	40
4	All	0	15	15
5		0	0	15

Table 3.1.2.2 Additional treatment for swampy or very soft ground that has an in-situ CBR after compaction below CBR 2

depth to minimum characteristic CBR 2 (DCP (30 degree tip) 65 mm/blow) below original ground in undisturbed soil excluding surface crust (cm)	Minimum thickness of capping (cm)	Minimum total depth of excavation below subgrade (cm)
< 45 cm	30	30 + D _{se2}
45 cm – < 90 cm	60	60 + D _{se2}
90 cm – 150 cm	100	100 + D _{se2}
> 150 cm	Full excavation or other special treatment Subject to Engineers instruction or approval	

Note :

D_{se2} is the subgrade improvement thickness from Table 3.1.1.1 for original ground CBR 2 – 3.

- (b) Expansive soil shall be removed to a depth of 1 metre below finished surface level.
- (c) Intermediate strength strength sub grades shall be excavated to the additional depth shown on the drawings or to the depth given by Table 3.1.2.1 if not stated on the drawings.

Care shall be taken to keep the excavation free of water at all times especially in soft or expansive soils, to minimize swell effects. Any treatment not specifically required by the Drawings shall be subject to the prior approval or instruction of the Engineer.

3.1.2.6 Cofferdams

- (a) Suitable and practically watertight cofferdams shall be used wherever water bearing strata are encountered above the elevation of the bottom of the excavation. Upon request, the Contractor shall submit drawings showing his proposed method of cofferdam construction to the Engineer for approval.
- (b) Cofferdams or cribs for foundation construction shall, in general be carried well below the bottoms of the footings and shall be well braced and as nearly watertight as practicable. In general, the interior dimensions of cofferdams shall be such as to give sufficient clearance for the construction of forms and the inspection of their exteriors, and to permit pumping outside of the forms. Cofferdams or cribs which are tilted or moved laterally during the process of sinking shall be righted or enlarged so as to provide the necessary clearance.
- (c) When conditions are encountered which, as determined by the Engineer, render it impracticable to de-water the foundation before placing the footing, the Engineer may require the construction of a concrete foundation seal of such dimensions as he may consider necessary, and of such thickness as to resist any possible uplift. The concrete for such seal shall be placed as shown on the Drawings or as directed by the Engineer. The foundation shall then be de-watered and the footing placed. When weighted cribs are employed and the weight is utilised to overcome partially the hydrostatic pressure acting against the bottom of the foundation seal, special anchorages such as dowels or keys shall be provided to transfer the entire weight of

the crib to the foundation seal. When a foundation seal is placed under water, the cofferdam shall be vented or parted at low water level as directed.

- (d) Cofferdams shall be constructed so as to protect green concrete against damage from sudden rising of the stream and to prevent damage to the foundation by erosion. No timber or bracing shall be left in cofferdams or cribs in such a way to extend into substructure masonry, without the approval of the Engineer.
- (e) Any pumping that may be permitted from the interior of any foundation enclosure shall be done in such a manner as to preclude the possibility of any portion of the concrete materials being carried away. Any pumping required during the placing of concrete, or for a period of at least 24 hours thereafter, shall be done from a suitable sump located outside the concrete forms. Pumping to de-water shall not commence until the seal has set sufficiently to withstand the hydrostatic pressure.
- (f) Unless otherwise provided, cofferdams or cribs, with all sheeting and bracing involved therewith, shall be removed by the Contractor after the completion of the substructure. Removal shall be effected in such a manner as not to disturb, or mark finished masonry.

3.1.2.7 Preservation of Channels

Unless otherwise permitted, no excavation shall be made outside of caissons, cribs, cofferdams, or sheet piling, and the natural stream bed adjacent to the structure shall not be disturbed without the approval of the Engineer. If any excavation or dredging is made at the site or the structure before caissons, cribs, or cofferdams are sunk in place, the Contractor shall, after the foundation base is in place, backfill all such excavations to the original ground surface or stream bed with material satisfactory to the Engineer. Material deposited within the stream area from foundation or other excavation or from the filling of cofferdams shall be removed and the stream area freed from obstruction thereby.

Cofferdam, shoring and bracing to be constructed for foundation of bridges or other structures shall be placed in such manner as to prevent the scouring on bottom, slope or stream areas.

3.1.2.8 Excavation for Borrow Materials

- (a) Borrow pits, whether within the highway right of way or elsewhere, shall be excavated in accordance with the provisions of these Specifications.
- (b) Approval to open a new borrow area or to operate an existing one shall be obtained from the Engineer in writing before any borrow operation is commenced
- (c) Borrow pits shall not be permitted in land which may be required for future road widening or other Government purposes.
- (d) Pits shall be prohibited or restricted where they might interfere with the nature or designed drainage
- (e) All borrow pits shall be so graded and drained as to control all surface water without ponding.
- (f) The edge of a borrow pit shall be not closer than 2 metres from the toe of embankment or 10 metres from the top of any cutting.

3.1.2.9 Excavation on Existing Asphalt Pavement Materials

- (a) Removal work may be performed with or without a cold milling machine. There shall be the minimum possible disturbance to the material below and beyond the prescribed limits of excavation. When removal is performed without cold milling the edges of the area to be excavated shall be sawn or cut by jack hammer so as to prevent overbreak. Where the material exposed on the formation level of the removal has been loosened or disturbed as a result of the removal operation, the loosened or disturbed material shall be thoroughly compacted or completely removed and replaced with the suitable materials, as directed by the Engineer. Any cavities in the formation level of the excavation shall be filled with acceptable material and thoroughly compacted, as directed by the Engineer.
- (b) Where the material exposed on the formation level of the removal in opinion of the Engineer, is loose or soft or mucky or otherwise unsuitable, the material shall be thoroughly compacted or completely removed and replaced with the suitable materials, as directed by the Engineer.

3.1.3 MEASUREMENT AND PAYMENT

3.1.3.1 Excavation Excluded from Measurement

Several categories of excavation work for the Contract shall not be measured or paid for under this Section, the work being deemed to be included instead, in the prices bid for various construction materials that shall be placed in the finished excavation, such Stone Masonry and Pipe Culverts. The types of excavation specifically excluded from measurement under this Section are:

- (a) Excavation beyond the lines shown on the approved profiles and cross-sections shall not be included in the volume to be measured for payment except where:
 - (i) The over-excavation is required for the removal of soft or unsuitable material as specified in Article 3.1.2.1.(c) above, or for the removal of rock or other hard material as specified in Article 3.1.2.1.(d) above.
 - (ii) The additional work results from the collapse of slopes which have previously been accepted as satisfactory by the Engineer in writing provided contractors actions or work methods not in compliance with this specification did not contribute significantly to the collapse.
- (b) Excavation work for drainage ditches and waterways, except for rock excavation, shall not be measured for payment under this Section. Measurement and payment shall be made under Section 2.1 of these Specifications.
- (c) Excavation work carried out for installing pipe culverts, except for rock excavation shall not be measured for payment compensation for this work being included in the various unit prices bid for the respective materials involved, in accordance with Section 2.3 of these Specifications.
- (d) Excavation work carried out in the reinstatement of existing road shall not be measured for payment, compensation for this work being included in the various unit prices bid for the materials used in the reinstatement operations in accordance with Section 8.1 of these Specifications.

- (e) Excavation for reinstatement of shoulders and other minor works undertaken as provided by Section 8.2, except for rock excavation shall not be measured for payment under this Section. Measurement and payment shall be made under Section 8.2 of these Specifications.
- (f) Excavation work required for routine maintenance operations shall not be measured for payment, compensation for this work being included in the lump sum prices bid for the various routine maintenance operations included in Section 10.1 of these Specifications.
- (g) Excavation work carried out to obtain construction materials from borrow pits or quarries outside the limits of the construction area shall not be measured for payment, the cost of this work being deemed to be included in the unit prices bid for the embankment or pavements.
- (h) Excavation and disposal work as prescribed in Article 3.1.2.1.(a), except of soil, rock, granular pavement materials, peat and existing asphalt pavement materials, shall not be measured for payment, the cost of this work being included in the various unit prices bid for the respective materials involved, in accordance with Section 7.15 of these Specifications.
- (i) Excavation work for benching of embankment bases or for preparation of ditches for filling, carried out in accordance with Article 3.2.3.1 (c) or (d), shall not be measured for payment, the cost of this work being deemed to be included in the unit prices bid for Fill.

3.1.3.2 Measurement of Excavation for Payment

- (a) Excavation work not excluded under Article 3.1.3.1.(a) to (i) above shall be measured for payment in cubic metre of excavation material removed. The following adjustment factors shall be used to calculate the equivalent quantity for compacted embankment:
 - (i) The measured volume of common excavation shall be multiplied by a shrinkage factor of 0.85 to determine the equivalent volume available for embankment.
 - (ii) The measured volume of rock excavation shall be multiplied by a swelling factor of 1.20 to determine the equivalent volume available for embankment.

The basis of the excavation quantity calculation shall be the approved cross section drawings and the agreed original ground profile adjusted for the agreed depth of clearing and grubbing and for structural excavation. The method of calculation shall be the average end area method, using cross sections of the work spaced no more than 25 m apart in general or 50 m apart for flat ground.

- (b) Where the material resulting from excavation has been confirmed in writing by the Engineer as suitable for embankment, but the excavation material is rendered surplus by reason of the Contractor having opened borrow pits solely for his own convenience, he shall not be paid.
- (c) The volume of material to be measured for Structure Excavation shall consist of a prismoid bounded by the following planes

- (i) above the horizontal plane reproducing the perimeter of the foundation and passing through the lowest point of the natural ground along the perimeter; therefore; above this plane, the excavation shall be considered as common excavation in earth or in rock as the case may be and shall be measured and paid for accordingly;
- (ii) the base of the foundation;
- (iii) the vertical planes coinciding with the perimeter of the footing.

Measurement for Structure Excavation shall not include material removed below the footing grade and beyond the specified limits of the excavation to compensate for anticipated swell or as a result of effective swell during pile driving or additional material resulting from slides, slips, cave-ins, silting or filling whether due to the action of the elements or to carelessness of the Contractor.

- (d) Excavation of existing asphalt pavement not covered by the provisions specified in Section 8.1, Reinstatement of Existing Pavement, shall be measured for payment as the in situ volume in cubic metre of material removed.
- (e) Excavation of granular pavement materials, peat, soft soil, expansive soil, unsuitable soil, mucky soil and intermediate bearing capacity soil, if not otherwise excluded under preceding clauses, shall be measured for payment as Common Excavation.

3.1.3.3. Measurement of Cofferdam and Dewatering

Cofferdam, shoring, bracing and related work, whenever included as a Pay Item in the Bill of Quantities, shall be paid for at the lump sum Bid Price under Pay Item No.7.6.30 and in accordance with the following provisions: this work shall include furnishing, constructing, maintaining, and removing any and all cofferdam, shoring, bracing, caissons, sheeting, water control, and other operations necessary for the acceptable completion of the excavation included in the work of this Article to a designated depth.

3.1.3.4. Basis of Payment

Quantities of Excavation, measured as provided above, shall be paid for per unit of measurement at the prices entered in the Bill of Quantities for the pay items listed below, which prices and payment shall be full compensation for all work, including cofferdam, shoring, bracing and related work, and costs involved in performing the required excavation work as prescribed in this Section.

Pay Item No.	Description	Unit of Measurement
3.1.1	Common Excavation	Cubic Metre
3.1.2	Rock Excavation	Cubic Metre
3.1.3	Structural Excavation 0 – 2 m depth	Cubic Metre
3.1.4	Structural Excavation 2 – 4 m depth	Cubic Metre
3.1.5	Structural Excavation 4 – 6 m depth	Cubic Metre
3.1.6	Excavation of Existing Asphalt Pavement Materials with Cold Milling Machine	Cubic Metre

3.1.7

Excavation of Existing Asphalt Pavement
Materials without Cold Milling Machine

Cubic Metre

SECTION 3.2

FILL

3.2.1 GENERAL

3.2.1.1 Description

- (a) This work shall consist of winning, hauling, placing, and compacting approved earth or granular materials for the construction of embankments. for backfilling trenches or excavations around pipes or structures and for general filling as required to shape the site to lines, grades and elevations of the specified or approved cross sections.
- (b) Fill covered by the provisions of this section shall be divided into three types, namely Common Embankment, Selected Embankment and Granular Selected Embankment for Swampy Areas.
- (c) Selected Embankment shall be used for improving the subgrade support capacity on capping layers and when required in cut areas. Selected Embankment shall also be used for slope stabilization or embankment widening works if steep slopes are required because of space or other restrictions.
- (d) Granular Selected Embankment shall be used as a capping layer on soft ground having an insitu CBR less than 2% that cannot be improved by compaction or stabilization, and in swampy areas, water courses, and similar locations where Selected or Common Embankment material could not be compacted satisfactorily.
- (e) Either Selected Embankment or Granular Selected Embankment shall be used for bridge abutment and retaining wall backfill and other critical areas with limited access for compaction equipment as shown on the drawings or when instructed or approved by the Engineer.
- (f) The work does not include fill material placed as bedding for pipes or concrete drains, nor porous drainage material placed for subsurface drainage purposes or for preventing the wash out of soil fines by filter action. These fill materials are covered in Section 2.4 of these Specifications.
- (g) Measures in addition to those described in this Specification may be required to address site specific effects including consolidation and slope stability.

3.2.1.2 Related Work Specified Elsewhere

Related work specified elsewhere includes but is not limited to the following

- (a) Transportation and Handling : Section 1.5
- (b) Traffic Management and Safety : Section 1.8
- (c) Field Engineering : Section 1.9
- (d) Materials and Storage : Section 1.11
- (e) Environmental Safeguards : Section 1.17
- (f) Porous Drainage : Section 2.4
- (g) Excavation : Section 3.1
- (h) Grade Preparation : Section 3.3
- (i) Concrete : Section 7.1
- (j) Stone Masonry : Section 7.9
- (k) Maintenance of Adjacent Roads and Bridges : Section 10.2

3.2.1.3 Dimensional Tolerance

- (a) The finished levels and grades after compaction shall be not more than 2 centimetres higher nor 3 centimetres lower than those specified or approved at any point.
- (b) All exposed finished fill surfaces shall be sufficiently smooth and uniform and have sufficient slope to ensure the free run-off of surface water.
- (c) Finished embankment slope surfaces shall not vary from the specified profile line by more than 10 centimetres
- (d) Fill other than Capping Layers over soft ground, shall not be placed in layers exceeding 20 centimetres compacted thickness nor in layers less than 10 centimetres compacted thickness.

3.2.1.4 Reference Standards

Standar Nasional Indonesia (SNI) :

SNI 03-3422-1994 (AASHTO T 88 - 00 (2004))	: Cara Uji Analisis Ukuran Butir Tanah.
SNI 03-1967-1990 (AASHTO T 89 - 02)	: Cara Uji Penentuan Batas Cair untuk Tanah.
SNI 03-1966-1990 (AASHTO T 90 - 00 (2004))	: Cara Uji Penentuan Batas Plastis dan Indeks Plastisitas Tanah.
SNI 03-1742-1989 (AASHTO T 99 - 01 (2004))	: Cara Uji Kepadatan Ringan untuk Tanah.
SNI 03-1743-1989 (AASHTO T180 - 01(2004))	: Cara Uji Kepadatan Berat untuk Tanah.
SNI 03-2828-1992 (AASHTO T191- 00 (2004))	: Metode Pengujian Kepadatan Lapangan Dengan Alat Konus Pasir.
SNI 03-1744-1989 (AASHTO T193 - 99(2003))	: Metode Pengujian CBR Laboratorium.
SNI 03-6795-2002 (AASHTO T258 - 81(2004))	: Metode Pengujian untuk Menentukan Tanah Ekspansif
SNI-03-6797-2002 (AASHTO M145-91(2004))	: Tata Cara Klasifikasi Tanah dan Campuran Tanah Agregat untuk Konstruksi Jalan

3.2.1.5 Submittals

- (a) For any fill to be paid under the provisions of this Section of the Specifications, the Contractor shall submit the following to the Engineer before any approval to commence the work may be granted by the Engineer.
 - (i) Detailed cross-section drawing showing the prepared surface on which the Fill is to be placed.
 - (ii) The results of density tests verifying the adequacy of compaction of the prepared surface on which the fill is to be placed, if required under Article 3.2.3.1.(b) below.
- (b) The Contractor shall submit the following to the Engineer at least 14 days prior to the proposed date of first using any material proposed for use as Fill:

- (i) Two samples of 50 kg weight each of the material, one of which shall be retained by the Engineer for reference throughout the Contract Period.
 - (ii) A statement of the origin and composition of any material proposed for use as Fill, together with laboratory test data verifying that the material properties specified in Article 3.2.2 are met.
- (c) The Contractor shall submit the following in written form to the Engineer immediately following completion of each section of the work and before any approval may be granted for the placing of other materials on top of the Fill;
- (i) The results of density tests as specified in Article 3.2.4.
 - (ii) The results of surface measurement tests and survey data verifying that the surface tolerances specified in Article 3.2.1.3 are met.

3.2.1.6 Work Schedule

- (a) Old sections of highway embankment shall be widened or constructed using half-width construction so that the road is maintained open to traffic at all times.
- (b) To avoid interference with the construction of bridge abutments and wing walls the Contractor shall, at points to be determined by the Engineer, suspend work on embankments forming the approaches to any such structures until such time as the construction of the latter is sufficiently advanced to permit the completion of the approaches without the risk of interference or damage to the bridge works.

3.2.1.7 Site Conditions

- (a) The Contractor shall ensure that the works are kept dry immediately prior to and during all laying and compaction work, that the embankment during construction shall have sufficient camber to assist drainage from the road of any rainfall and shall ensure that the finished works are well drained. When practicable, water from the site shall be discharged into the permanent drainage system. Adequate means of trapping silt shall be provided on temporary systems discharging into permanent drainage systems.
- (b) The Contractor shall maintain at the actual site of work adequate supplies of water for moisture control of the Fill during all placing and compacting operations.

3.2.1.8 Rectification of Unsatisfactory or Unstable Fill

- (a) Finished Fill which does not conform with the specified or approved cross sections or with the surface tolerance specified in 3.2.1.3, shall be rectified by loosening the surface and removing or adding material as required, followed by reshaping and re-compacting.
- (b) Fill which is too dry for compaction, in terms of the moisture content limits as specified in Article 3.2.2.3.(b) or as directed by the Engineer, shall be corrected by scarifying the material followed by sprinkling with an adequate quantity of water and thoroughly mixing by means of a motor grader or other approved equipment.
- (c) Fill which is too wet for compaction as defined by the moisture content limits specified in Article 3.2.2.3.(b) or as directed by the Engineer, shall be rectified by scarifying the material followed by intermittent working by motor grader or other

approved equipment, with rest periods between working, under dry weather conditions. Alternatively, or if sufficient drying cannot be achieved by working and resting the loose material, the Engineer may direct that the material be removed from the work and replaced with suitably dry material.

- (d) Fill which becomes saturated from rain or flood or otherwise after it has already been satisfactorily compacted in terms of this Specification will generally require no rectification work provided its material properties and surface uniformity still meet the requirements of these Specifications.
- (e) Rectification of Fill which does not meet the density or material property requirements of this Specification shall be as directed by the Engineer and may include additional compaction, loosening followed by moisture content adjustment and re-compaction, or removal and replacement of the material.
- (f) Rectification of Fill which is damaged by flood scour or slumping after the work has been completed and accepted by the Engineer shall be as specified in Article 3.2.1.8.(c) of these Specifications.

3.2.1.9 Restitution of the Work Following Testing

All holes in the finished work made by density testing or otherwise shall be back-filled by the Contractor without delay and compacted to the density and surface tolerance requirements of these Specifications.

3.2.1.10 Weather Limitation

Fill shall not be placed, spread or compacted while rain is falling, and no compaction shall be carried out after rain or otherwise when the moisture content of the material falls outside the range specified in Article 3.2.3.3.(b). All uncompacted fill surfaces shall be graded and compacted sufficiently to minimize water absorption or shall be covered with plastic sheeting at the end of each work day and also when heavy rain is expected.

3.2.1.11 Control of Traffic

Traffic control shall conform with the provisions of Section 1.8, Traffic Management and Safety.

3.2.2 MATERIALS

3.2.2.1 Material Sources

Fill materials shall be selected from approved sources in accordance with Section 1.11 of these Specifications.

3.2.2.2 Common Embankment

- (a) Fill classified as Common Embankment shall consist of excavated earth or rock material, approved by the Engineer as suitable for use in the permanent works as prescribed in Article 3.1.1.1 of these Specifications.
- (b) Materials shall also be selected preferentially to exclude the use of highly plastic clay soils, classified as A-7 by SNI-03-6797-2002 (AASHTO M145) or as CH on the Unified or Casagrande Soil Classification System. Where the use of highly plastic

soils cannot reasonably be avoided, such material shall be used only in the bottom portion of embankments or in backfill not required to possess good bearing or shear strength such as berm areas. No such highly plastic soil shall be used at all in the 30 cm of material directly beneath the subgrade level. In addition, the Fill in this zone shall, when tested in accordance with SNI 03-1744-1989, have a CBR value of not less than the characteristic subgrade strength adopted for design and shown on the drawings or not less than 6% otherwise (CBR after four days soaking when compacted to 100% of the maximum dry density as determined according to SNI 03-1742-1989).

- (c) Highly expansive soils having an Activity Value greater than 1.25, or a degree of expansion classified by SNI 03-6795-2002 as “Very High” or “Extra High”, shall not be used as embankment Fill, The Activity Value shall be measured as the ratio Plasticity Index (SNI 03-1966-1989) / Percent Clay Sizes (SNI 03-3422-1994).

3.2.2.3 Selected Embankment

- (a) Fill shall only be classified as Selected Embankment or Granular Selected Embankment when used in locations or for purposes where these materials have been specified or otherwise approved in writing by the Engineer. All other fill used shall be regarded as Common Embankment (or Porous Drainage if specified or approved as such in accordance with Section 2.4 of these Specifications).
- (b) Fill classified as Selected Embankment shall consist of soil or rock material which meets all the above material requirements for Common Embankment and in addition shall possess certain other required properties, depending on its intended use, as directed or approved by the Engineer. In all cases, all Selected Embankment shall, when tested in accordance with SNI 03-1744-1989 have a CBR value of at least 10% (ten percent) after four days soaking when compacted to 100% of the maximum dry density as determined according to SNI 03-1742-1989.
- (c) When used in slope or embankment stabilization works or in other situations where good shear strength is important, but normal dry compaction conditions prevail, Selected Embankment may be rock fill or well graded clayey gravel or sandy clay or low plasticity clay. The type of material selected, and approved by the Engineer, will depend on the steepness of the slopes to be constructed or filled, or on the bearing pressure to be sustained.

3.2.2.4 Granular Selected Embankment for Swampy Areas

Selected embankment materials for swampy areas and for situations where placing under saturated or flooded conditions cannot be avoided, shall be rock, sand or gravel or other clean granular material with a maximum Plasticity Index of 6 % (six percent).

3.2.3 **PLACING AND COMPACTING FILL**

3.2.3.1 Site Preparation

- (a) Before placing Fill on any area, all unsuitable material shall have been removed as instructed by the Engineer in accordance with Article 3.1.1.11, 3.1.2.1 or 3.1.2.5 of these Specifications.

- (b) Except for soft, unable to be compacted or swampy areas, the embankment foundation area shall be thoroughly compacted (involving, loosening and drying or moistening if required) until the top 15 cm of soil meets the density requirements specified for the Fill to be placed thereon.
- (c) When the embankments are to be constructed against existing ground grades exceeding 10%, placed against existing or newly constructed embankments, the existing slopes are to be cut back to sound material and to form level benches to allow access and operation of compaction equipment. Benches shall not exceed 4% grade and shall be separated vertically by not more than 30 cm for grades less than 15% and not more than 60 cm for grades equal to or exceeding 15%.
- (d) Ditch bases that are to be filled shall be flattened and widened sufficiently to permit effective operation of compaction equipment.

3.2.3.2 Placing Fill

- (a) Fill shall be delivered to the prepared surface and spread in uniform layers which when compacted shall meet the layer thickness tolerances given in Article 3.2.1.3 of this Section. Where more than one layer is to be placed, the layers are to be as nearly equal in thickness as possible.
- (b) Earth Fill generally shall be transferred directly from the borrow area to the prepared surface in dry weather and spread. Stockpiling of Earth Fill shall generally not be permitted, especially during the wet season.
- (c) In Placing Fill over or against sand blankets or other Porous Drainage material, care shall be taken to avoid intermingling of the two materials. In the case of forming vertical porous drains, a sharply defined interface between the two materials shall be ensured by the use of temporary forms of thin steel sheeting which shall be gradually withdrawn as placing of the Fill and Porous Drainage is carried out or by other means approved by the Engineer.
- (d) Backfilling over pipes and behind structures shall be performed systematically and as soon as possible following placing of the pipe or structure. Before backfilling however, a period of not less than 24 hours shall be allowed following the mortaring of pipe joints or the placing of gravity structures of concrete, stone masonry or mortared stonework. A period of not less than 14 days shall be allowed before backfilling around structural earth retaining structures of concrete, stone masonry or mortared stonework.
- (e) Where embankments are to be widened, the slope of the existing embankment shall be prepared by removing all surface vegetation and shall be stepped (or benched) so that the new embankment is keyed into the existing embankment to the satisfaction of the Engineer. The widened embankment shall then be built up in horizontal layers to the subgrade level where it shall be covered as soon as practical with sub-base to the level of the existing roadway surface so that the widened area can be used by traffic as soon as possible, enabling construction to proceed on the other side of the road if required.
- (f) Capping Layers over soft soil including swampy ground shall be placed as soon as possible and not more than three days after approval by the Engineer of any excavation or clearing and grubbing. Capping layers may be placed in one layer or several layers of between 0.5 and 1.0 metres total thickness with compaction subject

to site conditions and as instructed or approved by the Engineer. Article 3.2.4.2 shall not apply.

3.2.3.3 Compaction of Fill

- (a) Immediately following placing and spreading of the Fill, each layer shall be thoroughly compacted with suitable and adequate compaction equipment approved by the Engineer, to a density meeting the requirements specified in Article 3.2.4 of this Section.
- (b) Compaction of Earth Fill shall be carried out only when the moisture content of the material is within the range of 3 % less than optimum moisture content to 1 % more than optimum moisture content. The optimum moisture content shall be defined as the moisture content at which the maximum dry density is obtained when the soil is compacted in accordance with SNI 03-1742-1989.
- (c) All rock fills shall be constructed and compacted according to the Engineers instruction and shall be covered with one or more 20 cm thick layers of well graded material containing no stones larger than 5 cm and capable of filling all the interstices in the top of the rock fill. These capping layers shall be constructed to the density requirements for Earth Fill given in Article 3.2.4.2 below.
- (d) Each layer of Fill placed shall be compacted as specified, tested for density and accepted by the Engineer before the next layer is placed.
- (e) Embankment shall be compacted beginning at the outer edges and progressing toward the centre in such a manner that each section receives equal compacted effort. Where possible, construction traffic shall be routed over the Fill work and the lanes used varied continually to spread the compacted effect of the traffic.
- (f) In carrying embankments up to or over culverts and where required in the Contract up to or over bridges, the Contractor shall bring the embankments up equally on both sides. If conditions require placing backfill or embankment appreciable higher on one side than on the opposite side, the additional material on the higher side shall not be placed until permission shall have been given by the Engineer and preferable not until the structure has been in place 14 days, and tests made by the laboratory under the supervision of the Engineer establish that the structure has attained sufficient strength to withstand any pressure created by the methods used and materials placed without damage or strain beyond a safe factor.
- (g) To avoid interference with the construction of bridge abutments, wing walls and box culverts, the Contractor shall, at points to be determined by the Engineer, suspend work on embankment forming the approaches to any such structure until such time as the construction of the latter is sufficiently advanced to permit the completion of the approaches without the risk of interference or damage to the bridge works. The cost of suspension of work shall be included in the Contract unit price for “Common Excavation”, “Common Embankment” and “Selected Embankment”.
- (h) Material for embankment at points inaccessible to normal compacting equipment shall be placed in horizontal layers of loose material not more than 10 cm thick and thoroughly compacted by the use of mechanical rammers.
- (i) Fill in locations inaccessible to full sized compacting equipment shall be placed in horizontal layers of loose material not more than 15 centimetre thick and shall be thoroughly compacted by the use of powered pedestrian rollers, powered frog-

rammers or by hand tampers of at least 10 kg weight. Embankment used in these areas shall be Common Embankment having a CBR of not less than 5% for well drained areas. Selected Embankment shall be used where indicated on the drawings and for poorly drained areas when instructed or approved by the Engineer. Special care shall be taken to ensure satisfactory compaction beneath and beside pipes to prevent voids and to ensure the pipe is fully supported.

3.2.3.4 Preparation of Sub grade on Fill

The provisions of Section 3.3, Grade Preparation, shall apply.

3.2.4 **QUALITY ASSURANCE**

3.2.4.1 Material Quality Control

- (a) The amount of supporting test data required for initial approval of the quality of the material shall be as directed by the Engineer but shall include all the relevant tests specified in Article 3.2.2 on at least three representative samples from the proposed material source, selected to represent the range of material quality likely to be obtained from the source.
- (b) Following approval of the quality of a proposed Fill material, quality tests shall be repeated subsequently, at the discretion of the Engineer, in the event of observed changes in the material or in its source
- (c) A program of routine material quality control testing shall be carried out to control variability of the material being brought on site. The extent of the testing shall be as directed by the Engineer but for every 1000 cubic metre of Fill obtained from any source at least one determination of Activity, as defined in Article 3.2.2.2.(c), shall be carried out.

3.2.4.2 Compaction Requirements for Earth Fill

- (a) Layers more than 30 centimetres below subgrade level shall be compacted to 95 percent of the maximum standard dry density determined according to SNI 03-1742-1989. For soils containing more than 10 percent material retained on a 19 mm sieve, the maximum dry density thus obtained shall be adjusted for such oversize material as directed by the Engineer.
- (b) Layers 30 centimetres or less below subgrade level shall be compacted to 100 percent of the maximum standard dry density determined according to SNI 03-1742-1989.
- (c) Density tests shall be made on each layer of the compacted Fill in accordance with SNI 03-2828-1992 and if the result of any test shows that the density is less than the required density the Contractor shall rectify the work in accordance with Article 3.2.1.8 of this Section. The test shall be made to the full depth of the layer at locations as directed by the Engineer, but which shall not be more than 200 m apart. For backfill around structures or in culvert trenches, at least one test per complete layer of backfill placed shall be carried out. In embankments, at least one test shall be performed in every 1000 cubic metre of Fill placed.

3.2.4.3 Compaction Criteria for Rock Fill

Placing and compacting of Rock Fill shall be carried out using grid rollers or vibratory compaction plant. Compaction shall be done in a longitudinal direction along the embankment, beginning at the outer edge and progressing toward the centre and shall be continued until there is no visible movement under the equipment. Each layer shall consist of reasonably well graded rock and all surface voids shall be filled with broken fragments before the next layer is placed. Rock shall not be used in the top 15 cm of embankment and no stone with a dimension exceeding 10 cm shall be included in this top layer.

3.2.4.4 Compaction Criteria for Capping Layers

Granular Selected Embankment capping layers over soft soil (Insitu CBR less than 2%) may be placed in one or several layers which shall be compacted to the extent permitted by site conditions. The degree of compaction shall be sufficient to permit full compaction of the following selected embankment and pavement layers. Compliance with Article 3.2.18 is not required.

3.2.4.4 Compaction Trial

The Contractor shall be responsible for selecting equipment and methods of attaining the specified degree of compaction. In the event that he is unable to attain the required density, the following compaction procedure shall be followed.

A field trial shall be carried out wherein the number of passes of compaction equipment and the moisture content shall be varied until the specified density is attained to the satisfaction of the Engineer. The results of this field trial shall then be used to determine the number of passes, type of compaction equipment and moisture content of all subsequent compaction.

3.2.5 **MEASUREMENT AND PAYMENT**

3.2.5.1 Measurement of Fill

- (a) Fill shall be measured as the number of cubic metres of compacted material required, completed in place and accepted. The volumes to be measured shall be based on the approved cross section drawings of the ground profile or excavation profile before any Fill has been placed and on the specified or accepted lines, grades and levels of the finished Fill work. The method of calculating the volume of material shall be the average end area method, using cross sections of the work spaced no more than generally 25 m apart extending to no more than 50 metres apart in flat areas.
- (b) Fill placed beyond the approved lines and cross sections, including any additional Fill required as a result of, benching or keying into existing slopes, or as a result of settlement of the foundation, shall not be included in the volume to be measured for payment except where:
 - (i) The Fill is required for replacing unsuitable or soft material excavated in accordance with Article 3.1.2.1.(c) of these Specifications, or for replacing rock or other hard material excavated under Article 3.1.2.1.(d) of these Specifications.

- (ii) The additional Fill is required to rectify unsatisfactory or unstable or failed work in instances when the Contractor is not held liable under Article 3.2.1.8.(f) of this Section.
- (iii) If the selected embankment is to be constructed over swampy ground where significant consolidation of the original ground is anticipated. In such a situation selected embankment may be measured for payment by one of the following methods at the discretion of the Engineer.
 - by the installation of settlement plates and rods which shall be placed and surveyed jointly by the Engineer and Contractor, Earthworks quantities may then be determined on the basis of ground levels after settlement. Measurement on this basis shall be under Pay Items 3.2.2. If properly documented settlement records have not been maintained, measurement shall be based on original ground levels before settlement.
 - by loose volume as measured in the transport vehicles prior to unloading at the point of deposition. Earthwork quantities may then be determined on the basis of aggregated quantity of material supplied, as measured and recorded by the Engineer, after the material has been leveled in the truck body according to a horizontal plane parallel to the edges of the sides of the truck. Measurement on the basis shall be under Pay Item 3.2.3 and shall be permitted only against quantities certified by the Engineer.
- (c) Fill placed to replace soil removed by the Contractor in order to place pipes, concrete drains, culverts, subsurface drains or structures shall not be measured for payment under this Section, the cost of this work being deemed to be included in the unit prices bid for the materials involved, as provided for under other Sections of these Specifications.
- (d) Fill used anywhere outside the Contract limits of construction, or for burying unsuitable or waste materials, or for closing borrow pits, shall not be included in the measurement of Fill.
- (e) Fill which has been approved and accepted by the Engineer as Porous Drainage shall be measured under Section 2.4 of these Specifications and shall not be included in the measurement of Fill under this Section.

3.2.5.2 Basis of Payment

Quantities of Fill measured as provided above, whatever the hauling distance required, shall be paid for per unit of measurement at the respective prices entered in the Bill of Quantities for the Pay Item listed below, which prices shall be full compensation for winning, supplying, placing, compacting, finishing and testing the materials, and all other costs necessary or usual to the proper completion of the work prescribed in this Article.

Pay Item No.	Description	Unit of Measurement
3.2.1	Common Embankment	Cubic Metre
3.2.2	Selected Embankment	Cubic Metre
3.2.3	Granular Selected Embankment	Cubic Metre

SECTION 3.3 GRADE PREPARATION

3.3.1 GENERAL

3.3.1.1 Description

- (a) This work consists of preparing, scarifying and compacting of the subgrade surface or existing gravel surface (Grade) for placement of Aggregate Base, Unsealed Road Base, Soil Cement Base or Asphaltic Base Course in those areas of the carriageway (including lay-bys and intersections) not being designated for Reinstatement Works.
- (b) No payment shall be made under Section 8.1, Reinstatement of Existing Pavement and Section 8.2, Reinstatement of Shoulders on Sealed Roads for works measured under this section.
- (c) In the case of gravel roads the work may also consist of heavy grading for shape correction with or without scarification and without the addition of new materials.
- (d) The work involves minor excavation or scarification and filling work followed by shaping, compacting and testing of soil or granular materials, and maintenance of the surface prepared until the pavement materials are placed on it, all in accordance with the Drawings and these Specifications or as directed by the Engineer.

3.3.1.2 Related Work Specified Elsewhere

Work specified elsewhere may include but shall not be limited to the following:

- (a) Traffic Management and Safety : Section 1.8
- (b) Field Engineering : Section 1.9
- (c) Excavation : Section 3.1
- (d) Fill : Section 3.2
- (e) Pavement Widening : Section 4.1
- (f) Shoulders : Section 4.2
- (g) Aggregate Base : Section 5.1
- (h) Unsealed Road Base : Section 5.2
- (i) Soil Cement Base : Section 5.4
- (j) Hot Asphaltic Mixtures : Section 6.3
- (k) Reinstatement of Existing Pavement : Section 8.1
- (l) Reinstatement of Shoulders on Sealed Roads : Section 8.2
- (m) Maintenance of Adjacent Roads & Bridges : Section 10.2

3.3.1.3 Dimensional Tolerances

- (a) The finished grades after compaction shall be not more than 2 centimetre higher or 3 centimetres lower than those specified or approved.
- (b) All finished surfaces shall be sufficiently smooth and uniform, and have sufficient grade, to ensure the free run off of surface water.

3.3.1.4 Reference Standards

Relevant reference standards are those given in Article 3.2.1.4 of these Specifications.

3.3.1.5 Submittals

- (a) The submittals relating to Excavation, Article 3.1.1.4, and to Fill, Article 3.2.1.5, shall be made for all Excavation and Fill work respectively carried out for grade preparation.
- (b) The Contractor shall submit the following in written form to the Engineer immediately following completion of each section of the work and before any approval may be granted for the placing of other materials on top of the subgrade.
 - (i) The results of density tests as specified in Article 3.3.3.2 below.
 - (ii) The results of surface measurement tests and survey verifying that the surface tolerances specified in Article 3.3.1.3 are met.

3.3.1.6 Work Scheduling

- (a) Culverts, head walls and other minor structures below the subgrade or grade level including the fully compacted backfill over them, shall be completed before work is begun on the subgrade or grade. All drainage works shall be in good operative condition as to ensure effective drainage and thereby to avoid damage to the subgrade or grade by surface water.
- (b) When prepared too soon in relation to the laying of the sub-base, the subgrade surface is liable to deteriorate. Accordingly, the amount of Grade Preparation work left uncovered at any one time shall be limited to an area that can be maintained with the equipment available and the Contractor shall arrange for Grade Preparation and the placing of pavement materials to follow each other closely.

3.3.1.7 Site Condition

The provisions specified under Article 3.1.1.7 and 3.2.1.7, relating to site conditions required for Excavation and Fill respectively, shall apply also where relevant to all Grade Preparation work, even in areas where no Excavation or Fill is required.

3.3.1.8 Rectification of Unsatisfactory Grade Preparation

- (a) The provisions specified under Article 3.1.1.8 and 3.2.1.8, relating to rectification of unsatisfactory Excavation and Fill respectively, shall apply also to all Grade Preparation work, where relevant, even in areas not requiring Excavation or Fill work.
- (b) The Contractor shall repair at his own expense any ruts or ridges occasioned by his own workmen or traffic or that of others by reshaping and compacting with rollers of the size and type necessary for such repair.
- (c) The Contractor shall rectify, in the manner directed by the Engineer, any deterioration of the subgrade that may occur from drying out and cracking, or from flooding or other natural events.

3.3.1.9 Restitution of the Work following Testing

The provisions of Article 3.2.1.9 shall apply.

3.3.1.10 Control of Traffic

- (a) Traffic control shall conform with the provisions of Section 1.8, Traffic Management and Safety.
- (b) The Contractor shall be responsible for all the consequences of traffic being admitted to subgrade, and he shall prohibit such traffic whenever possible by providing a detour or by half width construction.

3.3.2 **MATERIALS**

Sub-grades may be formed on Common Embankment, Selected Embankment, Aggregate Base or Porous Drainage, or in the existing ground in cuttings. The material to be used in each instance shall be as directed by the Engineer and the material property requirements for placed materials forming the sub grade shall be as specified in these Specifications.

3.3.3 **EXECUTION OF GRADE PREPARATION**

3.3.3.1 Site Preparation

- (a) Excavation work required for forming sub-grades shall be carried out in accordance with Article 3.1.2.1 of these Specifications.
- (b) All Fill required shall be placed in accordance with Article 3.2.3 of these Specifications.

3.3.3.2 Compaction of Sub grade

- (a) Sub-grades shall be compacted in accordance with the relevant provisions of Article 3.2.3.3 of these Specifications.
- (b) The Compaction requirements and quality assurance requirements for sub-grades are given in Article 3.2.4 of these Specifications.

3.3.3.3 Subgrade bearing capacity in cut

Subgrade shall everywhere have the minimum bearing capacity value as given on the drawings, or at least a CBR of 6% if not stated.

3.3.4 **MEASUREMENT AND PAYMENT**

3.3.4.1 Measurement for Payment

Areas of an existing carriageway that are severely broken, whereby reinstatement operations specified in Section 8.1 or 8.2 of these Specifications are not designated as appropriate, shall be classified as areas for improvement and the Grade Preparation shall be paid for under this Section as the area of prepared subgrade surface accepted by the Engineer.

3.3.4.2 Basis of Payment

Quantities of Grade Preparation, measured as provided above, shall be paid for per unit of measurement at the prices entered in the Bill of Quantities for the Pay Item listed below, which price and payment shall be full compensation for all work and costs involved in performing the required Grade Preparation work as prescribed in this Section.

Pay Item No.	Description	Unit of Measurement
3.3	Grade Preparation	Square Metre

SECTION 3.4 CLEARING, GRUBBING AND TREE REMOVAL

3.4.1 GENERAL

3.4.1.1 Description

- (a) The Clearing and grubbing shall consist of clearing of all trees less than 15 cm in diameter, downed timber, snags, bush, other vegetation, rubbish, and all other objectionable material, and shall include grubbing stumps, roots, and disposing of all spoil material resulting from the clearing and grubbing in accordance with these Specifications or as directed by the Engineer. It shall also include the removal and disposal of structures that obtrude, encroach upon, or otherwise obstruct the Works except where otherwise provided for in these Specifications or ordered by the Engineer
- (b) Selected tree removal shall consist of the removal of all trees shown on the Drawings or designated by the Engineer measuring 15 cm or more in diameter at a point measured one meter above the ground surface. The work shall consist of not only the removal and disposal to the satisfaction of the Engineer of the individual tree but the stump and roots as well.

3.4.1.2 Related Work Specified Elsewhere

Work specified elsewhere may include but shall not be limited to the following:

- (a) Traffic Management and Safety : Section 1.8
- (b) Field Engineering : Section 1.9
- (c) Excavation : Section 3.1
- (d) Fill : Section 3.2
- (e) Pavement Widening : Section 4.1
- (f) Shoulders : Section 4.2

3.4.1.3 Submittals and Records

The Contractor shall either accept the Contract detail cross-section drawings or shall submit to the Engineer prior to commencing the work, detailed corrections to the cross-section drawings showing the existing ground before any clearing and grubbing operations, or any tree removal have been carried out

3.4.1.4 Safety of Work

The Contractor shall bear full responsibility for ensuring the safety of workmen carrying out the clearing, grubbing and tree removal work and of the general public.

3.4.1.5 Work Scheduling

The extent of any clearing and grubbing opened in any one operation shall be limited consistent with maintaining the exposed surfaces in a sound condition, having regard to the effects of drying out, soaking by rain and disturbance by subsequent work operations.

3.4.1.6 Work Site Condition

All exposed surface of the clearing and grubbing work shall be maintained free of water and the Contractor shall provide all necessary equipment and labor for dewatering (pumping), diverting waterways and the construction of temporary drains. Stand by pumps shall be maintained on site at all times to ensure no interruption in the continuity of dewatering procedures.

3.4.2 **CONSTRUCTION**

3.4.2.1 Clearing and Grubbing

Clearing and grubbing shall be executed to the limits as shown on the Drawings or as directed by the Engineer for the actual occupation of the road and its appurtenance. Outside the above area, clearing and grubbing may be limited to cutting the existing vegetation flush with the ground as directed by the Engineer.

It is understood that the area occupied by the existing road is excluded from the strip considered, and the clearing and grubbing is limited to the surface area directed by the Engineer or shown on the Drawings.

In roadway cut areas, all stumps and roots shall be removed to a depth of not less than 50 cm below the finished subgrade level.

In areas under roadway embankments, from which topsoil or unsuitable materials are to be removed or which are designated to be compacted, all stumps and roots shall be removed to a depth of at least 30 cm below the original ground surface and at least 30 cm below the bottom of the lowest pavement layer.

Grubbing of channels and ditches will be required only to the depth necessary for the proposed excavation within such areas.

On the Drawings, clearing and grubbing areas are indicated with respect to three types of vegetation:

- rubber forest;
- jungle vegetation;
- sparse vegetation.

This differentiation is made for the purposes of payment according to three different prices, and it shall be the duty of the Contractor, before making his Bid to visit the sites where he will have to work in order to take note of all the items that will contribute to the cost of the work for the three types of clearing and grubbing in accordance with these Specifications and the Drawings.

3.4.2.2 Removal of Top Soil

In areas under roadway embankments designated by the Engineer, the Contractor shall remove the topsoil and dispose of it on adjacent land as directed.

In general the removal of topsoil should include only the removal of soil which is sufficiently fertile to encourage or sustain a growth of vegetation.

No removal of topsoil over any designated area shall be less than 30 cm in depth measured vertically or as directed by the Engineer, and the topsoil shall be kept separate from other excavated material.

This removal of topsoil shall be paid for as provided for Common Excavation in Section 3.1.

3.4.2.3 Tree Removal

When necessary to prevent damage to structures, other property or to prevent danger or prolonged interruption of traffic, trees designated for removal shall be cut in sections from the top downward. The Contractor shall fill the holes caused by the removal of the stumps and roots as a consequence of the selected tree removal, with suitable material approved by the Engineer. This work shall not be paid for directly, but shall be considered a subsidiary obligation of the Contractor covered by the Contract Price for Selected Tree Removal.

All trees, stumps, roots and other refuse resulting from these operations shall be disposed of by the Contract outside the highway right of way.

3.4.3 MEASUREMENT AND PAYMENT

3.4.3.1 Measurement for Clearing and Grubbing

The quantities of clearing and grubbing to be paid for according to these Specifications or as directed by the Engineer shall be the number of square meters acceptably cleared and grubbed within the limits directed by the Engineer.

Clearing and grubbing required for permanent structures will be measured for payment.

Clearing and grubbing for haul roads, services road and all temporary construction will not be measured for payment.

3.4.3.2 Measurement for Tree Removal

The quantities of the removal and disposal of trees including the stump and roots shall be measured for payment as number of trees actually cut and accepted by the Engineer.

3.4.3.3 Basis of Payment

- (a) The quantities of clearing and grubbing, whether or not water of any depth is present, determined as provided above, shall be paid for at the Contract Price per square meter for Pay Items listed below and shown in the Bill of Quantity, which prices and payment shall constitute full compensation for all labour, equipments, tools and all other costs necessary or usual for the proper completion of the work prescribed in this Article.
- (b) The removal and disposal of any trees equal or more than 15 cm in diameter at a point measured one metre above the ground surface, in accordance with the Engineer's instructions shall be paid for at the Contract Price per unit of measurement for Pay Items listed below and shown in the Bill of Quantity, which prices and payment shall constitute full compensation for all labour, equipments, tools and incidentals necessary to complete the work prescribed in this Article.

Pay Item No.	Description	Unit of Measurement
3.4.1	Clearing and grubbing in rubber vegetation	Square Metre
3.4.2	Clearing and grubbing in jungle vegetation	Square Metre
3.4.3	Clearing and grubbing in sparse vegetation	Square Metre
3.4.4	Selected Tree Removal Diameter 15 - 30 cm	Each
3.4.5	Selected Tree Removal Diameter 30 - 50 cm	Each
3.4.6	Selected Tree Removal Diameter 50 - 75cm	Each
3.4.7	Selected Tree Removal Diameter > 75 cm	Each