CONSTRUCTION OF THE JATIBARANG MULTIPURPOSE DAM

PACKAGE 1: JATIBARANG MULTIPURPOSE DAM INCLUDING APPURTENANT STRUCTURES

SPECIFICATION

SECTION 6. EMBANKMENT CONSTRUCTION

TABLE OF CONTENTS

6.1 EMBANKMENT CONSTRUCTION – GENERAL 6-1
6.1.1 General 6-1
6.1.2 Tolerances 6-1
6.1.3 Foundation Treatment 6-2
6.1.4 Materials 6-3
6.1.5 Compaction 6-4
6.1.6 Ramps 6-4
6.1.7 Quality Control 6-4
6.1.8 Measurement 6-7
6.1.9 Payment 6-7
6.2 IMPERVIOUS ZONE 6-8
6.2.1 Sources of Materials 6-8
6.2.2 Required Properties of Impervious Core Material 6-8
6.2.3 Required Properties of Contact Material 6-8
6.2.4 Selection of Material for Impervious Zone and Contact Material 6-8
6.2.5 Testing Placed Impervious Zone Material and Contact Material 6-9
6.2.6 Foundation Treatment below Impervious Zone Material and Contact Material 6-9
6.2.7 Placing Contact Slurry 6-9
6.2.8 Placing Contact Material 6-9
6.2.9 Placing Impervious Zone Material 6-10
6.2.10 Control of Moisture Content and Density 6-10
6.2.11 Conditioning Impervious Core Material and Contact Material at the Source 6-10
6.2.12 Required Density 6-11
6.2.13 Conditioning Impervious Zone Material and Contact Material After Placement 6-11
6.2.14 Compaction Equipment 6-11
6.2.15 Rolling Trials 6-12
6.2.16 Measurement and Payment 6-12
6.3 SEMI PERVIOUS ZONE 6-13
6.3.1 General 6-13
6.3.2 Required Properties of Semi-Pervious Material 6-13
6.3.3 Testing 6-14
6.3.4 Foundation Treatment Below Semi-Pervious Zone 6-15
6.3.5 Placing 6-15
6.3.6 Compaction 6-15
6.3.7 Rolling Trials 6-16
6.3.8 Measurement and Payment 6-16
6.4 PERVIOUS ZONE 6-17
6.4.1 General 6-17

6.4.2 Requirement for Rockfill for Pervious Zones 6-17
6.4.3 Control Tests 6-18
6.4.4 Foundation Treatment Below Rockfill 6-18
6.4.5 Placing Rockfill in Embankment 6-18
6.4.6 Compaction 6-18
6.4.7 Rockfill Rolling Trials 6-19
6.4.8 Repairs to Placed Rockfill 6-19
6.4.9 Measurement and Payment 6-19

6.5 QUARRY 6-20

6.5.1 General 6-20
6.5.2 Scope of Work 6-20
6.5.3 Proposed Method of Operation 6-20
6.5.4 Operation 6-21
6.5.5 Payment 6-21

6.6 SPECIAL COMPACTION OF MATERIALS IN IMPERVIOUS AND SEMI-PERVIOUS ZONES 6-22

6.6.1 General 6-22
6.6.2 Special Compaction of Impervious Core Material and Contact Material 6-22
6.6.3 Special Compaction of Semi Pervious Material 6-22
6.6.4 Measurement 6-22
6.6.5 Payment 6-23

6.7 TRIAL EMBANKMENTS 6-23

6.7.1 General 6-23
6.7.2 Trial Embankments for Impervious Zone Materials 6-23
6.7.3 Trial Embankments for Semi-Pervious and Pervious Zone Materials 6-23
6.7.4 Payment 6-24

SECTION 6. EMBANKMENT CONSTRUCTION

6.1 EMBANKMENT CONSTRUCTION – GENERAL

6.1.1 General

a. The dam embankment, which comprises the following zones and features as shown on the Drawings, shall be constructed in accordance with this Section 6.

- Impervious Zone
- Upstream Semi-Pervious Zone
- Downstream Fine Semi-Pervious Zone
- Downstream Coarse Semi-Pervious Zone
- Inner Pervious Zone
- Outer Pervious Zone
- Rip-Rap

b. The embankment shall be constructed to the lines, grades and dimensions directed which, in general, will be those shown on the Drawings provided that, at any time before or during construction, the Engineer may vary the dividing lines between zones of the embankment and the position of the outside faces of the embankment. The Contractor shall not be entitled to any adjustment to the rates and lump sums tendered in the Bill of Quantities by reason of such changes, unless it is determined by the Engineer that rates and lump sums will vary as a result of such changes.

c. The upstream face of the embankment above EL. 136.00 and the downstream face of the embankment shall, when completed, present an appearance of uniform texture and general smoothness.

d. The Contractor shall perform the work listed below in accordance with the proposals submitted with his Tender and approved in the Letter of Acceptance, with such modifications as required by the Employer:

(i) Obtaining suitable materials from borrow pits, surface excavation or other sources and mixing, blending, placing and compacting impervious core material and contact zone material;

(ii) Obtaining suitable materials from borrow pits, surface excavation or other sources and mixing, blending, placing and compacting semi-pervious material;

(iii) Working the quarry and placing and compacting pervious zone material and rip-rap.

6.1.2 Tolerances

a. After compaction, materials in the embankment shall not encroach into adjacent zones further than allowed by the tolerance specified in Table 6.1.2.a measured perpendicular to the dam axis, and in a horizontal plane from the dividing line shown on the Drawings or adjusted by the Engineer, provided that the filters, comprising the semi-pervious zones, shall be constructed to at least the minimum widths shown on the Drawings.

TABLE 6.1.2.a TOLERANCE ON DIMENSIONS OF ZONES

Interface or Surface		Tolerance (mm)	
		Towards Axis of Dam	Away from Axis of Dam
i.	Interfaces between:		
	Impervious and Semi-Pervious Zones	600	600
	Semi-Pervious and Pervious Zones	600	600
ii.	Outside faces of dam embankment:		
	Outer Pervious Zone	Zero	1000
	Rip-Rap	Zero	1000

b. Abrupt changes will not be permitted in the dividing lines between zones.

c. Except as otherwise approved or as specified in Sub-Clause 6.1.2.b, the differential height between adjacent zones, during construction, measured at the interface between zones, after compaction, shall be maintained within the limits specified in Table 6.1.2.b.

TABLE 6.1.2.b TOLERANCES ON DIFFERENTIAL HEIGHT

Zones		Tolerance (mm)	
		Minus	Plus
i.	Elevation of Impervious Zone above Semi-Pervious Zones	500	250
ii	Elevation of Semi-Pervious Zone above Pervious Zones	1000	500

6.1.3 Foundation Treatment

a. The Engineer will determine the suitability of each part of the foundation for placing embankment materials thereon.

b. Material shall not be placed in any Zone of the embankment until the foundation has been prepared in accordance with this Specification and has been approved.

c. Materials other than concrete or shotcrete shall not be placed at any point on the foundation until all grouting of the foundation within 30 m of that point has been completed and approved in writing by the Engineer.

d. Materials shall not be placed on any part of the foundation until that part has been dewatered, cleaned up, prepared and approved.

e. Unless otherwise directed, all portions of exploratory trenches below the final excavation line shall be filled with material of the zone to be placed on that part of the foundation and shall be compacted as specified.

f. The Engineer will generally direct that seams and other defects below the general level of the embankment foundation be excavated and filled or covered with the applicable materials specified in Clauses 6.2, 6.3 and 6.4, including hand grouting of open joints. The Engineer may direct that seams and other defects excavated and backfilled with concrete, and abutment contact slopes be modified as provided in Clause 3.4.5 and 3.4.6 and Clause 6.2, 6.3 and 6.4.

6.1.4 Materials

a. Material for construction of the embankment shall only be obtained from sources for which the Engineer has given his prior approval in writing.

b. The Contractor shall not be entitled to any adjustment of the rates and lump sum tendered in the Bill of Quantities if materials from required surface excavation need to be deposited in temporary stockpiles before being placed in the embankment.

c. Materials which are required to be composed of a mix of materials in order to meet specified grading requirements shall be mixed and blended at approved stockpiles prior to being transported to the area for placement.

d. Each load of material shall be placed in the embankment to produce the best practicable distribution of the material as determined by the Engineer. For this purpose, the Engineer may designated the locations in the embankment where individual loads shall be deposited.

e. If, during or after placement, material in any zone has become contaminated with material from another zone or with topsoil or other objectionable material the contaminated material shall be entirely removed at the Contractor's expense.

f. Fill adjacent to a concrete structure shall be placed and compacted with such equipment and in such manner that no damage is caused to the concrete structure.

g. Except as allowed in Sub-Clauses 6.1.2.c , the embankment shall be raised uniformly over the entire length and no section of the embankment shall be higher than any other section without prior approval.

Where the Engineer approves construction of any portion of the embankment to a higher elevation than an adjacent section, the slope between such section along the dam axis shall not exceed 2 horizontal to 1 vertical.

Immediately before placing materials against the sloping face of an already placed section, the sloping face shall be stripped to the sufficient depth to remove those surface materials in the Impervious and Semi-Pervious Zones which are contaminated or do not meet the requirements of this Specification for moisture content and density and those materials in all zones which have, in opinion of the Engineer, been adversely affected by exposure to water and weather.

If, after such stripping, the surface of the exposed material in Impervious or Semi-Pervious zones is, in the opinion of the Engineer, too dry or smooth to bond properly with newly placed fill, it shall be moistened and scarified in an approved manner to provide a satisfactorily bonding surface before new fill is placed upon it. During compaction of new fill, the compaction equipment shall completely overlap the contact surfaces.

Material stripped from the sloping face of the already placed section which, when conditioned to have the correct moisture content, will be suitable for embankment construction may, after such conditioning, be re-deposited elsewhere in the appropriate zone as embankment construction proceeds.

6.1.5 Compaction

The types and capacities of rollers to be use for the compaction of the various zones will be determined by trials carried out by the Contractor on Site, and at his expense which show that the compaction, grading, and other requirements of this Specification can be obtained. Such trials shall be carried out simulating normal construction conditions using all equipment and methods proposed for placing and compacting the materials. In submitting his proposal, the Contractor shall supply all details of the material, and shall state any advantages in time and cost to the Employer in adopting the Contractor's proposal.

6.1.6 Ramps

a. Where ramps are constructed within the embankment, all material within the ramps shall be placed in accordance with the requirements of the Specification for each Zone and tolerances in interfaces and differential heights of the various fill shall be in accordance with Sub-Clause 6.1.2.c The side slopes of ramps shall not be steeper than 1.3 horizontal to 1 vertical in rockfill. As the remainder of a zone adjacent to ramps is placed, the side slopes of the ramps shall be cut back a minimum of 1 m to remove any loosened or segregated material and the resulting material combined with new material before re-compaction in the relevant Zone.

b. The Contractor shall not construct temporary ramps on or in the upstream or downstream face of the embankment.

6.1.7 Quality Control

Tests for the control of quality of embankment materials shall be carried out in accordance with the Table 6.1.7.a or as otherwise approved or directed by the Engineer.

TABLE 6.1.7.a: QUALITY CONTROL TESTS

Zone	Item	Standard to be followed
Impervious Zone Contact Material	Moisture Content	JIS A 1203
	Gradation	JIS A 1102, 1204
	Specific Gravity	JIS A 1110, 1202
	Atterberg Limits	JIS A 1205, 1206
	Standard Compaction	JIS A 1210, 10 cm mould
	In-situ Density	10 cm in diameter, Water Replacement Method
Impervious Zone Regular Impervious Material	Moisture Content	JIS A 1203
	Gradation	JIS A 1102, 1204
	Specific Gravity	JIS A 1110, 1202
	Atterberg Limits	JIS A 1205, 1206
	Standard Compaction	JIS A 1210, 10 cm mould
	Permeability	JIS A 1218, 10 cm mould, Falling Head Method
	In-situ Density	30 cm in diameter, Water Replacement Method
	In-situ Permeability	30 cm in diameter, Constant Head Method
	Tri-axial Compressive Strength	CU Test with Pore Pressure Measurement
Semi-pervious Zone	Gradation	JIS A 1102, 1204
	Specific Gravity	JIS A 1109, 1110
	Relative Density	30 cm mould, Max. and Min. Dry Density
	Permeability	30 cm mould, Constant Head Method
	In-situ Density	40 cm in diameter, Water Replacement Method
	Durability	JIS A 1121, 1122
	In-situ Permeability	40 cm in diameter, Falling Head Method
Pervious Zone	Gradation	JIS A 1102, 1204
	Specific Gravity	JIS A 1110
	In-situ Density	200 cm in diameter, Water Replacement Method
	In-situ Permeability	200 cm in diameter, Falling Head Method

The frequency of quality control tests specified in Table 6.1.7.a and in the relevant clauses of this section of the specification shall be in accordance with Table 6.1.7 b or as otherwise approved or directed by the Engineer.

TABLE 6.1.7. b: FREQUENCY OF QUALITY CONTROL TESTS

Zone	Material	Location	No.	Sampling	Items	Frequency
Impervious Zone	Contact Material	Source	1	Before Stockpiling	Moisture Content	as directed
					Gradation	as directed
					Specific Gravity	as directed
					Atterberg Limits	as directed
					Density	as directed
					Permeability	as directed
		Stockpile	2	During Stockpiling	Moisture Content	as directed
					Gradation	as directed
					Specific Gravity	as directed
					Atterberg Limits	as directed
			3	Before Loading	Moisture Content	1 per day
					Gradation	1 per day
					Specific Gravity	1 per day
			4	During Embankment	Moisture Content	2 per month
					Gradation	2 per month
					Specific Gravity	2 per month
					Atterberg Limits	2 per month
					Density	2 per month
					Permeability	2 per month
		Embankment	5	After Compaction	Moisture Content	1 per layer
					Gradation	1 per unit
					In Situ Density	1 per unit
	Regular Impervious Material	Source for Sand & Gravel	1	Before Stockpiling	Gradation	as directed
					Specific Gravity	as directed
		Source	2	Before Stockpiling	Moisture Content	as directed
					Gradation	as directed
					Specific Gravity	as directed
					Atterberg Limits	as directed
					Density	as directed
					Permeability	as directed
		Stockpile	3	During Stockpiling	Moisture Content	as directed
					Gradation	as directed
					Specific Gravity	as directed
					Atterberg Limits	as directed
					Moisture Content	as directed
			4	After Completion of Stockpiling	Gradation	3 per stockpile
					Specific Gravity	3 per stockpile
					Atterberg Limits	3 per stockpile
					Density	3 per stockpile
					Permeability	3 per stockpile
					Tri-Axial	3 per stockpile
			5	Before Loading	Moisture Content	2 per day
					Gradation	1 per day
			6	During Embankment	Moisture Content	2 per month
					Gradation	2 per month
					Specific Gravity	2 per month
					Atterberg Limits	2 per month
					Density	2 per month
					Permeability	2 per month
					Tri-Axial	as directed
		Embankment	7	After Compaction	Moisture Content	1per unit
					Gradation	1 per unit
					Density	1 per unit
					In Situ Density	1 per unit
					In Situ Permeability	2 per month

TABLE 6.1.7. b continued

Semi-pervious Zone	Semi-pervious Material	Crushing Plant	1	Before Stockpiling	Gradation Durability Specific Gravity	as directed as directed as directed
		Stockpile	2	During Embankment	Gradation Specific Gravity Minimum Density Maximum Density Permeability	2 per month 2 per month 2 per month 2 per month 2 per month
		Embankment	3	After Compaction	In Situ Density In Situ Permeability	1 per unit 2 per month
Pervious Zone	Pervious Material	Quarry	1	During Embankment	Gradation Specific Gravity	1 per 50,000m3 1 per 50,000m3
		Embankment	2	After Compaction	Gradation Specific Gravity In Situ Density In Situ Permeability	1 per 100,000m³ 1 per 100,000m³ 1 per 100,000m³ 1 per 100,000m³
	Riprap	Embankment	3	After Placing	Gradation Specific Gravity	as directed 1 per month

In the above table unit shall mean material placed in one day's work, using material from a single source or stockpile, placed under the same conditions.

The Engineer shall be entitled to request additional tests if there appears to be any significant change in the material delivered and placed in the embankment or the degree of compaction and the Contractor shall not be entitled to any additional payment for such testing over the applicable rates tendered in the Bill of Quantities for furnishing, placing and compacting the material of the various categories.

6.1.8 Measurement

Measurement, for payment, for construction of the embankment shall be made of all material compacted in place in the various zones in accordance with the Specification to the lines grades and dimensions shown on the Drawings or directed, notwithstanding any departure from the dividing lines as allowed by the tolerances specified in Clause 6.1 Camber on the crest of the embankment shown on the Drawing will be added to the measurement, for payment, for the embankment.

6.1.9 Payment

a. Payment for construction of the embankment will be made in accordance with Clauses 6.2 to 6.4.

b. Payment for hand grouting open joints in the embankment foundations will be made in accordance with Clause 6.2.

c. Payment for concrete for filling seams or defects below the general level of the embankment foundations and for modifying abutment slopes will be made in accordance with Sub-Clauses 9.30.3 and 3.4.5.2.

d. Payment for excavation and haulage of materials from surface excavation described in Section 3 to the embankment, or area where it is to be mixed and blended if applicable, will be made in accordance with Clause 3.3 Separate payment will not be made for excavation and haulage from sources other than required excavation.

e. Payment for final clean up and preparation of the foundation surface shall be included in the rates and lump sums tendered in the Bill of Quantities for the construction of the various zones of the embankment.

6.2 IMPERVIOUS ZONE

6.2.1 Sources of Materials

Materials for the Impervious Zone and for contact materials beneath the Impervious Zone shall be consist of a uniformly blended mixture of soil, sand and gravel obtained from excavated materials from the Site or from other sources approved by the Engineer.

6.2.2 Required Properties of Impervious Core Material

Material for the Impervious Zone shall be well graded having the following properties:

a. The grading shall be as shown on the Drawings.

Sieve Size (mm)	Percentage Passing by Weight
150	100
53.0	72-100
19.0	50-80
4.75	35-65
.075	15-25

b. To achieve the required grading, the Contractor shall establish a mixing and blending plant which shall be capable of consistently providing the grading as shown on the Drawings and procedure the quantities required to meet the Construction Programme.

c. The plasticity index (PI) shall not be less than 15 percent.

d. The in situ permeability shall be less than 1.0×10^{-5} cm/second.

6.2.3 Required Properties of Contact Material

The contact material, when compacted in the Impervious Zone shall have the following properties:

a. Grading shall be as follows:

(i) The maximum particle size shall be 50 mm

(ii) Greater than 50 % of the material shall pass the .075 mm sieve

b. The plasticity index (PI) shall not be less than 15 percent.

6.2.4 Selection of Material for Impervious Zone and Contact Material

The Contractor shall select, mix and blend soil, sand and gravel, from approved sources, to furnish material for the Impervious Zone and contact material suitable for use in the Impervious Zone and shall perform such testing as he considers necessary to establish the suitability of the material and its compliance with this Clause. The results of all testing shall be submitted for approval. The minimum frequency of testing of the materials at the borrow areas and after mixing and blending shall be in accordance with Table 6.1.7.b.

6.2.5 Testing Placed Impervious Zone Material and Contact Material

a. The Contractor shall test samples of Impervious Zone materials and contact material taken from the embankment after compaction. The Contractor shall remove or recondition materials that do not comply with Sub-Clauses 6.2.2 and 6.2.3.

b. The Contractor shall test samples of impervious core material and contact material taken from the embankment after compaction in accordance with the standards and frequencies specified in Tables 6.1.7.a and 6.1.7.b.

6.2.6 Foundation Treatment below Impervious Zone Material and Contact Material

a. It is anticipated that after completing the surface excavation for the impervious zone in accordance with the requirements of clause 3.4.5, exposed defects will need to be treated in accordance with the following

b. The foundation shall be treated in accordance with the following and the directions of the Engineer:

Where directed, seams or other defects below the general level of the foundations shall be :

(i) filled with contact material compacted as specified in this Clause or specially compacted in accordance with Clause 6.6;

(ii) backfilled with concrete; or

Open joints in otherwise sound rock shall be grouted by hand, using cement or mortar slurry or treated with shotcrete.

Immediately before placing contact material on the foundation shall be cleaned by barring, wedging and picking or by other approved means to remove all loose, shattered, disintegrated and other objectionable materials and all water shall be removed from depressions. The foundation shall then be cleaned to the satisfaction of the Engineer by brooming, vacuuming, air and water jets or with jets of air as directed. The prepared foundation shall be approved by the Engineer before proceeding with the placement of the contact slurry or contact materials.

6.2.7 Placing Contact Slurry

The surface of the prepared, approved foundation shall be wetted by the manual placement of a slurry comprising silt and clay and water, having a moisture content between 150% to 200% .

6.2.8 Placing Contact Material

a. Contact material shall be placed over the full area of the embankment foundation for the impervious zone in three (3) layers of approximately horizontal layers 100 mm when compacted using hand-operated mechanical equipment as approved by the Engineer.

b. The moisture contents of the contact material shall be adjusted such that the first layer shall have a moisture content within the range of optimum moisture content OMC +10% to OMC+20%. The second and third layers shall have moisture content progressively reduced to the range of OMC + 5% to OMC + 10%. The foregoing moisture content ranges shall be confirmed by the Engineer following rolling trials as specified in Sub-Clause 6.2.15.

c. Contact materials shall be compacted to obtain a wet density of not less than 98% of the wet density of the same material compacted using the standard compaction test (JIS A 1210) and shall be free from laminations, lenses, streaks and other discontinuities.

d. Contact material placed against abutments shall be sloped away from the abutment for a distance of at least 3m at an inclination of 6 horizontals to 1 vertical or steeper so that the material can be compacted directly against the abutment surface.

e. Contact materials shall always be placed prior to the placement of impervious zone material and shall be approved by the Engineer before subsequent impervious zone material may be placed.

6.2.9 Placing Impervious Zone Material

a. The Contractor shall handle and spread impervious zone material on the embankment so as to produce a uniform distribution and gradation throughout. Clusters of rock or areas of segregation, which would interfere with proper compaction, shall be removed.

b. Impervious core material shall be placed in continuous, approximately horizontal layers from one abutment to the end of the section being constructed for the full width of the Impervious Zone. After being compacted as herein specified layers shall not be thicker than 250 mm.

6.2.10 Control of Moisture Content and Density

a. The optimum moisture content (OMC) of impervious zone material and contact material shall be that moisture content which is required to produce the maximum dry density (MDD) when impervious zone material is compacted in accordance with JIS A 1210 provided that routine control tests may be performed in accordance with the method as approved by the Engineer. Should any dispute arise in relation to the values of OMC or MDD determined by the approved method the Contractor shall repeat the tests on samples selected by the Engineer in accordance with procedure JIS A 1210 and the results of such tests shall take precedence.

b. The in-situ moisture content of impervious core material, as placed in embankment, shall be determined by the Contractor by testing selected samples in accordance with JIS A 1203 and at the frequencies shown in Table 6.1.7.b or more frequently as when so directed by the Engineer.

c. Unless otherwise approved or directed, impervious core material in each layer of the Impervious Zone shall have a moisture content, during and after compaction within the range to be advised by the Engineer following rolling trials as specified in Sub-Clause 6.2.15. The moisture content shall be uniform throughout each layer. In general, the average placement moisture content will be required to be a maintained above the OMC.

6.2.11 Conditioning Impervious Core Material and Contact Material at the Source

a. The Contractor shall condition impervious zone material and contact material at the mixing and blending area to bring them within the ranges of moisture contents specified in Sub-Clauses 6.2.8 and 6.2.10 respectively.

b. Procedures for drying the material shall include, but not be restricted to, effective drainage, regular harrowing to ensure maximum drying of the soil by wind and sun and selective removal of the topmost conditioned layers of soil, using light equipment if necessary.

c. Procedures for wetting the material shall include, but not be restricted to harrowing, watering and mixing.

d. Water shall be only added at the embankment to replace loss by evaporation and shall be mixed uniformly throughout the layer by procedures approved by the Engineer.

6.2.12 Required Density

When each layer of impervious zone material has been conditioned to have the specified moisture content, it shall be compacted using an approved roller conforming to Sub-Clause 6.2.14 until the dry density exceeds 95 percent of the MDD, as determined in accordance with Sub-Clause 6.2.10. Impervious zone material shall be compacted to a uniform density and be free from laminations, lenses, streaks and other discontinuities.

6.2.13 Conditioning Impervious Zone Material and Contact Material After Placement

a. If the surface of the Impervious Zone is left exposed for any length of item, the Contractor shall prevent drying of the underlying material by periodic watering, by covering, by maintaining the surface layer in a loosened condition or by other approved methods.

If, in the opinion of the Engineer the surface of a layer of Impervious Zone material has dried excessively or become too smooth to bond properly with the layer of material to be placed thereon, it shall be moistened, if necessary, and worked with harrow, scarifier or other suitable equipment, in an approved manner to a sufficient depth to provide a satisfactory bonding surface before the next layer of Zone 1 material is placed.

b. If impervious core material or contact material cannot be brought conveniently to the specified moisture content it shall be removed from the embankment.

c. Adequate slopes or sealing of Impervious Zone embankment surfaces shall be provided during or before rainfall to obtain better drainage and prevent water percolation into the fill.

6.2.14 Compaction Equipment

a. Based on his own assessment of the material, the Contractor shall propose specific equipment and methods for compacting trial embankments. The Contractor shall submit details of the equipment and its previous use on similar work and similar material.

b. The Contractor shall construct a trial embankment in accordance with Clause 6.7. The Contractor shall construct the Impervious Zone of trial embankments as specified in Clause 6.7 and Sub-clause 6.2.15. Apart from the purposes defined in Sub-clause 6.2.15 the purpose of these trials is to establish whether the proposed equipment and methods can compact impervious zone material to meet the requirements of Sub-Clause 6.2.2.

c. Once the Engineer has approved the method of compaction and the compaction equipment to be used, the Contractor shall not vary the method and/or equipment without further approval.

d. If more than one roller is used on any one layer of fill, all rollers so used shall be of the same type and essentially of the same dimensions. Tractors used for pulling rollers shall have sufficient power to pull the rollers satisfactorily when the drums are fully loaded. During rolling, the Contractor shall keep the spaces between the ends of the feet and the surface of the drum clear of accumulated material.

6.2.15 Rolling Trials

a. Trial embankments shall be constructed as specified in Sub-Clause 6.7. The site of each trial embankment shall be prepared by stripping an area approximately 60 m wide by 40 m long of all vegetation, top soil and loose and soft material to provide a generally level test area not less than 50 m wide by 30 m long. The test area shall be compacted to the satisfaction of the Engineer before construction the trial embankment.

b. Impervious zone material for use in the trial embankment shall be conditioned and mixed and blended until the grading and moisture content is within the limits specified for impervious core material in Sub-Clause 6.2.10

c. The first 4 layers of the trial embankment shall be placed and compacted to a thickness not exceeding 250 mm. Subsequent layers, up to a maximum of 8 layers, shall be compacted in a manner and to thickness directed. The Engineer may direct that such things as selection and mixing of materials, moisture contents, roller characteristics, number of passes and depth of layers be varied from layer to layer. During the operation of tamping rollers, the Contractor shall keep the spaces between the ends of the feet and the surface of the drum clear of accumulated material and the rollers shall be fitted with cleaning bars for this purpose. All rollers shall be properly maintained to ensure that they retain consistent compaction characteristics.

d. The Contractor shall carry out tests during the construction of the trial embankments. Such tests shall include all of those tests required for the final construction of the embankment specified in Sub-Clause 6.1.7 The cost of all such testing shall be included in the rate tendered in the Bill of Quantities for Dam Embankment in Impervious Zone including Contact Slurry and Contact Material Embankment (Item F1).

6.2.16 Measurement and Payment

a. Measurement, for payment, of Dam Embankment in Impervious Zone including Contact Slurry and Contact Material Embankment (Item F1) shall be made of the volume of material compacted in place as shown on the Drawings or directed.

b. Separate payment will not be made for any work performed in connection with construction and testing of trial embankments by the Contractor.

c. The Contractor will not be entitled to any adjustment to the rate tendered in the priced Bill of Quantities for Dam Embankment in Impervious Zone including Contact Slurry and Contact Material Embankment (Item F1) if the compaction equipment and/or method proposed by the Contractor is

not approved as a result of the rolling trials, and alternative compaction equipment and/or compaction method is tested and approved.

d. Payment for construction of Dam Embankment in Impervious Zone including Contact Slurry and Contact Material Embankment (Item F1) will be made at the applicable rate per cubic meter tendered therefor in the Bill of Quantities Such rate shall include the cost of all work in approved sources, excavating, hauling, mixing, and blending Impervious Zone material or contact material from approved sources; placing, spreading and compacting on the embankment, the construction of impervious Zone material trial embankments, the raising of instrument cables and tubes through the embankment in accordance with Clause 13.3 and all other operations including all laboratory and field testing in accordance with the provisions of this Clause and include for Royalties in accordance with Clause 1.2.10 and any other requirements necessary under the terms of the Contract. For impervious zone material and contact material requiring special compaction additional payment will be made as provided in Clause 6.6.

e. Payment for backfill concrete for modifying foundation and abutment contact slopes will be made in accordance with the provisions of Sub-Clauses 9.30.3 and 3.4.5.2.

f. Payment for grouting open joints will be made in accordance with Sub-Clause 5.6.9.

6.3 SEMI PERVIOUS ZONE

6.3.1 General

a. The specifications in this Clause 6.3 refers to the three (3) Semi-Pervious Zones. viz.

- Upstream Semi-Pervious Zone
- Downstream Fine Semi-Pervious Zone
- Downstream Coarse Semi-Pervious Zone

b. Materials for the Semi-Pervious Zones shall consist of a uniformly blended mixture of sand and gravel obtained from excavated materials from the Site, crushed stone from sources approved by the Engineer.

c. The Contractor's proposed method of producing and placing semi-pervious materials shall be in accordance with the proposals approved in the Letter of Acceptance and as modified from time to time in accordance with Sub-Clause 6.3.7. At least 60 days before erecting a processing plant, the Contractor shall submit, for approval, drawings showing the proposed general arrangement for the plant, together with a description of the equipment and methods proposed to be used for processing, placing and compacting the filter material.

6.3.2 Required Properties of Semi-Pervious Material

a. The semi pervious material shall consist of a non-plastic mixture of sand, gravel and cobbles in which the individual particles are hard and durable, free from clay, silt and organic material.

b. The in situ permeability shall be not less than 1.0×10^{-4} cm/second.

c. Material for semi pervious shall be processed to meet the requirements of Sub-Clause 6.3.3. Such processing may involve, but will not

necessarily be restricted to a combination of screening, washing, separating and re-blending.

d. The Contractor shall provide the necessary plant for processing the semi-pervious material.

6.3.3 Testing

a. Before placing semi-pervious materials the Contractor shall test the materials in accordance with JIS A 1121 and JIS A 1122. The material may be rejected if:

(i) At 500 revolution the loss, using grading A in the Los Angeles abrasion test, exceeds 45% by mass;

(ii) When subjected to 5 cycles of the sodium sulphate test for soundness the weighted loss by mass is more than 14%.

b. The Contractor shall test the materials for the Semi-Pervious Zones in accordance with the requirements of Clause 6.1.7

c. The semi pervious material, when placed and compacted, shall conform to the gradings shown on the in the following tables.

Grading Limits for Downstream Fine Semi-Pervious Zone

Sieve Size (mm)	Percentage Passing by Weight
50.0	100
4.75	60-80
0.70	15-40
0.25	0-10
.075	Not more than 5

Grading Limits for Downstream Coarse Semi-Pervious Zone

Sieve Size (mm)	Percentage Passing by Weight
150	100
53.0	60-100
19.0	15-50
4.75	0-10
.075	Not more than 5

Grading Limits for Upstream Semi-Pervious Zone

Sieve Size (mm)	Percentage Passing by Weight
150	100
53.0	60-100
19.0	30-60
4.75	20-40
0.075	Not more than 5

d. When each layer of semi-pervious material has been conditioned to comply with the specified requirements, it shall be compacted using an approved roller until the relative density exceeds 75 percent when tested in accordance with ASTM D 2049 or another method as approved by the Engineer.

e. The Contractor shall remove or condition semi-pervious materials that do not meet the requirements of this Sub-Clause.

f. The Contractor shall test samples of semi-pervious material taken from the embankment after compaction in accordance with the criteria in Clause 6.1.7

6.3.4 Foundation Treatment Below Semi-Pervious Zone

The Contractor shall prepare the foundations for the semi-pervious zones in accordance with Clause 3.4.5 and the requirements for the Impervious Zone foundations, as described in Clause 6.2, except that seams and other defects below the general level of the foundation shall, where directed, be filled with material for the overlying Zone and compacted as specified in this Clause. Where directed, the materials shall be specially compacted in accordance with Clause 6.6.

6.3.5 Placing

a. Before compaction, material for each of the respective semi-pervious zones shall be placed and spread to an approximately horizontal surface in such a way as to prevent segregation of particles or the formation of large voids. The thickness of each layer shall be not more than 500 mm after the required compaction, except as otherwise provided in Clause 6.7.

b. Blending of semi-pervious material on the dam embankment, in order to produce the required grading, will not be approved except that the Engineer may direct blending required to correct any segregation as a result of placing or spreading.

c. The Engineer may direct that semi-pervious material be placed in locations other than in Semi-Pervious zones shown on the Drawings, for the treatment of defects of more weathered rock in accordance with Sub-Clause 6.4.4. Such material shall be placed in accordance with this Clause.

d. If, during or after placement, any material in any of the semi-pervious zones has become contaminated by Clay, topsoil or other objectionable material the contaminated material shall be entirely removed at the expense of the Contractor.

e. If, on completion of each layer of each zone of semi-pervious material, the surface of the layer is such that, in the opinion of the Engineer, it will obstruct free drainage of water through the Zone, the Contractor shall scarify, sluice or otherwise prepare the surface of the layer, or remove such material and, at his own expense, replace it with suitable material which will permit free drainage.

6.3.6 Compaction

a. The first two layers shall be approximately 300 mm thick and compacted using the special compaction specified in Sub-Clause 6.6.3.

b. Subsequent layers of the semi-pervious zone material shall be compacted in the manner as directed by the Engineer and as determined the rolling trials secified in Sub-Clause 6.3.7. Where required, the Engineer may direct special compaction as provided in Clause 6.6.

6.3.7 Rolling Trials

a. Trial embankments shall be constructed as specified in Clause 6.7 and this Sub-Clause.

b. The Engineer will require several series of settlement measurements and other tests as specified in Tables 6.1.7.a and b to determine the effectiveness of various rollers, in compacting the fill materials. The settlement measurements will be made in accordance with the provisions of Clause 6.4. The cost of the work required for the settlement measurements and testing shall be included in the rates tendered in the Bill of Quantities for placing and compacting materials in semi-pervious Zone.

6.3.8 Measurement and Payment

a. Measurement, for payment, of Dam Embankment in Semi-Pervious Zone in each of Upstream Semi-Pervious Zone (Item F.2.1), Downstream Fine Semi-Pervious Zone (Item F.2.2) and Downstream Coarse Semi-Pervious Zone (Item F.2.3) shall be made of the volume of material compacted in place as shown on the Drawings or as directed.

b. Payment for construction of Dam Embankment in Semi-Pervious Zone in each of Upstream Semi-Pervious Zone (Item F.2.1), Downstream Fine Semi-Pervious Zone (Item F.2.2) and Downstream Coarse Semi-Pervious Zone (Item F.2.3), will be made at applicable rates per cubic meter tendered therefor in the Bill of Quantities These rates shall include for Royalties in accordance with Clause 1.2.10, purchase cost, and any other payments required under the terms of the Contract, the entire cost of excavating, loading and hauling from the sand and gravel borrow areas to the processing plant or embankment; placing, spreading, wetting and compacting the material, final clean up and foundation treatment; all laboratory and field testing; and all other operations necessary for the completion of the Semi-Pervious Zones as specified in this Clause.

c. Separate payment will not be made for any work performed in connection with construction and testing of trial embankments by the Contractor.

d. The Contractor will not be entitled to any adjustment to the rates tendered in the Bill of Quantities for semi-pervious materials in the dam embankment if the compaction equipment and/or method proposed by the Contractor are not approved as a result of rolling trials, and alternative compaction equipment and/or compaction method are tested and approved.

e. Payment for backfill concrete for modifying foundation and abutment contact slopes will be made in accordance with provisions of Sub-Clause 9.30.3.

f. Payment for grouting open joints will be made in accordance with Sub-Clause 5.6.9.

g. Special compaction will be paid in accordance with Sub-Clause 6.6.5.

6.4 PERVIOUS ZONE

6.4.1 General

a. This clause refer to the rockfill requirements for the inner and outer pervious zones and for rip rap.

b. Rock fill for the inner and outer pervious zones and for rip rap shall be obtained from the designated quarry site as shown on the Drawings or other sources approved by the Engineer

c. Rockfill for each of the pervious zones shall consist of a well-graded mixture of hard and durable particles. After compaction the rockfill shall be free draining such that it will not retain pools of water.

d. The particles of rock shall not break down significantly during compaction.

e. All excavation in the quarry shall be carried out in accordance with Clause 6.5

6.4.2 Requirement for Rockfill for Pervious Zones

6.4.2.1 Requirements for Inner and Outer Pervious Zones

Rockfill for the pervious zones (excluding rip rap) shall meet the following criteria:

a. After compaction the pervious zone shall be free draining with a permeability of not less than 1.0×10^{-3} cm/sec.

b. The grading limits shall be as shown in the following table:

Sieve Size (mm)	Percentage Passing by Weight	
	Inner Zone	Outer Zone
750	100	100
100	15-70	15-60
4.75	0-20	0-10
.075	Not more than 5	Not more than 5

The compacted thickness of any layer shall not be greater than 1000 mm.

(i) Rip-rap shall be dumped or placed in the rip-rap zone and spread in a manner which will ensure the stability of the zone and the absence of large voids. No compaction will be required.

6.4.2.2 Requirements for Rip Rap

Rip rap shall meet the following criteria:

a. The grading limits shall be as shown in the following table.

Sieve Size (mm)	Percentage Passing by Weight
1000	100
500	Not more than 50

b. The minimum bulk density of rock shall be 2500 kg /m³

c. The maximum permissible water absorption shall be 4%

d. Rock shall be placed in a manner so as to avoid large voids

6.4.3 Control Tests

a. The Contractor shall carry out tests to ensure that rockfill and rip-rap complies with the requirements specified in Sub-Clause 6.4.2

b. Testing shall be carried out using the tests and at the frequencies specified in Sub-Clause 6.1.7.

c. The Contractor shall remove or recondition material that does not meet the requirements of this Clause.

At least 60 days before any rockfill is placed in the embankment, the Contractor shall submit, for approval, details of proposed method of performing field tests.

6.4.4 Foundation Treatment Below Rockfill

a. Foundations for the pervious zones shall be excavated in accordance with Sub-Clause 3.4.5

b. Where weathered or unsuitable materials have been excavated in accordance with Sub-Clause 3.4.5.1 c), the resulting void shall be backfilled in accordance with the requirements for material for the inner pervious zone.

c. The final foundation clean-up shall be done with suitable equipment to Engineer's approval so as not to damage foundations. Rockfill material shall not be placed in the dam embankment until the foundation has been dewatered, and prepared in accordance with Sub-Clause 3.4.5 and approved by the Engineer. The foundation, except rock surfaces, shall be prepared by levelling and rolling so that the surface material of the foundation will be compact and well bonded with the first layer as specified for the subsequent layers.

6.4.5 Placing Rockfill in Embankment

a. Before compaction, rockfill shall be placed and spread to an approximately horizontal surface in such a way as to prevent segregation or the formation of large voids. The thickness of each layer after compaction shall not be greater than 1000 mm.

b. Rocks shall be distributed in the outer pervious zone such that smaller-sized rocks are placed in the first layer and closer to the interface between the inner and outer pervious zones and larger rocks are placed towards the outer faces of the embankment.

c. Loads of rockfill for the outer pervious zone which, in the opinion of the Engineer, contain high but acceptable proportions of weaker rock shall be placed away from the upstream face of the dam embankment and shall be placed towards the inner regions of the zone.

6.4.6 Compaction

a. Each layer of rockfill shall be compacted by a vibrating roller meeting the following requirements:

(i) the static mass of the roller, in operating condition, transmitted to the ground through the surface of the drum shall not be less than 15 tonne; and

(ii) the centrifugal force generated by the vibrating part of the roller shall not be less than 240 kN at the maximum frequency permitted by the manufacturer for the continuous operation of the roller.

b. Each layer of rockfill shall be compacted by the number of passes of the vibrating roller determined by rolling trials.

c. The operation of the vibrating rollers, including frequency of vibration, and speed of travel shall be as directed. If more than one vibrating roller is used, all rollers shall be of the same type and essentially of same dimensions. Tractors shall have sufficient power to pull the rollers at the speed determined by the Engineer in accordance with Sub-Clause 6.4.7 under all conditions encountered on the embankment. The surface of the rollers shall be kept free of adhering material. The rollers shall be properly maintained to ensure that they retain consistent compaction characteristics. Self propelled vibrating rollers which meet all the foregoing requirements will be permitted.

6.4.7 Rockfill Rolling Trials

The Contractor shall carry out trial embankment in rockfill in accordance with Clause 6.7 and this Sub-Clause.

a. The Engineer may require several series of rolling trials to determine the effectiveness of compaction by vibrating roller and to test the properties of the rockfill. Several series of settlement measurements will be made on a prepared test area of approximately 200 m² on the surface of the rockfill. In each series, the Contractor shall measure the elevation of selected points in the test area before rolling, and after each pass of the vibrating roller up to a maximum of 16 passes. The location of the test areas and measurement points, will be as directed. The cost of the work required for the rockfill rolling trials shall be included in the rates tendered in the priced Bill of Quantities for Dam Embankment in Pervious Zone. (Items F.3.1 and F.3.2)

b. The Contractor shall carry out the test in accordance with Sub-Clause 6.1.7 during the construction of trial embankments. The cost of all testing required to be carried out during rockfill rolling trials shall be included in the rates tendered in the priced Bill of Quantities for Dam Embankment in Pervious Zone. (Items F.3.1 and F.3.2)

6.4.8 Repairs to Placed Rockfill

If on completion of each layer of any of the inner pervious zone, the outer pervious zone or the rip rap, the surface of the layer is such that it will obstruct either free drainage of water through the zone, , the Contractor shall, at his own expense, remove such material and replace it with material which will permit free drainage. If, in the opinion of the Engineer, the surface is such that a satisfactory bond with the succeeding layer cannot be achieved, the Contractor shall rip, sluice or otherwise prepare the surface of the layer as directed and re-compact the layer.

6.4.9 Measurement and Payment

a. Measurement, for payment, of rockfill placed in the various categories of Dam Embankment in Pervious Zone shall be made of the volume of

material compacted in place as shown on the Drawings or directed.

b. Payment for construction of Dam Embankment in Pervious Zone in Inner Pervious Zone (Item F.3.1), in Outer Pervious Zone (Item F.3.2) and in Rip Rap Zone (Item F.3.3) will be made at the applicable rates per cubic metre tendered therefor in the Bill of Quantities. Such rates shall include for Royalties in accordance with Clause 1.12.10 and the entire cost of excavation, handling loading and hauling from the quarry to the dam embankment; stockpiling, placing and spreading; compacting material where required; ripping and sluicing where directed; final clean up and preparation of the foundation surface; all laboratory and field testing; and all other operations necessary for the completion of the rockfill in the embankment as directed in this Clause.

c. Separate payment will not be made for any work performed in connection with construction and testing of trial embankments by the Contractor.

6.5 QUARRY

6.5.1 General

A quarry site, situated approximately 17 km South of the dam site and as shown in the Drawings, shall be used by the Contractor. The quarry is designated as part of the Site in accordance with Sub-Clause 1.1 of the General Conditions of Contract.

The Contractor shall develop and operate the quarry in accordance with this Clause to obtain material use in the Works which will include but not be limited to the following:

a. Rip Rap

b. Material for Impervious Zones

c. Concrete Aggregate

d. Material for Semi-Pervious and Pervious Zones

e. Material for mixing and blending with materials from other sources in order to achieve specified mix properties

f. Other uses in the Works

6.5.2 Scope of Work

The Contractor's obligations shall include the following:

a. Design and construction of an access road from the existing main road to the quarry using the route shown on the Drawings

b. Develop and operate the quarry

c. On completion, leave the quarry in safe, reinstated condition

d. On completion, demolish the access road and reinstate the area

e. Pay royalties to the land owner

6.5.3 Proposed Method of Operation

a. The Contractor's proposed method of working the rock quarry shall be in accordance with the Contractor's proposal submitted with his tender and approved in the Letter of Acceptance or with such modifications as

approved by the Engineer from time to time.

b. Not less than 60 days before excavating any rock the Contractor shall submit, for approval, details of his proposed method of working the quarry. Such proposal shall include details of the sequence of operation, height of faces location of benches and measure for preventing erosion.

c. Nothing in this Clause shall relieve the Contractor from the responsibility for the adequacy and safety of the rock excavation operations.

d. In preparing these procedures the Contractor shall take all of the requirements of Sub-Clause 6.5.4 into account.

6.5.4 Operation

a. As far as is practicable, as determined by the Engineer, the Contractor shall locate and work the quarry to ensure that the maximum amount of sound rock is obtained.

b. The quarry shall be cleared and grubbed in accordance with Clause 3.2.

c. Topsoil material stripped from the quarry shall be stockpiled in approved areas in accordance with Clause 3.3

d. Material from the quarry which is unsuitable or not required for permanent construction shall be excavated and disposed of in an approved disposal area or stockpiled for use in reinstatement works on completion. The Contractor shall minimise the contamination of material for permanent construction by such unsuitable material.

e. Irrespective of the approved method of operation in the quarry, the Contractor shall take extreme care in determining final rockfill quantities required towards the end of embankment construction such that the final batters and berms are established as shown in the Contractor's proposal as approved by the Engineer. Pre-splitting techniques will be used on the final batters in accordance with Clause 3.4 The final batters and berms to remain after completion of quarrying operations shall be scaled and cleaned down to remove all loose and dangerous rocks and other material.

f. The Contractor shall carry out soil conservation measures out in accordance with Clause 7.10 as directed by the Engineer and all costs for such work shall be borne by the Contractor including topsoiling and grassing of the quarry floor if directed.

g. The Contractor shall not remove material from the quarry for his own use without approval.

h. The Contractor shall leave the borrow pits in a neat condition with stable slopes as approved by the Engineer and carry out soil conservation measures in accordance with Clause 7.10 to the extent directed by the Engineer and all costs for such work shall be borne by the Contractor.

i. The Contractor shall demolish the access road and reinstate the area to the Engineer's approval.

6.5.5 Payment

Excavation in the quarry is not classified as required excavation under the terms of the Contract. Separate payment will not be made for work carried out in accordance with this Clause. The cost of all work in the quarry including clearing, stripping, design and construction of access road and its subsequent removal and reinstatement, excavating, separating, selecting,

hauling, stockpiling and dumping and of soil conservation measures shall be included in the rates tendered in the priced Bill of Quantities for the construction of the applicable zones of the dam embankments and other locations where the material is used.

6.6 SPECIAL COMPACTION OF MATERIALS IN IMPERVIOUS AND SEMI-PERVIOUS ZONES

6.6.1 General

a. Adjacent to foundations and structures and elsewhere where compaction of material in the Impervious or Semi-Pervious zones by means of pneumatic-tyred vehicles, rollers or tractor treads is impracticable or undesirable, as determined by the Engineer, such material shall be specially compacted as specified in this Clause. All equipment and methods used shall be subject to the Engineer's approval.

b. The differential height between material being specially compacted in any zone and the adjacent material not requiring special compaction shall be no greater than 300 mm, and the material being specially compacted shall be higher than adjoining material.

6.6.2 Special Compaction of Impervious Core Material and Contact Material

Impervious zone material and contact material in the impervious zone requiring special compaction shall be deposited in approximately horizontal layers not more than 100 mm in thickness when compacted and shall have a moisture content as directed. When each layer of such material has been conditioned to have the moisture content required for compaction, it shall be compacted by hand operated mechanical tampers or by other approved methods, The compacted densities shall be equivalent to those specified for the Contact material or Impervious Zone material in Sub-Clauses 6.2.8 and 6.2.12

6.6.3 Special Compaction of Semi Pervious Material

Semi pervious material requiring special compaction shall be deposited in approximately horizontal layers not more than 300 mm in thickness when compacted, and shall be compacted by mechanical tampers, or by other approved methods, to a density equivalent to that achieved by compaction as specified in Sub-Clause 6.3.3

6.6.4 Measurement

a. Measurement, for payment, of Special Compaction for Dam Embankment in Impervious Zone Embankment shall be made of the volume of material specially compacted, as specified in this Clause, to the lines, grades and dimensions shown on the Drawings or directed; provided that about structures measurement, for payment, will be limited to a thickness of 1 m normal to the surfaces against which the material is to be compacted; and further provided that measurement, for payment, shall not be made of special compaction of impervious zone material used for backfill in protective surrounds for instrumentation installations in the dam embankments as shown on the Drawings. No distinction shall be made between special compaction made of contact material or regular impervious zone material

b. Measurement, for payment, of Special Compaction for Dam Embankment in Upstream and Downstream Semi-Pervious Zones shall be made of the volume of material specially compacted, as specified in this Clause, to the lines, grades and dimensions directed, provided that measurement, for payment, shall not be made of special compaction of selected Impervious zone materials used for backfill in protective surrounds for instrumentation installations in the dam embankment as shown on the Drawings.

6.6.5 Payment

a. Payment for Special Compaction for Dam Embankment in Impervious Zone Embankment will be made at the rate per cubic meter tendered therefor in the Bill of Quantities (Item F.4.1), which will be in addition to payment for item F1

b. Payment for Special Compaction for Dam Embankment in Upstream and Downstream Semi-Pervious Zones will be made at the rate per cubic meter tendered therefor in the Bill of Quantities (Item F.4.2), which payment will be in addition to payment for Items F.2.1, F.2.2, F.2.3.

6.7 TRIAL EMBANKMENTS

6.7.1 General

a. At least 6 months prior to the commencement of the dam embankment construction, the Contractor shall carry out trial embankments and tests to assure the soil mechanical and rock mechanical properties of the embankments and to determine the effectiveness of proposed construction methods especially of blending, wetting, spreading and compaction. Findings obtained from the trial embankments and tests will be provided as a basis of re-examination of the dam design and for establishing desirable limits for quality control during construction. The Contractor shall make joint efforts with the Engineer in accordance with Clause 6.2, 6.3 and 6.4 on tests and adjustments until acceptable criteria are established.

b. The trial embankments shall be carried out simulating normal construction conditions using all equipment and methods proposed for mixing, blending, placing and compacting the material. The Contractor shall submit his proposal for trial embankments and test including time, location procedure and method of excavation for the Engineer's approval, and carry out the trial embankments and tests under the supervision of the Engineer.

c. The site of trial embankments and tests shall be stripped of all vegetation, top soil and loose and soft materials to provide a generally level area. The tests area shall be compacted to the satisfaction of the Engineer before construction of the trial embankments.

6.7.2 Trial Embankments for Impervious Zone Materials

Trial embankments for the impervious core shall be carried out in accordance with the requirements of Clause 6.2.

6.7.3 Trial Embankments for Semi-Pervious and Pervious Zone Materials

Test areas for semi-pervious zone materials and pervious zone materials

shall be approximately 200 m² each. The material, thickness of layers and testing shall comply with Clauses 6.3 and 6.4

6.7.4 Payment

No separate payment will be made for complying with the requirements of this Clause and the costs shall be included in the rates tendered for applicable items in the Bill of Quantities.