

SECTION 2
SPECIAL PROVISION



PEOPLE'S REPUBLIC OF CHINA
SHANHAI MUNICIPAL PEOPLE'S GOVERNMENT

SHANGHAI PUDONG INTERNATIONAL AIRPORT PROJECT
FINAL REPORT

TENDER DOCUMENT
PART IV-1
SPECIFICATION
FOR
AIRSIDE CIVIL WORKS
SECTION 2 SPECIAL PROVISION

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CHAPTER 1 GENERAL

SECTION 1.1 SCOPE OF WORKS AND GENERAL REQUIREMENTS

1.1-1.1 These technical specifications cover the directions and requirements for completing the Airside Civil Works comprising the following works and facilities.

- 1) Earth Works
 - Stripping and Leveling
 - Excavation and Embankment
 - Treatment of Existing Channels
 - Ram Compaction
 - Sodding and Seeding
- 2) Concrete Pavement
 - Sub-base Work
 - Concrete Pavement
 - Grooving
 - Marking
 - Anchor Beam
- 3) Drainage Works
 - Masonry Ditch
 - In-situ Concrete Structures
 - Precast Concrete
 - Steel Grating
- 4) Pump Station and Regulating Pond
 - Regulating Pond
 - Pump Station
 - Gate Chamber
 - Oil Separator
 - Control Room
 - Mechanical Work
- 5) Appurtenant Works
 - Asphalt Concrete Pavement Roads
 - Perimeter Fence (Brick type)
 - Perimeter Fence (Steel type)
 - Gate
 - Blast Fence
 - Power Cable Duct
 - Miscellaneous Steel Works
 - Precast Concrete Pile Work

- 1.1-1.2 Standards for specifying materials or testing which are cited in these specifications are basically applicable Chinese Standards (GB, JT, etc.) or equivalent international standards (ASTM, JIS, etc.).

Inspection and testing methods for all materials, semi-finished products, and finished products that are not provided in these technical specifications shall be performed in accordance with the relevant Chinese national standards and departmental standards currently in effect.

- 1.1-1.3 The accuracy for the site surveys shall meet the requirements (third order for traverse survey and third order for leveling survey) as specified in the national standards TJ-26-78 (Construction Survey Standards).

No special payment will be made for site surveying and the cost thereof shall be included in the prices quoted in the Bill of Quantities for the various items of work.

SECTION 1.2 MEASUREMENT AND PAYMENT

1.2.1 Measurement of Quantities

All work completed under the Contract will be measured by the Engineer, or his/her authorized representatives, using Chinese Customary Units of Measurement or the International System of Units.

The method of measurement and computations to be used in determination of quantities of material furnished and of work performed under the Contract will be those methods generally recognized as conforming to good Engineering practice in China.

Unless otherwise specified, longitudinal measurements for area computations will be made horizontally, and no deductions will be made for individual fixtures (or leave-outs) having an area of 0.8 square meter or less. Unless otherwise specified, transverse measurements for area computations will be the neat dimensions shown on the Drawings or ordered in writing by the Engineer.

Structures will be measured according to neat lines shown on the Drawings or as altered to fit field conditions.

Unless otherwise specified, all Contract items which are measured by the linear meter such as electrical ducts, conduits, pipe culverts, underdrains, and similar items shall be measured parallel to the base or foundation upon which such items are placed.

In computing volumes of excavation the average end area method or other acceptable methods will be used.

All materials which are measured or proportioned by weights shall be weighed on accurate, approved scales by competent, qualified personnel at locations designed by the Engineer.

Materials to be measured by volume in the hauling vehicle shall be hauled in approved vehicles and measured therein at the point of delivery.

The term "lump sum" when used as an item of payment will mean complete payment for the work described in the Contract.

When a complete structure or structural unit (in effect, "lump sum" work) is specified as the unit of measurement, the unit will be construed to include all necessary fittings and accessories.

1.2.2 Scope of Payment

The Contractor shall receive and accept compensation provided for in the Contract as full payment for furnishing all materials, for performing all work under the Contract in a complete and acceptable manner, and for all risk, loss, damage, or expense of whatever character arising out of the nature of the work or the prosecution thereof.

When the "payment" subsection of the technical specification requires that the Contract price (price bid) include compensation for certain work or material essential to the item, this same work or material will not also be measured for payment under any other Contract item which may appear elsewhere in the Contract, Drawings, or specifications.

No separate payment will be made for facilities or operations not listed in the Bill of Quantities. The costs of the unlisted items shall be included in the Contract prices for relevant items of works.

1.2.3 Partial Payment

Partial payments will be made at least once each month as the work progresses. Said payments will be based upon estimates prepared by the Engineer of the value of the work performed and materials complete in place in accordance with the contract, plans, and specifications.

1.2.4 Acceptance and Final Payment

When the contract work has been accepted in accordance with Clause 60.5 of the Conditions of Contract, the Engineer will prepare the final estimate of the items of work actually performed. The Contractor shall approve the Engineer's final estimate or advise the Engineer of his/her objections to the final estimate which are based on disputes in measurements or computations of the final quantities to be paid under the contract as amended by change order or supplemental agreement.

SECTION 1.3 ACCEPTANCE AND EVALUATION OF THE WORKS

Once the works have been entirely completed, the proper inspections must be made to determine whether each category meets the "Standards for Completion of Work" of Chapter 3 of the "Compression Acceptance Inspection for Standard Civil Works of the Ministry of Construction."

The inspection of the works shall follow the Contract Documents, the instructions made by the Engineer, and the detailed completion documentation submitted by the Contractor.

After inspection of the works is completed, the Contractor shall notify the Engineer in writing to that effect, and the Engineer shall after receiving the notification determine those sections that have been completed through inspections made in accordance with prescribed procedures.

CHAPTER 2 EARTHWORK

SECTION 2.1 STRIPPING AND LEVELING

2.1.1 Description

This item shall consist of stripping of topsoil including disposal of materials, leveling for unpaved areas, formation of subgrade for pavement areas within the grading limits designated on the Drawings or as required by the Engineer.

2.1.2 Construction Requirements

The areas to be paved shall be stripped of all topsoil including till soil, humus, tree roots, mud, all vegetable growth such as brush, heavy sods, heavy growth of grass, decayed vegetable matter, rubbish, and any other unsuitable material. The topsoil shall be stripped at an uniform depth of 30 cm.

All spoil materials removed by stripping shall be disposed of by burning, when permitted by local laws, or by removal to approved disposal areas. In no case shall any discarded materials be left in windrows or piles adjacent to or within the airport limits. The manner and location of disposal of materials shall be subject to the approval of the Engineer and shall not create an unsightly or objectionable view. When the Contractor is required to locate a disposal area outside the airport property limits at his/her own expense, he shall obtain and file with the Engineer, permission in writing from the property owner for the use of private property for this purpose.

The removal of existing structure and utilities required to permit orderly progress of work shall be accomplished by local agencies, unless otherwise shown on the Drawings. Whenever a telephone or telegraph pole, pipeline, conduit, sewer, roadway, or other utility is encountered and must be removed or relocated the Contractor shall advise the Engineer who will notify the proper local authority or owner and attempt to secure prompt action.

All existing roads, irrigation canals and structures, unsuited soil for embankment or backfilling, tree roots, and brushes, etc., shall be removed, and transported to a designated spoil area.

All plants shall be removed from the unpaved area of the runway strip. Tree roots and grasses shall be removed even from sections where excavation is not required. The ground surface of the unpaved areas shall be cut and fill plus or minus 10 cm, and rolled.

The ground surface of the pavement areas shall be cut and fill plus or minus 10 cm, and compacted by rolling. The subgrade under areas to be paved shall be compacted

to a depth of 20 cm or more and to a density of not less than 87 percent of the maximum density as determined by ASTM [] or JTJ 051-93.

2.1.3 Measurement and Payment

a. Method of Measurement

The quantities of topsoil stripping as shown the Drawings or as ordered by the Engineer shall be the number of cubic meters of land specifically stripped.

The quantities of unpaved area leveling as shown the Drawings or as ordered by the Engineer shall be the number of square meters of land specifically leveled.

The quantities of pavement area subgrade formation as shown the Drawings or as ordered by the Engineer shall be the number of square meters of subgrade specifically formed.

b. Basis of Payment

Payment for topsoil stripping shall be made at the Contract unit price per cubic meter. This price shall be full compensation for stripping topsoil, moving, and disposing; and for furnishing all labor, equipment, tools, and incidentals necessary to complete the item.

Payment for unpaved area leveling shall be made at the Contract unit price per square meter. This price shall be full compensation for leveling and rolling ground surface; and for furnishing all labor, equipment, tools, and incidentals necessary to complete the item.

Payment for pavement area subgrade formation shall be made at the Contract unit price per square meter. This price shall be full compensation for leveling, rolling and compacting ground surface; and for furnishing all labor, equipment, tools, and incidentals necessary to complete the item.

Payment will be made under:

<u>Item No.</u>	<u>Description of Work</u>	<u>Unit of Measurement</u>
I-1-1	Topsoil stripping	cubic metre
I-1-2	Leveling and subgrade preparation	square metre

SECTION 2.2 EXCAVATION AND EMBANKMENT

2.2.1 Description

2.2-1.1 This item covers excavation, disposal, placement, and compaction of all materials within the limits of the work required to construct runway safety areas, runways, taxiways, aprons, and intermediate as well as other areas for drainage, building construction, parking, or other purposes in accordance with these specifications and in conformity to the dimensions and typical section shown on the Drawings.

2.2-1.2 **CLASSIFICATION.** All material excavated shall be classified as "unclassified" as defined below unless otherwise specified on the Drawings or by the Engineer.:

- a. **Unclassified Excavation.** Unclassified excavation shall consist of the excavation and disposal of all material, regardless of its nature, which is not otherwise classified and paid for under the following items.
- b. **Muck Excavation.** Muck excavation shall consist of the removal and disposal of deposits of mixtures of soils and organic matter not suitable for foundation material. Muck shall include materials which will decay or produce subsidence in the embankment. It may be made up of decaying stumps, roots, logs, humus, or other material not satisfactory for incorporation in the embankment.
- c. **Drainage Excavation.** Drainage excavation shall consist of all excavation made for the primary purpose of drainage and includes drainage ditches, such as masonry ditches, box culverts, U-shape ditches, regulating ponds, pump stations; temporary levee construction; or any other type as shown on the Drawings.
- d. **Borrow Excavation.** Borrow excavation shall consist of approved material required for the construction of embankment or for other portions of the work in excess of the quantity of usable material available from required excavations. Borrow material shall be obtained from areas within the limits of the airport property but outside the normal limits of necessary grading, or from areas outside the airport.

2.2-1.3 **Unsuitable Excavation.** Any material containing vegetable or organic matter, such as muck, peat, organic silt, or sod shall be considered unsuitable for use in embankment construction. Material, when approved by the Engineer as suitable to support vegetation, may be used on the embankment slope.

2.2.2 Construction Methods

2.2-2.1 **General.** Before beginning excavation, grading, and embankment operations in any area, the area shall be completely stripped and leveled in accordance with Section 2.1.

The suitability of material to be placed in embankments shall be subject to approval by the Engineer. All unsuitable material shall be disposed of in waste areas shown on the Drawings. All waste areas shall be graded to allow positive drainage of the area and of adjacent areas. The surface elevation of waste areas shall not extend above the surface elevation of adjacent usable areas of the airport, unless specified on the Drawings or approved by the Engineer.

When the Contractor's excavating operations encounter artifacts of historical or archaeological significance, the operations shall be temporarily discontinued. At the direction of the Engineer, the Contractor shall excavate the site in such a manner as to preserve the artifacts encountered and allow for their removal. Such excavation will be paid for as extra work.

Those areas outside of the pavement areas in which the top layer of soil material has become compacted, by hauling or other activities of the Contractor shall be scarified and disked to a depth of 10 cm, in order to loosen and pulverize the soil.

If it is necessary to interrupt existing surface drainage, sewers or under-drainage, conduits, utilities, or similar underground structures the Contractor shall be responsible for and shall take all necessary precautions to preserve them or provide temporary services. When such facilities are encountered, the Contractor shall notify the Engineer, who shall arrange for their removal if necessary. The Contractor shall, at his/her own expense, satisfactorily repair or pay the cost of all damage to such facilities or structures which may result from any of the Contractor's operations during the period of the Contract.

2.2-2.2 EXCAVATION. No excavation shall be started until the work has been staked out by the Contractor and the Engineer has obtained elevations and measurements of the ground surface. All suitable excavated material shall be used in the formation of embankment, subgrade, or for other purposes shown on the Drawings. All unsuitable material shall be disposed of as shown on the Drawings.

When the volume of the excavation exceeds that required to construct the embankments to the grades indicated, the excess shall be used to grade the areas of ultimate development or disposed of as directed. When the volume of excavation is not sufficient for constructing the fill to the grades indicated, the deficiency shall be obtained from borrow areas.

The grade shall be maintained so that the surface is well drained at all times. When necessary, temporary drains and drainage ditches shall be installed to intercept or divert surface water which may affect the work.

a. Selective Grading. When selective grading is indicated on the Drawings, the more suitable material as designated by the Engineer shall be used in constructing

the embankment or in capping the pavement subgrade. If, at the time of excavation, it is not possible to place this material in its final location, it shall be stockpiled in approved areas so that it can be measured for payment for rehandling as specified in paragraph 3.3.

- b. **Undercutting.** Rock, shale, hardpan, loose rock, boulders, or other material unsatisfactory for runway safety areas, subgrades, roads, shoulders, or any areas intended for turfing shall be excavated to a minimum depth of 30 cm, or to the depth specified by the Engineer, below the subgrade. Muck, peat, matted roots, or other yielding material, unsatisfactory for subgrade foundation, shall be removed to the depth specified. Unsuitable materials shall be disposed of at locations shown on the Drawings. This excavated material shall be paid for at the Contract unit price per cubic meter for unclassified excavation. The excavated area shall be refilled with suitable material, obtained from the grading operations or borrow areas and thoroughly compacted by rolling. The necessary refilling will constitute a part of the embankment.
- c. **Overbreak.** Overbreak, including slides, is that portion of any material displaced or loosened beyond the finished work as planned or authorized by the Engineer. The Engineer shall determine if the displacement of such material was unavoidable and his/her decision shall be final. All overbreak shall be graded or removed by the Contractor and disposed of as directed; however, payment will not be made for the removal and disposal of overbreak which the Engineer determines as avoidable.
- d. **Removal of Utilities.** The removal of existing structures and utilities required to permit the orderly progress of work will be accomplished by someone other than the Contractor, e.g., the utility unless otherwise shown on the Drawings. All existing foundations shall be excavated for at least 6 cm below the top of subgrade or as indicated on the Drawings, and the material disposed of as directed. All foundations thus excavated shall be backfilled with suitable material and compacted as specified herein.
- e. **Compaction Requirements.** The compaction depth and densities for the subgrade under areas to be paved shall be as follows unless otherwise specified on the Drawings.
- f. The compaction density for the soil in each of the blocks within the airside zone shall be as set forth in the following table.

Block			Depth Under Sub-base Course or Unpaved Section (cm)	Relative Density	
				Standard Compaction Method (%)	Heavy Compaction Method (%)
Pavement Area	Filling		Unrestricted	98	96
	Cut	Frozen Block	≥ 30		
		Unfrozen Block	≥ 15		
Non-Pavement Area	Fill	End Safety Non-Paved Block	Unrestricted	95	92
		Other Non-Paved Blocks		90	87
	Cut	End Safety Non-Paved Block	≥ 15	95	92
		Other Non-Paved Blocks		90	87

The in-place field density shall be determined in accordance with ASTM D 1556 or ASTM D 2167 or JTJ 051-93. Stones or rock fragments larger than 10 cm in their greatest dimension will not be permitted in top 15 cm of the subgrade. The finished grading operations, conforming to the typical cross section, shall be completed and maintained at least 1,000 feet (300 m) ahead of the paving operations or as directed by the Engineer.

In cuts, all loose or protruding rocks on the back slopes shall be bared loose or otherwise removed to line of finished grade of slope. All cut-and-fill slopes shall be uniformly dressed to the slope, cross section, and alignment shown on the Drawings or as directed by the Engineer.

2.2-2.3 BORROW EXCAVATION. Borrow area(s) within the airport property are indicated on the Drawings. Borrow excavation shall be made only at these designated locations and within the horizontal and vertical limits as staked or as directed.

When borrow sources are outside the boundaries of the airport property, it shall be the Contractor's responsibility to locate and obtain the supply, subject to the approval of the Engineer. The Contractor shall notify the Engineer, at least 15 days prior to beginning the excavation, so necessary measurements and tests can be made. All unsuitable material shall be disposed of by the Contractor. All borrow pits shall be opened up to expose the vertical face of various strata of acceptable material to enable obtaining a uniform product. Borrow pits shall be excavated to regular lines to permit accurate measurements, and they shall be drained and left in a neat, presentable condition with all slopes dressed uniformly.

2.2-2.4 DRAINAGE EXCAVATION. Drainage excavation shall consist of excavating for drainage ditches such as masonry ditches, box culverts, U-shape ditches, regulating ponds, pump stations, for temporary levee construction; or for any other type as designed or as shown on the Drawings. The work shall be performed in the proper sequence with the other construction. All satisfactory material shall be placed in fills; unsuitable material shall be placed in waste areas or as directed. Intercepting ditches for temporary levee construction shall be constructed prior to starting adjacent excavation operations. All necessary work shall be performed to secure a finish true to line, elevation, and cross section.

The Contractor shall maintain ditches constructed on the project to the required cross section and shall keep them free of debris or obstructions until the project is accepted.

2.2-2.5 PREPARATION OF EMBANKMENT AREA. Where an embankment is to be constructed, all sod and vegetable matter shall be removed from the surface upon which the embankment is to be placed, and the cleared surface shall be completely broken up by plowing or scarifying to a minimum depth of 15 cm. This area shall then be compacted as indicated in paragraph 2.6.

Where embankments are to be placed on natural slopes steeper than 3H to 1V, horizontal benches shall be constructed as shown on the Drawings.

No direct payment shall be made for the work performed under this section. The necessary stripping and leveling and the quantity of excavation removed will be paid for under the respective items of work.

2.2-2.6 FORMATION OF EMBANKMENTS. Embankments shall be formed in successive horizontal layers of not more than 20 cm in loose depth for the full width of the cross section, unless otherwise approved to the Engineer.

The grading operations shall be conducted, and the various soil strata shall be placed, to produce a soil structure as shown on the typical cross section or as directed. Materials such as brush, hedge, roots, stumps, grass and other organic matter, shall not be incorporated or buried in the embankment.

Operations on earthwork shall be suspended at any time when satisfactory results cannot be obtained because of rain, freezing, or other unsatisfactory conditions of the field. The Contractor shall drag, blade, or slope the embankment to provide proper surface drainage.

The material in the layer shall be within plus or minus 2 percent of optimum moisture content before rolling to obtain the prescribed compaction. In order to achieve a uniform moisture content throughout the layer, wetting or drying of the material and manipulation shall be required when necessary. Should the material be too wet to permit proper compaction or rolling, all work on all of the affected portions

of the embankment shall be delayed until the material has dried to the required moisture content. Sprinkling of dry material to obtain the proper moisture content shall be done with approved equipment that will sufficiently distribute the water. Sufficient equipment to furnish the required water shall be available at all times. Samples of all embankment materials for testing, both before and after placement and compaction, will be taken for each 30 cubic meters of materials placed per layer. Based on these tests, the Contractor shall make the necessary corrections and adjustments in methods, materials or moisture content in order to achieve the correct embankment density.

Rolling operations shall be continued until the embankment is compacted to not less than 95 percent of maximum density for noncohesive soils, and 90 percent of maximum density for cohesive soils as determined by ASTM D 698 or JTJ 051-93. Under all areas to be paved, the embankments shall be compacted to a depth of 15 cm and to a density of not less than 96 percent of the maximum density as determined with heavy compaction method by JTJ 051-93.

On all areas outside of the pavement areas, no compaction will be required on the top 10 cm.

The in-place field density shall be determined in accordance with ASTM D 1556 or ASTM D 2167 or JTJ 051-93.

Compaction areas shall be kept separate, and no layer shall be covered by another until the proper density is obtained.

During construction of the embankment, the Contractor shall route his/her equipment at all times, both when loaded and when empty, over the layers as they are placed and shall distribute the travel evenly over the entire width of the embankment. The equipment shall be operated in such a manner that hardpan, cemented gravel, clay, or other chunky soil material will be broken up into small particles and become incorporated with the other material in the layer.

In the construction of embankments, layer placement shall begin in the deepest portion of the fill; as placement progresses, layers shall be constructed approximately parallel to the finished pavement grade line.

When rock and other embankment material are excavated at approximately the same, time, the rock shall be incorporated into the outer portion of the embankment and the other material shall be incorporated under the future paved areas. Stones or fragmentary rock larger than 10 cm in their greatest dimensions will not be allowed in the top 15 cm of the subgrade. Rockfill shall be brought up in layers as specified or as directed and every effort shall be exerted to fill the voids with the finer material forming a dense, compact mass. Rock or boulders shall not be disposed

of outside the excavation or embankment areas, except at places and in the manner designated by the Engineer.

When the excavated material consists predominantly of rock fragments of such size that the material cannot be placed in layers of the prescribed thickness without crushing, pulverizing or further breaking down the pieces, such material may be placed in the embankment as directed in layers not exceeding 60 cm in thickness. Each layer shall be leveled and smoothed with suitable leveling equipment and by distribution of spalls and finer fragments of rock. These type lifts shall not be constructed above an elevation 120 cm below the finished subgrade. Density requirements will not apply to portions of embankments constructed of materials which cannot be tested in accordance with specified methods.

Frozen material shall not be placed in the embankment nor shall embankment be placed upon frozen material.

For the filling for the foundation in the soil ground it shall be sufficient to use borrow materials, excavated materials from the pavement area, topsoil, or soil excavated from other areas. If excavated materials are to be used for the filling, the materials shall first be dried in the sun, and must have the appropriate moisture content. Topsoil shall be used only for the layer down to 20 cm below the planning level. The topsoil shall not contain any clumps of tree roots, grass or leaves, and shall not contain any roots, stems or leaf particles longer than 15 cm. Excavated materials and topsoil shall not be used as filling for the access road (including the shoulder) for the airside, and the area within 5 m of either side of the access road.

Filling for the top 20 cm level of the soil ground shall be sandy soil or topsoil. It shall not be appropriate to use silt or sandy silt.

The filling compaction density for the foundation in the soil ground shall be at least 90%.

2.2-2.7 FINISHING AND PROTECTION OF SUBGRADE. After the subgrade has been substantially completed the full width shall be conditioned by removing any soft or other unstable material which will not compact properly. The resulting areas and all other low areas, holes or depressions shall be brought to grade with suitable select material. Scarifying, blading, rolling and other methods shall be performed to provide a thoroughly compacted subgrade shaped to the lines and grades shown on the Drawings.

Grading of the subgrade shall be performed so that it will drain readily. The Contractor shall take all precautions necessary to protect the subgrade from damage. He/she shall limit hauling over the finished subgrade to that which is essential for construction purposes.

All ruts or rough places that develop in a completed subgrade shall be smoothed and recompact.

No subbase, or surface course shall be placed on the subgrade until the subgrade has been approved by the Engineer.

2.2-2.8 HAUL. All hauling will be considered a necessary and incidental part of the work. Its cost shall be considered by the Contractor and included in the Contract unit price for the pay of items of work involved. Payment will be made separately or directly for hauling on the materials onsite or delivering and hauling them to a specified stockyard.

2.2-2.9 TOLERANCES. In those areas upon which a subbase or base course is to be placed, the top of the subgrade shall be of such smoothness that, when tested with a 4.8 m straightedge applied parallel and at right angles to the centerline, it shall not show any deviation in excess of 12 mm, or shall not be more than 15 cm from true grade as established by grade hubs or pins. Any deviation in excess of these amounts shall be corrected by loosening, adding, or removing materials; reshaping; and recompact by sprinkling and rolling.

On runway safety areas, intermediate and other designated areas, the surface shall be of such smoothness that it will not vary more than 3 cm from true grade as established by grade hubs. Any deviation in excess of this amount shall be corrected by loosening, adding or removing materials, and reshaping.

The compaction density must at all times meet the requirements of paragraph 2.2. The number of samples must meet the following requirements.

- a. Samples shall be taken from two locations every 1000 m² in the foundations for the drains and the border unpaved area.
- b. Samples of ditches, ponds, drains, mire and other irregularities in the foundations for drains and the border unpaved areas shall be taken every 200 m². One sample shall be taken for areas of less than 200 m².
- c. For other unpaved areas, samples shall be taken every 1000 m² for each layer. One sample shall be taken for areas of less than 1000 m².

A leveling apparatus shall be used for the finish height, and the margin for error shall be as set forth below:

- a. The margin for error in the drain foundation earthworks shall be no more than 2 or 3 cm in a mesh inspection of 10 m X 10 m.

- b. For other earthworks in the unpaved area, the margin for error shall be no more than 5 cm pursuant to the mesh inspection for each 20 m X 20 m.
- c. Care shall be taken so that within the margin of error for the finished height the slope of the finished surface does not contrast with the direction of the design slope. It shall not be permissible for the slopes to be reversed, or for shafts to be closed over.

The surface smoothness shall be inspected in all locations with a straight edge. Any voids shall conform with the following:

- a. For the drain foundation surfaces, any voids must be no more than 3 cm.
- b. For other unpaved areas any voids must not be any more than 5 cm.

2.2.3 Method of Measurement

- 2.2-3.1 The quantity of excavation to be paid for shall be the number of cubic meters measured in its original position.

Measurement shall not include the quantity of materials excavated without authorization beyond normal slope lines, or the quantity of material used for purposes other than those directed.

- 2.2-3.2 The quantity of cut-area compacting shall be paid for on the basis of the number of square meters measured in its final position.

- 2.2-3.3 Supply of borrow materials shall be paid for on the basis of the number of cubic meters measured in its original position at the borrow site.

- 2.2-3.4 The quantity of embankment to be paid for shall be the number of cubic meters measured in its final position.

- 2.2-3.5 For payment specified by the cubic meter, measurement for all excavation or embankment shall be computed by the average end area method. The end area is that bound by the original ground line established by field cross sections and the final theoretical pay line established by excavation or embankment cross sections shown on the Drawings, subject to verification by the Engineer. After completion of all excavation or embankment operations and prior to the placing of base or subbase material, the final excavation or embankment shall be verified by the Engineer by means of field cross sections taken randomly at intervals not exceeding 150 meters.

2.2.4 Basis of Payment

- 2.2-4.1 For Excavation of soil including hauling to fill area by dump trucks, payment shall be made at the Contract unit price per cubic meter. This price shall be full compensation for excavating, moving, hauling and disposing materials, and for furnishing all labor, equipment, tools, and incidentals necessary to complete the item.
- 2.2-4.2 For "Excavation and hauling by motor scrapers" payment shall be made at the Contract unit price per cubic meter. This price shall be full compensation for excavating, hauling up to 500 m, and depositing or disposing materials with motor scrapers, and for furnishing all labor, equipment, tools, and incidentals necessary to complete the item.
- 2.2-4.3 For "Cut-area compacting" payment shall be made at the Contract unit price per square meter. This price shall be full compensation for spreading and water materials, rolling and compacting to the density specified; and for furnishing all labor, equipment, tools, and incidentals necessary to complete the item.
- 2.2-4.4 For "Embankment" payment shall be made at the Contract unit price per cubic meter. This price shall be full compensation for spreading and rolling materials and compacting to the density specified; and for furnishing all labor, equipment, tools, and incidentals necessary to complete the item.
- 2.2-4.5 For "Supply of soft ground improvement materials" payment shall be made at the Contract unit price per cubic meter. This price shall be full compensation for furnishing all materials and for delivering and depositing at stockyard; and for all labor, equipment, tools, and incidentals necessary to complete the item.
- 2.2-4.6 For "Supply of materials pumped up from Yangzi river" payment shall be made at the Contract unit price per cubic meter. This price shall be full compensation for pumping up all materials and for hauling to stockyard; and for all labor, equipment, tools, and incidentals necessary to complete the item.

Payment will be made under:

<u>Item No.</u>	<u>Description of Work</u>	<u>Unit of Measurement</u>
I-1-3	Cut-Area compacting (relative density 90%)	square metre
	Cut-Area compacting (relative density 95%)	square metre
I-1-4	Excavation of soil including hauling to fill area by scrapers (S=0-500 m)	cubic metre
I-1-5	Excavation of soil including hauling to fill area by dump trucks (S=500-1,000 m)	cubic metre
I-1-6	Excavation of soil including hauling to fill area by dump trucks (S=1,000-2,000 m)	cubic metre
I-1-7	Embankment (relative density 90%)	cubic metre

I-1-8	Embankment (relative density 95%)	cubic metre
	Soft ground improvement embanking materials	cubic metr
I-9-1	Materials pumped up from Yangzi River	cubic metre

SECTION 2.3 Treatment of Existing Channels

2.3.1 Description

This item consists of sludge dredging, bench-cutting, sand bedding and backfilling or embankment for existing water channels located within the pavement area; and only backfilling for other areas in accordance with these Specifications, and to the lines, levels, grades, dimensions and cross-sections as shown on the Drawings, and as directed by the Engineer.

2.3.2 Materials

Materials for sand bedding shall consist of middle course sand all of which passes a 9.5 mm sieve and not more than 10 percent of which passes a 0.3 mm sieve. The middle course sand shall be used with less than 3% mud content. The sand for bedding shall meet the requirements of JT 1003-66.

2.3.3 Construction Requirements

a. Sludge Dredging

Levees shall be built, and the water shall be drained from the channel. All sludge shall be dredged completely, and the inside of the water channel shall be dried out.

Any stagnant water, mud, and topsoil mixed with grass shall be completely removed down to the original foundation for large ponds and water channels and drains within the area for the foundation work for drains. After excavating the surrounding area with a bench cut (at least 1V:1H), the old foundation shall be compacted as stated in the specified compacting requirements. If compacting cannot be performed because a pond is too deep, the groundwater is too high, or the soil is too soft, stones shall first be placed within the problem area. Then the area shall be rolled and stabilized, following which fill shall be added for each layer, and the area shall be compacted to the height of the original base.

For comparatively small ditches, holes and channels, the mud, grass and other debris shall be excavated down to the level of the old foundation. A bench-cut shall then be made at height to width ratio of 1 V:2 H. Each layer shall then be backfilled, and compacted to the specified density.

b. Bench Cut Excavation

The bench cut shall be performed at a slope of 1V:2H. The bench-cut excavation shall conform to paragraph 2.2 of Section 2.2 of this Special Provision.

c. Sand Bedding

- (1) After excavation is completed and the Engineer approves excavated bottom condition, sand shall be placed to the dimensions shown on the Drawings, and then thoroughly rammed by mechanical rammer after sufficiently watering.

The minimum height of any material as placed shall be 7 cm as shown on the Drawings.

The complete surface shall then be thoroughly compacted to the satisfaction of the Engineer using a mechanical rammer or vibrating roller.

- (2) The sand mat density after compacting shall be mid-level.
- (3) The margin of error for the sand mat thickness shall be no more than 5 cm.

d. Backfilling or Embankment

Backfill for the existing channels that have been dug into the soil ground shall meet the following conditions:

- (1) Any standing water shall be drained prior to backfilling, and the mud shall be dried out in the open air. Levees shall be built as necessary, and the water channels within the site shall be isolated from the water channels outside of the site.
- (2) Backfilling of existing channels shall be performed in separate layers. When laying the backfilling layers, each layer of backfilling laid down shall not exceed 25 cm. The thickness of each layer shall be determined depending on the equipment used.
- (3) Borrow materials, excavated materials from the pavement area, topsoil, or soil and excavated materials from the other areas may be used for the backfilling. If excavated materials are to be used for the backfilling, the materials shall first be dried in the sun, and must have the appropriate moisture content. Topsoil shall be used only for the layer down to 0.8 m below the planning level. The topsoil shall not contain any clumps of tree roots, grass or leaves, and shall not contain any roots, stems or leaf particles

longer than 15 cm. Furthermore excavated materials and topsoil shall not be used to backfill existing channels in the following areas:

- (i) the area within 8 m from either side of the center line for the airside drainage channel; and
 - (ii) the access road (including the shoulder) for the airside, and the area within 5 m of either side of the access road.
- (3) The relative density for the backfill compaction shall be at least 90% of maximum dry density (using heavy compaction, with the same to apply hereinafter) for the unpaved area, and shall be at least 90% for the paved area.
- (4) If the natural gradient of the original base is 1 V : 10 H to 1 V : 5 H, the surface layer shall first be mixed and filled again. If the gradient is steep at 1 V : 5 H or greater, a bench cut shall be made at 1 V : 2 H. The top of the bench cut must be equivalent to the internal slope.
- e. Confirmation by On-site Survey

Although the locations of the water channels are indicated in the Drawings, these shall be confirmed by survey on-site.

f. Treatment of Underground Water Channels

Filling and bottom sludge shall be removed from the underwater channels, and these channels shall be treated in the same manner as the above-ground channels, as mentioned above.

2.3.4 Measurement and Payment

Method of Measurement

- a. The quantity of sludge dredging to be paid for shall be the number of cubic meters in its original position. Measurement shall be computed by the average end area method from the lines and grades before dredging, and the lines and grades for completion of dredging.
- b. The quantity of bench-cut excavation to be paid for shall be the number of cubic meters in its original position. Measurement shall be computed by the average end area method from the lines and grades before excavation, and the lines and grades for completed excavation as shown on the Drawings or as determined by the Engineer.

- c. The quantity of sand bedding to be paid for shall be the number of cubic meters in its final position. Measurement shall be computed by the net volume of required and accepted filling, actually constructed and completed in accordance with the Specification, to the lines, levels, grades and cross sections shown on the Drawings or as directed by the Engineer.
- d. The quantity of backfilling or excavation to be paid for shall be the number of cubic meters in its final position. Measurement shall be computed by the net volume of required and accepted filling, actually constructed and completed in accordance with the Specification, to the lines, levels, grades and cross sections shown on the Drawings or as directed by the Engineer.

Basis of Payment

- a. The payment for sludge dredging shall be made at the Contract unit price per cubic meter. The price shall be full compensation for construction of temporary dikes, dewatering, removal and disposal of the sludge, and for furnishing all labor, equipment, tools and incidentals necessary to complete the work.
- b. The payment for bench-cut excavation shall be made at the Contract unit price per cubic meter. The price shall be full compensation for excavation, shaping, and completion of surfaces and for furnishing all labor, equipment, tools and incidentals necessary to complete the work.
- c. The payment for sand bedding shall be made at the Contract unit price per cubic meter. The price shall be full compensation for placing, spreading, compacting of the materials, and for furnishing all materials, labor, equipment, tools and incidentals necessary to complete the work.
- d. The payment for backfilling or excavation shall be made at the Contract unit price per cubic meter. The price shall be full compensation for placing, spreading, compacting of the materials, and for furnishing all labor, equipment, tools and incidentals necessary to complete the work.

Payment shall be made under:

<u>Item No.</u>	<u>Description of Work</u>	<u>Unit of Measurement</u>
I-1-9-2	Sludge dredging	cubic metre
I-1-4,5,6	Bench-cut excavation	cubic metre
I-1-9-5	Middle coarse sand bedding (T 50 cm)	cubic metre
I-1-7	Backfilling or Embankment (relative density 90%)	cubic metre
I-1-8	Backfilling or Embankment (relative density 95%)	cubic metre

SECTION 2.4 RAM COMPACTION

2.4.1. Description

This item consists of slag or debris bedding, chip leveling and ram dropping in accordance with the Specification, and to the lines, levels, grades, dimensions and cross-sections as shown on the Drawings, and as directed by the Engineer.

2.4.2 Materials and Construction Requirements

a. Slag or Debris Bedding

Bedding shall be placed at one time. The thickness based on the results of the drop tests during the work, and the work itself, shall be adjusted taking into consideration an average foundation settling of 30 cm for the foundation height and subgrade height after spreading.

Slag shall be used as the bedding material for the main section of the runway and taxiway (hereinafter referred to as "Zone A"), and debris shall be used for the shoulder and overrun section.

For the slag bed, mixed slag shall be used with a maximum particle size of no more than 30 cm. Technical requirements shall conform with the Shanghai Standard Ground Treatment Code (DBJ08-40-94).

Gravel with a maximum particle size of no more than 20 cm shall be used for the debris bed. Gravel (> 2 mm) content shall be at least 50% of total mass, with mud constituting no more than 5% of total mass. The coefficient of uniformity should be $C_u \geq 5$, and the coefficient of curvature should be $C_c = 1 \sim 3$.

b. Ram Dropping

- (1) Ram dropping shall be conducted twice, once for the main drop and once for the finish drop. The finish drop shall take place at least 10 days and no more than 15 days after the main drop.
- (2) The main drop shall be performed in two stages. Dropping shall be performed at every other point for each line. The impact energy in the first drop stage shall be 1500 kN.m ~ 2000 kN.m, with 8~10 drops per point. The impact energy for the second stage of drops shall be 1500 kN.m ~ 2000 kN.m, with 6-8 drops per point. The drop pitch shall be 3.0 m ~ 3.5 m.

- (3) The standards for completing the main drop are as follows. The depth of the drop hole shall be 1.0 m ~ 1.2 m (to be determined depending on the conditions of each work zone). If the cumulative drop settling is less than 1.0 m ~ 1.2 m, the entire recommended number of drops shall be performed, and the dropping shall be finished if the cumulative drop settling has exceeded 1.0 m ~ 1.2 m. The average settling for the final two drops shall not exceed 5 ~ 10 cm.
- (4) The finish drop shall be performed in two stages. The first stage shall focus on intervals of four points or one point. The impact energy in the drop shall be 800 kN.m ~ 1200 kN.m, with 3 ~ 5 drops per point. The second finish drop shall be performed after the ground grading, at an impact energy of 500 kN.m ~ 800 kN.m, with 2 ~ 3 drops per point.
- (5) The second main drop shall be performed after 70% of the pore water pressure has been dispersed, or after an interval of at least 15 days. The drop holes created by the main drop shall be spread and graded 3 ~ 5 days prior to the finish drop. The chip screed layer shall be laid after at least 10 days have passed since the finish drop.
- (6) Location of drop points shall be accurately measured, with a margin of error of not more than 5 cm. Each drop point shall be set with a wood marker or with lime.
- (7) The designated drop energy shall be followed accurately for each point. Settlement and any unusual conditions shall be recorded for each drop.
- (8) If the drop points shift during the work process, the points shall be re-set.
- (9) If any distortion occurs during dropping, the cause shall be determined, and immediate adjustments shall be made. Dropping shall be recommenced after spreading and grading the holes flat.
- (10) Any water standing in the drop piles shall be removed immediately. If the groundwater level has a material effect on the work, the proper lowering or draining measures shall be taken.
- (11) Round iron weights with air pores (or concrete weights coated with iron) shall be used to resolve problems of energy loss and shifting off the designated point of contact with the ground.
- (12) After completion of the main drop and the finish drop, the foundation height shall be measured after grading with a 20 m X 20 m mesh.

c. Chip Leveling

- (1) After grading, a chip layer shall be laid with 0 cm ~ 10 cm crushed chips. Mud content shall be less than 5%, and water shall be dispersed at the time of rolling. Roll with a 12 ton tire roller until the surface is flat, hard and stable, and until the roller leaves no tracks.
- (2) The height after rolling and screeding shall be measured using a level and a 10 m x 10 m mesh. This shall vary by no more than +2 or -3. In the event of any differences in height, care shall be taken that the slope direction on the completed surface does not reverse the planned slope, and that there is no reverse sloping or closed depressions.
- (3) The surface smoothness shall be measured at selected locations using a 3 m straight-edge. Voids shall not exceed 3 cm.

2.4.3 Tests and Inspections

a. Types of Tests

Tests shall consist of a laboratory soil test, a standard penetration test, a static sounding test, a dry bed density test, a bearing capacity coefficient test, and a field CBR test. Quantities, locations and specifications are as indicated in the Drawings.

b. Measurement and Settlement

- (1) Measurements shall consist of surface layer settling, and settling measurements for each layer. Quantities and specifications are as indicated in the Drawings.
- (2) The average drop settling for the ram drop surface shall be at least 30 cm and not less than 28 cm.

c. Verification of Ram Drop Bed

- (1) The dry density of the ram drop beds (slag and debris) in each zone after rolling and grading shall be $(\gamma_d) \geq 1.9 \text{ g / cm}^3$.
- (2) The average bearing capacity coefficient in Zone A shall be at least 50 MN / m³. The minimum coefficient at the drop points shall be at least 40 MN / m³, and the minimum coefficient between points shall be no less than 30 MN / m³.

- (3) The average bearing capacity coefficient in Zone B shall be 40 MN / m³, and the minimum coefficient shall be no less than 30 MN / m³.

d. Inspection of Bedding Foundation

- (1) Static Sounding (within 5 m below the bed bottom surface)

The average penetration resistance shall be at least 3 Mpa in Zone A. The minimum resistance shall be 2 Mpa in Zone A and the average penetration resistance shall be 2 Mpa in Zone B.

- (2) Standard Penetration Test (within 5 m below the bed bottom surface)

The average values for the number of standard penetration impacts shall be at least 8 times for Zone A, and a minimum of 6 times. The number of penetration impacts for Zone B shall be an average minimum of 6 times.

e. Testing Requirements

- (1) Static sounding shall be the main test for the bedding foundation, and the standard resistance test shall serve a checking function.
- (2) The bedding tests shall be conducted after the finish drop, laying the chip screed layer, and after rolling so that the surface is flat, compact, stable and no tire tracks can be seen. First the compacting shall be tested, and if the bedding meets the requirements, then the bearing capacity shall be tested.
- (3) If the inspection results do not meet the requirements, check again in at least two surrounding locations. If the results of the second inspection meet the requirements, then the initial inspection location shall be redone so that it meets the requirements. If the second inspection results do not meet the requirements, measures shall be taken such as are necessary to improve the entire area within the scope of the inspection.
- (4) Care shall be taken that the surface after improvement is not damaged during inspection by frequent use of heavy equipment as reaction devices.

f. Supporting Measures

The contractor shall perform such supporting measures as are necessary for the ram dropping to obtain a certain level of consistency for the bedding and to improve strength between drop locations, after obtaining the consent of the Engineer and at the liability and expense of the contractor.

2.4.4 Measurement and Payment

Method of Measurement

- a. The quantity of slag bedding to be paid for shall be the number of cubic meters in its final position. Measurement shall be computed by the net volume of required and accepted filling, actually constructed and completed in accordance with the Specification, to the lines, levels, grades and cross sections shown on the Drawings or as directed by the Engineer.
- b. The quantity of debris bedding to be paid for shall be the number of cubic meters in its final position. Measurement shall be computed by the net volume of required and accepted filling, actually constructed and completed in accordance with the Specification, to the lines, levels, grades and cross sections shown on the Drawings or as directed by the Engineer.
- c. The quantity of ram dropping to be paid for shall be the number of square meters of the area actually compacted. Measurement shall be computed by the net area actually compacted in accordance with the Specification, to the lines, levels, grades and cross sections shown on the Drawings or as directed by the Engineer.
- d. The quantity of chip leveling to be paid for shall be the number of square meters of the materials as in place, completed and accepted.

Basis of Payment

- a. The payment for slag bedding shall be made at the Contract unit price per cubic meter. The price shall be full compensation for placing, spreading, compacting of the materials, and for furnishing all materials, labor, equipment, tools and incidentals necessary to complete the work.
- b. The payment for debris bedding shall be made at the Contract unit price per cubic meter. The price shall be full compensation for placing, spreading, compacting of the materials, and for furnishing all materials, labor, equipment, tools and incidentals necessary to complete the work.
- c. The payment for ram dropping shall be made at the Contract unit price per square meter. The price shall be full compensation for main and finish drops, and for furnishing all labor, equipment, tools and incidentals necessary to complete the work.
- d. The payment for chip leveling shall be made at the Contract unit price per square meter. The price shall be full compensation for leveling, rolling, and

screeding of the materials, and for furnishing all materials, labor, equipment, tools and incidentals necessary to complete the work.

- e. No separate measurement or payment will be made for tests and inspections for the ram drop compacting. All costs for these items shall be considered to be included in the applicable prices quoted for the items below.

Payment shall be made under:

<u>Item No.</u>	<u>Description of Work</u>	<u>Unit of Measurement</u>
I-1-9	Ram Compaction	
3)	Slag bedding (T 80 cm)	cubic metre
4)	Debris bedding (T 80 cm)	cubic metre
7)	Ram dropping	square metre
6)	Chip leveling	square metre

SECTION 2.5 SODDING AND SEEDING

2.5.1 Description

- 2.5-1.1 This item shall consist of sodding and seeding the areas in accordance with these specifications at the locations shown on the Drawings or as directed by the Engineer.
- 2.5-1.2 Planting around the runway and taxiways will be 100 % sodded for 2 meters from the shoulder edge, and 50 % sodded for 3 meters beyond the 100 % sodded zones to avoid the effect of jet blast. The areas around roads and drainage channels will be also 100 % sodded.
- 2.5-1.3 The areas other than sodded areas will be seeded to protect the landscaped surfaces from rain and wind erosion.

2.5.2 Materials

- 2.5-2.1 **SOD.** Sod furnished by the Contractor shall have a good cover of living or growing grass. This shall be interpreted to include grass that is seasonally dormant during the cold or dry seasons and capable of renewing growth after the dormant period. All sod shall be obtained from areas where the soil is reasonably fertile and contains a high percentage of loamy topsoil. Sod shall be cut or stripped from living, thickly matted turf relatively free of weeds or other undesirable foreign plants, large stones, roots, or other materials which might be detrimental to the development of the sod or to future maintenance. At least 70% of the plants in the cut sod shall be composed of the species stated in the special provisions, and any vegetation more than 150 mm in height shall be mowed to a height of 75 mm or less before sod is lifted. Sod, including the soil containing the roots and the plant growth showing above, shall be cut uniformly to a thickness not less than that stated in the special provisions.
- 2.5-2.2 **SEED** Seed shall conform to the requirements of GB [] .Seeding dates, species and seeding rates shall be decided considering local conditions and soil conditons.

Seed shall be furnished separately or in mixtures in standard containers with the seed name, lot number, net weight, percentages of purity and of germination and hard seed, and percentage of maximum weed seed content clearly marked for each kind of seed. The Contractor shall furnish the Engineer duplicate signed copies of a statement by the vendor certifying that each lot of seed has been tested by a recognized laboratory for seed testing within 6 months of date of delivery. This statement shall include: name and address of laboratory, date of test, lot number for each kind of seed, and the results of tests as to name, percentages of purity and of germination, and percentage of weed content for each kind of seed furnished, and, in case of a mixture, the proportions of each kind of seed.

Seeds shall be applied as follows:

Seed	Minimum Seed Purity (Percent)	Minimum Germination (Percent)	Rate of Application liter / square meter
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Seeding shall be performed during the period between [] and [] inclusive, unless otherwise approved by the Engineer.

2.5-2.3 LIME. Lime shall be ground limestone containing not less than 85% of total carbonates, and shall be ground to such fineness that 90% will pass through a No. 20 mesh sieve and 50% will pass through a No. 100 mesh sieve. Coarser material will be acceptable, providing the rates of application are increased to provide not less than the minimum quantities and depth specified in the special provisions on the basis of the two sieve requirements above.

Dolomitic lime or a high magnesium lime shall contain at least 10% of magnesium oxide. Lime shall be applied at the rate of []. All liming materials shall conform to the requirements of ASTM C 602 or GB [].

2.5-2.4 FERTILIZER. Fertilizer shall be standard commercial fertilizers supplied separately or in mixtures containing the percentages of total nitrogen, available phosphoric acid, and water-soluble potash. They shall be applied at the rate and to the depth specified herein, and shall meet the requirements of GB [] and applicable state laws. They shall be furnished in standard containers with name, weight, and guaranteed analysis of contents clearly marked thereon. No cyanamide compounds or hydrated lime shall be permitted in mixed fertilizers.

The fertilizers may be supplied in one of the following forms:

- a. A dry, free-flowing fertilizer suitable for application by a common fertilizer spreader;
- b. A finely-ground fertilizer soluble in water, suitable for application by power sprayers; or
- c. A granular or pellet form suitable for application by blower equipment.

Fertilizers shall be [] commercial fertilizer and shall be spread at the rate of [].

2.5-2.5 WATER. The water shall be sufficiently free from oil, acid, alkali, salt, or other harmful materials that would inhibit the growth of grass. It shall be subject to the approval of the Engineer prior to use.

2.5-2.6 OIL FOR REPAIRS. The soil for fill and top-oiling of areas to be repaired shall be at least of equal quality to that which exists in areas adjacent to the area to be repaired. The soil shall be relatively free from large stones, roots, stumps, or other materials that will interfere with subsequent sowing of seed, compacting, and establishing turf, and shall be approved by the Engineer before being placed.

2.5.3 Construction Methods for Sodding

2.5-3.1 GENERAL. Areas to be solid, strip, or spot sodded shall be shown on the Drawings. Areas requiring special ground surface preparation such as tilling and those areas in a satisfactory condition which are to remain undisturbed shall also be shown on the Drawings.

Suitable equipment necessary for proper preparation of the ground surface and for the handling and placing of all required materials shall be on hand, in good condition, and shall be approved by the Engineer before the various operations are started. The Contractor shall demonstrate to the Engineer before starting the various operations that the application of required materials will be made at the specified rates.

2.5-3.2 PREPARING THE GROUND SURFACE. After grading of areas has been completed and before applying fertilizer and limestone, areas to be sodded shall be raked or otherwise cleared of stones larger than 50 mm in any diameter, sticks, stumps, and other debris which might interfere with sodding, growth of grasses, or subsequent maintenance of grass-covered areas.

If any damage by erosion or other causes occurs after grading of areas and before beginning the application of fertilizer and ground limestone, the Contractor shall repair such damage. This may include filling gullies, smoothing irregularities, and repairing other incidental damage.

2.5-3.3 APPLYING FERTILIZER AND GROUND LIMESTONE. Following ground surface preparation, fertilizer shall be uniformly spread at a rate which will provide not less than the minimum quantity of each fertilizer ingredient, as stated in the special provisions. If use of ground limestone is required, it shall then be spread at a rate which will provide not less than the minimum quantity stated in the special provisions. These materials shall be incorporated into the soil to a depth of not less than 50 mm by discing, raking, or other methods acceptable to the Engineer. Any stones larger than 50 mm in any diameter, large clods, roots, and other litter brought to the surface by this operation shall be removed.

2.5-3.4 OBTAINING AND DELIVERING SOD. After inspection and approval of the source of sod by the Engineer, the sod shall be cut with approved sod cutters to such a thickness that after it has been transported and placed on the prepared bed, but before it has been compacted, it shall have a uniform thickness of not less than 50 mm. Sod sections or strips shall be cut in uniform widths, not less than 250 mm, and in lengths of not less than 45 cm, but of such length as may be readily

lifted without breaking, tearing, or loss of soil. Where strips are required, the sod must be rolled without damage with the grass folded inside. The Contractor may be required to mow high grass before cutting sod.

The sod shall be transplanted within 24 hours from the time it is stripped, unless circumstances beyond the Contractor's control make storing necessary. In such cases, sod shall be stacked, kept moist, and protected from exposure to the air and sun and shall be kept from freezing. Sod shall be cut and moved only when the soil moisture conditions are such that favorable results can be expected. Where the soil is too dry, permission to cut sod may be granted only after it has been watered sufficiently to moisten the soil to the depth the sod is to be cut.

- 2.5-3.5 **LAYING SOD.** Sodding shall be performed only during the seasons when satisfactory results can be expected. Frozen sod shall not be used and sod shall not be placed upon frozen soil. Sod may be transplanted during periods of drought with the approval of the Engineer, provided the sod bed is watered to moisten the soil to a depth of at least 100 mm immediately prior to laying the sod.

The sod shall be moist and shall be placed on a moist earth bed. pitch forks shall not be used to handle sod, and dumping from vehicles shall not be permitted. The sod shall be carefully placed by hand, edge to edge and with staggered joints, in rows at right angles to the slopes, commencing at the base of the area to be sodded and working upward. The sod shall immediately be pressed firmly into contact with the sod bed by tamping or rolling with approved equipment to provide a true and even surface, and insure knitting without displacement of the sod or deformation of the surfaces of sodded areas. Where the sod may be displaced during sodding operations, the workmen when replacing it shall work from ladders or treaded planks to prevent further displacement. Screened soil of good quality shall be used to fill all cracks between sods. The quantity of the fill soil shall not cause smothering of the grass. Where the grades are such that the flow of water will be from paved surfaces across sodded areas, the surface of the soil in the sod after compaction shall be set approximately 25 mm below the pavement edge. Where the flow will be over the sodded areas and onto the paved surfaces around manholes and inlets, the surface of the soil in the sod after compaction shall be placed flush with pavement edges.

- 2.5-3.6 **WATERING.** Adequate water and watering equipment must be on hand before sodding begins, and sod shall be kept moist until it has become established and its continued growth assured. In all cases, watering shall be done in a manner which will avoid erosion from the application of excessive quantities and will avoid damage to the finished surface.

- 2.5-3.7 **ESTABLISHING TURF.**

- a. **General.** The Contractor shall provide general care for the sodded areas as soon as the sod has been laid and shall continue until final inspection and acceptance of the work.
- b. **Protection.** All sodded areas shall be protected against traffic or other use by warning signs or barricades approved by the Engineer.
- c. **Mowing.** The Contractor shall mow the sodded areas with approved mowing equipment, depending upon climatic and growth conditions and the needs for mowing specific areas. In the event that weeds or other undesirable vegetation are permitted to grow to such an extent that, either cut or uncut, they threaten to smother the sodded species, they shall be mowed and the clippings raked and removed from the area.

2.5-3.8 REPAIRING. When the surface has become bullied or otherwise damaged during the period covered by this Contract, the affected areas shall be repaired to re-establish the grade and the condition of the soil, as directed by the Engineer, and shall then be sodded as specified in 2.5-3.5.

2.5.4 Construction Methods for Seeding

2.5-4.1 ADVANCE PREPARATION AND CLEANUP. After grading of areas has been completed and before applying fertilizer and ground limestone, areas to be seeded shall be raked or otherwise cleared of stones larger than 50 mm in any diameter, sticks, stumps, and other debris which might interfere with sowing of seed, growth of grasses, or subsequent maintenance of grass-covered areas. If any damage by erosion or other causes has occurred after the completion of grading and before beginning the application of fertilizer and ground limestone, the Contractor shall repair such damage. This may include filling gullies, smoothing irregularities, and repairing other incidental damage.

An area to be seeded shall be considered a satisfactory seedbed without additional treatment if it has recently been thoroughly loosened and worked to a depth of not less than 125 mm as a result of grading operations and, if immediately prior to seeding, the top 75 mm of soil is loose, friable, reasonably free from large clods, rocks, large roots, or other undesirable matter, and if shaped to the required grade.

However, when the area to be seeded is sparsely sodded, weedy, barren and unworked, or packed and hard, any grass and weeds shall first be cut or otherwise satisfactorily disposed of, and the soil then scarified or otherwise loosened to a depth not less than 125 mm. Clods shall be broken and the top 75 mm of soil shall be worked into a satisfactory seedbed by discing, or by use of cultipackers, rollers, drags, harrows, or other appropriate means.

2.5-4.2 DRY APPLICATION METHOD.

- a. **Liming.** Lime shall be applied separately and prior to the application of any fertilizer or seed and only on seedbeds which have previously been prepared as described above. The lime shall then be worked into the top 75 mm of soil after which the seedbed shall again be properly graded and dressed to a smooth finish.
- b. **Fertilizing.** Following advance preparations and cleanup fertilizer shall be uniformly spread at the rate which will provide not less than the minimum quantity stated in paragraph 2.5-2.4.
- c. **Seeding.** Grass seed shall be sown at the rate specified in paragraph 2.5-2.2 immediately after fertilizing, and the fertilizer and seed shall be raked within the depth range stated in the special provisions. Seeds of legumes, either alone or in mixtures, shall be inoculated before mixing or sowing, in accordance with the instructions of the manufacturer of the inoculant. When seeding is required at other than the seasons shown on the Drawings or in the special provisions, a cover crop shall be sown by the same methods required for grass and legume seeding.
- d. **Rolling.** After the seed has been properly covered, the seedbed shall be immediately compacted by means of an approved lawnroller, weighing 60 to 97 kg per meter of width for clay soil (or any soil having a tendency to pack), and weighing 223 to 298 kg per meter of width for sandy or light soils.

2.5-4.3 WET APPLICATION METHOD.

- a. **General.** The Contractor may elect to apply seed and fertilizer (and lime, if required) by spraying them on the previously prepared seedbed in the form of an aqueous mixture and by using the methods and equipment described herein. The rates of application shall be as specified in the special provisions.
- b. **Spraying Equipment.** The spraying equipment shall have a container or water tank equipped with a liquid level gauge calibrated to read in increments not larger than 190 liters over the entire range of the tank capacity, mounted so as to be visible to the nozzle operator. The container or tank shall also be equipped with a mechanical power-driven agitator capable of keeping all the solids in the mixture in complete suspension at all times until used.

The unit shall also be equipped with a pressure pump capable of delivering 380 liters per minute at a pressure of 690 kPa. The pump shall be mounted in a line which will recirculate the mixture through the tank whenever it is not being sprayed from the nozzle. All pump passages and pipe lines shall be capable of providing clearance for 15 mm solids. The power unit for the pump and agitator shall have controls mounted so as to be accessible to the nozzle operator. There

shall be an indicating pressure gauge connected and mounted immediately at the back of the nozzle.

The nozzle pipe shall be mounted on an elevated supporting stand in such a manner that it can be rotated through 360 degrees horizontally and inclined vertically from at least 20 degrees below to at least 60 degrees above the horizontal. There shall be a quick-acting, three-way control valve connecting the recirculating line to the nozzle pipe and mounted so that the nozzle operator can control and regulate the amount of flow of mixture delivered to the nozzle. At least three different types of nozzles shall be supplied so that mixtures may be properly sprayed over distance varying from 6 to 30 m. One shall be a close-range ribbon nozzle, one a medium-range ribbon nozzle, and one a long-range jet nozzle. For ease of removal and cleaning, all nozzles shall be connected to the nozzle pipe by means of quick-release couplings.

In order to reach areas inaccessible to the regular equipment, an extension hose at least 15 m in length shall be provided to which the nozzles may be connected.

- c. Mixtures. Lime, if required, shall be applied separately, in the quantity specified, prior to the fertilizing and seeding operations. Not more than 100 kg of lime shall be added to and mixed with each 380 liters of water. Seed and fertilizer shall be mixed together in the relative proportions specified, but not more than a total of 100 kg of these combined solids shall be added to and mixed with each 380 liters of water.

All water used shall be obtained from fresh water sources and shall be free from injurious chemicals and other toxic substances harmful to plant life. Brackish water shall not be used at any time. The Contractor shall identify to the Engineer all sources of water at least 2 weeks prior to use. The Engineer may take samples of the water at the source or from the tank at any time and have a laboratory test the samples for chemical and saline content. The Contractor shall not use any water from any source which is disapproved by the Engineer following such tests.

All mixtures shall be constantly agitated from the time they are mixed until they are finally applied to the seedbed. All such mixtures shall be used within 2 hours from the time they were mixed or they shall be wasted and disposed of at locations acceptable to the Engineer.

- d. Spraying. Lime, if required, shall be sprayed only upon previously prepared seedbeds. After the applied lime mixture has dried, the lime shall be worked into the top 8 cm, after which the seedbed shall again be properly graded and dressed to a smooth finish.

Mixtures of seed and fertilizer shall only be sprayed upon previously prepared seedbeds on which the lime, if required, shall already have been worked in. The mixtures shall be applied by means of a high-pressure spray which shall always be directed upward into the air so that the mixtures will fall to the ground like rain in a uniform spray. Nozzles or sprays shall never be directed toward the ground in such a manner as might produce erosion or runoff.

Particular care shall be exercised to insure that the application is made uniformly and at the prescribed rate and to guard against misses and overlapped areas. Proper predetermined quantities of the mixture in accordance with specifications shall be used to cover specified sections of known area. Checks on the rate and uniformity of application may be made by observing the degree of wetting of the ground or by distributing test sheets of paper or pans over the area at intervals and observing the quantity of material deposited thereon.

On surfaces which are to be mulched as indicated by the Drawings or designated by the Engineer, seed and fertilizer applied by the spray method need not be raked into the soil or rolled. However, on surfaces on which mulch is not to be used, the raking and rolling operations will be required after the soil has dried.

- 2.5-4.4 **MAINTENANCE OF SEEDED AREAS.** The Contractor shall protect seeded areas against traffic or other use by warning signs or barricades, as approved by the Engineer. Surfaces gullied or otherwise damaged following seeding shall be repaired by regrading and reseeding as directed. The Contractor shall mow, water as directed, and otherwise maintain seeded areas in a satisfactory condition until final inspection and acceptance of the work.

When either the dry or wet application method outlined above is used for work done out of season, it will be required that the Contractor establish a good stand of grass of uniform color and density to the satisfaction of the Engineer. If at the time when the Contract has been otherwise completed it is not possible to make an adequate determination of the color, density, and uniformity of such stand of grass, payment for the unaccepted portions of the areas seeded out of season will be withheld until such time as these requirements have been met.

2.5.5 Method of Measurement

- 2.5-5.1 Sodding shall be measured on the basis of the area in square meters of the surface covered with sod and accepted.
- 2.5-5.2 The quantity of seeding to be paid for shall be the number of square meters measured on the ground surface, completed and accepted.

2.5.6 Basis of Payment

2.5-6.1 Payment for sodding shall be made at the Contract unit price per square meter for sodded area, which price shall be full compensation for all labor, equipment, material, staking, and incidentals necessary to satisfactorily complete the items as specified.

2.5-6.2 Payment for seeding shall be made at the Contract unit price per square meters, which price shall be full compensation for furnishing and placing all material and for all labor, equipment, tools, and incidentals necessary to complete the work prescribed in this item.

Payment will be made under:

<u>Item No.</u>	<u>Description of Work</u>	<u>Unit of Measurement</u>
I-1-10		
1)	Full (100%) sodding	square metre
2)	50% sodding	square metre
3)	Seeding	square metre