

ROYAL GOVERNMENT OF LAOS

VIENTIANE AIRPORT EXTENSION PROJECT-I

VOLUME II

GENERAL SPECIFICATIONS

DETAILED SPECIFICATIONS

FORM OF TENDER

June 1971

Nippon Koei Co., Ltd.

Consulting Engineers

Tokyo

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VIENTIANE AIRPORT EXTENSION PROJECT - II

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SECTION 4

GENERAL SPECIFICATIONS

## SECTION 4

### GENERAL SPECIFICATIONS

#### 4.1 - LOCATION AND DESCRIPTION OF THE PROJECT

##### 4.1.1 - Location

The site of the works is located approximately 3 kilometers northwest of Vientiane, Laos.

##### 4.1.2 - Description

Wattay Airport is an existing international airport with 3,000 m runway in Vientiane, which was extended under Extension project-I to accommodate modern ultrasonic jet planes. The full execution of Extension project-II for the existing airport will change this airport into a more complete international airport, equipped with two runway exit taxiways, extended parallel taxiway, expanded apron, improved fillet and lighting installation.

##### 4.1.3 - Principal Features of the Project

Principal features of the project and the structures to be built under these Specifications are as follows:

(a) Location:

Wattay Airport	Reference point	
	Latitude	17° 58' N
	Longitude	102° 35' E
	Elevation	
	Above sea level	170.0 m

(b) Principal features:

1. 2-Runway Exit Taxiways West & East sides, length 600 m each  
Width to be paved 23 m each
2. Extended Parallel Taxiway Length to be extended 440 m  
Width 22.825 m
3. Expanded Apron Expanded area 21,310 m<sup>2</sup>
4. Fillet Improvement Improved area 650 m<sup>2</sup>
5. Drainage
  - a) Concrete Box culvert No.1 1.2m x 0.8m x 114.0m
  - b) Concrete Box Culvert No.2 2 nos. x 1.6m x 0.6m x 52.86m
  - c) Concrete Box culvert No.3 1.0m x (0.838-0.844) m x 14.0m
  - d) Concrete "U" Type culvert 1.0m x (0.828-0.838) m x 23.5m
  - e) " " " " 1.0m x (0.844-0.905) m x 137.5m
6. Electrical facilities
  - a) Lighting equipment  
Taxiway edge lights 202 nos.  
Unserviceability lights 5 nos.  
Runway edge lights 9 nos.  
Alteration of the wind cone 1 set
  - b) Alteration of the flashing equipment for flashing beacon 1 set
  - c) Detour of the main cable duct and hand holes 500 m
  - d) Power receiving equipment 1 set

4.2 - SCOPE OF WORK

The work of the contract comprises the performance and completion of the project as stated below:

- a) Construction of concrete work for runway exit taxiway No.1 (17,446 m<sup>2</sup>), runway exit taxiway No.3 (17,445 m<sup>2</sup>), extended parallel taxiway (10,058 m<sup>2</sup>), expanded apron (21,310 m<sup>2</sup>), fillet improvement (650 m<sup>2</sup>) & sidewalk (220 m<sup>2</sup>).
- b) Construction of earth work for stripping of topsoil by dump truck and or carrier, cutting & filling, embankment with borrowing & sub-grading & compaction, base course with borrowing and grading & compaction, shoulder with sodding and graded approach area with seeding.

- c) Replacement with sand after removal of soft clay, for which is intended back filling with sand and satisfactory selected material.
- d) Drainage work for concrete box culvert No. 1 (New, 114 m) at runway exit taxiway No. 3, concrete box culvert No. 2 (Repair, 52.86 m) at access taxiway No. 4, concrete box culvert No. 3 (New, 14 m) at across under "Vehicle entrance" to expanded apron, "U" type concrete culvert with reinforced concrete cover (161 m) along edge of apron, and cutting or filling of earth open ditch (new and or existing ditch, 2,200 m<sup>3</sup>).
- e) Miscellaneous civil work for asphalt surfaced vehicle entrance, installation of distance sign board to 3,000 m existing runway, paint marking on concrete pavement of all taxiways, aprons and both over-run, and deforesting with grubbing (163,000 m<sup>2</sup>, thicket of assorted trees), removal of existing fence (75 m) in expanded apron area and existing pierced steel plank (landing mat, 40 m x 400 m) on extended parallel taxiway.
- f) Installation of electrical equipment for airport illumination for the existing apron, parallel taxiway, access taxiways No. 2 and No. 4, and that for extended apron, parallel taxiway, runway exit taxiways No. 1 and No. 3, both including taxiway edge lights, un-serviceability lights, and runway edge lights for the intersections between existing runway and new runway exit taxiways No. 1 and No. 3.
- g) Constructions of main cable ducts and hand holes, and installation of a flashing beacon and power receiving equipment.

The abovementioned work shall include the supply of all plant, materials, labour, electric energy and water supply for construction purpose, construction plant and equipment, small tools, contractor's camps including labour barracks, offices, stores, workshop, power transmission and distribution system for construction purpose, etc.

#### 4.3. - PLANT AND MATERIALS

The Contractor shall furnish all plant and materials required for the

completion of the Work. All plant and materials which form part of the work shall be new and shall conform to Japan Industrial Standards (JIS) or to standards as referred to elsewhere in these Specifications.

The Contractor shall obtain Engineer's prior approval in writing when he proposes to supply plant and materials conforming to other standards than the specified.

Plant and materials furnished by the Contractor, shall be subject to inspection in accordance with the provision of the Contract at any one or more of the following locations as determined by the Purchaser:

- a) the place of production or manufacture;
- b) the shipping point;
- c) the site

The Contractor shall submit to the Purchaser any information covering plant and materials required by the Purchaser for the purpose of inspection.

The inspection of plant and materials or the waiving of the inspection thereof shall in no way relieve the Contractor of the responsibility for furnishing plant and materials complying with these Specifications.

#### 4.4 - CONSTRUCTION PLANT AND EQUIPMENT

The Contractor shall provide all construction plant and equipment required for the efficient prosecution of the work within the period stated in the Tender and in accordance with the contract documents.

In particular, the Contractor shall provide all those items listed in the Construction Plant and Equipment Schedule in the Tender at the time stated therein or at such other time as may be deemed necessary in the opinion of the Engineer.

Construction plant and equipment shall not be moved from the Site without the written permission of the Engineer.

Construction plant and equipment may only be employed outside of the Site with the written permission of the Engineer.



The Engineer may, if it is considered necessary for the execution of the work in accordance with the Contract documents, instruct the Contractor to provide additional construction plant and equipment.

The Contractor shall maintain at the Site sufficient stock of spare parts to ensure the efficient performance of the work.

The cost for the construction plant and equipment as provided in the Schedule of Quantities and Prices shall cover the cost required to provide and retain at the Site during the construction and evacuate from the Site after completion of the work respectively assigned of all construction plant and equipment including those provided in accordance with the Construction Plant and Equipment Schedule, added by the direction of the Engineer, or provided by the Contractor's own consideration.

The cost to be incurred by keeping sufficient stock of spare parts at the Site shall also be included in the abovementioned cost.

#### 4.5 - ACCESS AND TRANSPORTATION

##### 4.5.1 - Access

The Contractor shall make all arrangements and pay all the necessary costs, duties and taxes required in respect of the transportation of plant, tools, materials, and personnel to Laos.

Access from Bangkok to Vientiane is possible by:

- (a) Air from Bangkok to Vientiane
- (b) Combined route of railway and public road to Nong Khai, by Mekong ferry from Nongkhai to Tha Deua or Tha Naleng, and by road from Tha Deua or Tha Naleng to Vientiane. Access to Nong Khai is also possible by air from Bangkok.

The distance from Vientiane to Wattay Airport is about 3 kilometers on the Route Nationale No. 13.

By the Government order in Thailand, all transit goods to Laos through Thailand are required to be transported exclusively by the

"EXPRESS TRANSPORTATION ORGANIZATION", one of the organizations authorized by the Thai Government.

#### 4.5.2 - Mekong Ferry

Ferry service is maintained throughout the year across the Mekong between Nong Khai (Thai side) and Tha Naleng (Laos side). The river at the ferry site is about 700 meters wide; the one-way trip by ferry boat takes 20 minutes. At present two ferry boats each having a capacity of 90 tons are being operated during working hours 8:30 - 12:00 and 13:00 - 16:00.

Usually, transit goods to Laos are transported by railway from Bangkok to Nong Khai, then ferried to Tha Naleng, all under the control of the Express Transportation Organization (ETO).

#### 4.5.3. - Tha Naleng-Vientiane

The road from Tha Naleng to Vientiane and the Route Nationale No. 13 to Wattay Airport are both asphalt paved. The existing bridges and culverts in this section have enough capacity to bear the heaviest load anticipated for this project.

#### 4.6.- CONSTRUCTION TIME SCHEDULE

A construction time schedule has been prepared by the Purchaser and indicated together with drawings.

This construction time schedule is shown to assist tenderers in preparing their own construction time schedule which shall be included in the tenders.

Within 15 days after the date of issue of letter of intent, the Contractor shall submit the detailed construction time schedule for the approval of the Engineer, and upon approval of the Engineer the said construction time schedule form a part of Contract documents and the completion date therein shall be taken as the completion date as defined in the General Conditions of this Contract.

#### 4.7 - ELECTRIC POWER FOR CONSTRUCTION PURPOSE

The supply of electric power for construction purpose including the use in the Contractor's camp shall be arranged by the Contractor. The Contractor may buy power from the Electricity du Laos (to be referred to as EDL hereinafter) or provide by himself engine generating equipment at the Site.

In the case of electric power supply from EDL, the supply end may be at the existing airport terminal building to where 6.6 KV transmission line (3-phase) is extended.

The means of electric power supply shall be to the Engineer's approval. All expenditures to be required in connection with the electric power supply for the construction purpose such as power and energy cost to be charged by EDL, fuel cost, labour cost, cost for providing and maintaining the extension of transmission lines, transformers, meters, switches, protective devices etc. or the generating equipment complete with accessories, foundation and housing shall be covered by the cost as provided in the Schedule of Quantities and Prices.

#### 4.8 - CONTRACTOR'S CAMP

The Contractor may select his camp area within the project area as shown on the drawings, subject to the approval of the Engineer, and use it free of charge during the Contract period.

The Contractor shall construct and maintain, at the cost as provided in the Schedule of Quantities and Prices, construction office, staff residences, labour barracks, stores, workshops, and other necessary buildings, water supply system, drainage and sewage system, road, fencing etc.

No water will be available at the Site, but it may be obtained from the city water supply of Vientiane at B. Sikhay, which is located 2.5 kilometers away from the Site.

All expenditures for the water supply such as supply and installation of branch valves, water tankers, elevated tanks and pumps if necessary, distribution pipes, water supply charge from the city etc, shall be covered by

cost as provided in the Schedule of Quantities and Prices.

Contractor's plan for his camp including the water supply system shall be subject to the approval of the Engineer.

#### 4.9 - BENCH MARKS

The Contractor shall relate all elevations of the Works to the elevation of the permanent bench marks, situated in the Meteorological Station near the Site, as shown on the drawings.

The Contractor may establish additional temporary bench marks for his own convenience but each temporary bench mark so established shall be of such design and location as approved by the Engineer.

#### 4.10 - MEASUREMENT

All measurements of the work for payment shall be performed by the Contractor in the presence of the Engineer's representative and submitted to the Engineer for his approval before any subsequent operations, which would prevent checking of the measurement by the Engineer, are performed. Failure on the part of the Contractor to conform to the above requirements shall be deemed sufficient cause for rejection or amendment of the Contractor's measurement by the Engineer.

The method of measurement to be employed for each classification of work in the Schedule of Quantities and Prices shall be as described under the corresponding clauses in the Detailed Specifications.

Where earth excavation is to be measured, cross section shall be taken after the initial clearing and grubbing operation.

Notwithstanding anything stated elsewhere in the Specifications no work shall be measured more than once for payment.

#### 4.11 - CONTRACT DRAWINGS

The following drawings accompany and form part of the Specifications for

the General Contract. The drawings have been reduced in size to allow presentation in book form.

<u>Drawing No.</u>	<u>Title</u>
<u>Civil Works</u>	
1	General site plan
2	Survey control layout plan with vicinity and location map
3-4	Detail site plan, runway exit taxiway No. 1 (A) - (B)
5	" " " " " " No. 3
6	" " " , extended parallel taxiway
7	" " " , expanded apron and fillet improvement
8	Profile, runway exit taxiway No. 1
9	" , " " " No. 3
10	" , extended parallel taxiway
11	" , expanded apron
12	Typical cross section, runway exit taxiway
13	" " , extended parallel taxiway
14	" " , expanded apron
15	" " , borrow and disposal area
16-17	Detail, distance sign board (1) - (2)
18	Civil miscellaneous detail
19	Marking
20-22	Cross Section, runway exit taxiway No. 1 (1) - (3)
23-25	" , " No. 3 (1) - (3)
26-31	" , extended parallel taxiway (1) - (6)
32-34	" , expanded apron (1) - (3)
35	" , fillet improvement
36-37	Drainage structure, box culvert No. 1 (1) - (2)
38-41	" , " No. 2 (1) - (4)
42-44	" , " No. 3 (1) - (3)
45-47	Portland cement concrete pavement, joint plan
48	" " " " , joint details
49	" " " " , parking tie-down & grounding anchor.

## Electrical Works

50	General arrangement of taxiway light
51	Detail arrangement of taxiway light (1)
52	Detail arrangement of taxiway light (2)
53	Detail arrangement of taxiway light (3)
54	Connection diagram
55	Sequence diagram for illumination
56	Layout of panel arrangement
57	Layout of power receiving equipment
58	Detail of wind cone
59	Detail of light base
60	Detail of handholes and cable ducts
61	Construction time schedule

#### 4.12 - COOPERATION FOR AIRCRAFT OPERATIONS UNDER CONSTRUCTION

All new facilities area shall be concerned with aircraft operations of the Royal Air Lao, Laos Air Forces and Air America in the present circumstances. The Contractor will be given consideration possible in regard to aircraft traffic under construction. The proposed all facilities area of this project and existing facilities area where the Contractor has working for all civil construction included paint marking, installation of distance sign boards and electrical installations, the Contractor shall be closed to aircraft traffic during indicated working period. However, it may be necessary to occasions to open the over-run, runway, aprons and taxiways on which under construction, at a very short notice, in order to permit an emergency landing or any other aircraft operations. If such cases should arise, the Contractor, upon being notified, shall immediately clear the all facilities of authorized personnel, equipment and materials. The Contractor shall take a conference with the authorities concerned of the aircraft operations, on the main point to keep a safety and schedule as conformable the construction time schedule.

All electrical works such as detour of the main cable duct and illumination works, etc. shall also be carefully executed by the Contractor's responsibilities not to affect the aircraft operations.

SECTION 5

DETAILED SPECIFICATIONS



## SECTION 5

### DETAILED SPECIFICATIONS

#### 5.1 - EARTHWORK

##### 5.1.1 - General

The work covered by this item of the specifications consists of furnishing all labor, equipment and materials, and performing all operations in connection with stripping of topsoil, excavation, embankment construction, including wetting or drying, compacting and other incidental operations pertaining to the construction of earthwork for two runway exit taxiways, extended parallel taxiway, expanded apron, fillet improvement and related facilities. All work shall be done in strict accordance with the drawings and these specifications, and as directed by the Engineer.

##### 5.1.2 - Preparatory Work

###### 5.1.2.1 - Preparatory Work

All field surveys necessary for the construction of the work and quantity measurement shall be done by the Contractor under direction of the Engineer. The cost of all field surveys, measurements, and setting of leading frames as similar devices done by the Contractor shall be considered incidental to any or all items of work and no direct payment will be made therefor.

Leading frames or similar devices shall be used as guides for smoothing and furnishing all cut and embankment lines, grades, and elevations. They shall be carefully set to accurate grade at 20 m or less intervals in general to insure the proper grade and finish.

#### 5.1.2.2 - Drainage

Before starting earthwork, any standing water in the embankment foundation areas shall be drained.

During construction, the contractor shall keep cut section and embankment in such a condition that it will be drained freely by means of temporary drainage facilities such as ditches, so that no water may be impounded.

The cost of temporary facilities constructed prior to or during the earthwork shall be considered incidental to any or all items of work and no direct payment will be made therefor.

#### 5.1.3 - Stripping of Top Soil

##### 5.1.3.1 - Stripping Operations

The Contractor shall strip top soil from excavation and embankment areas to the depth of 30 cm below the existing ground surface in general. Stripping of top soil shall be carefully done so as to remove undesirable materials to keep the soil surface free from roots, sticks, decayed vegetable matter, and other unsuitable debris.

Stripped top soil to spoil shall be removed from immediate area and be spread to about 30 cm thickness in the waste area in airport boundaries directed by the Engineer. Waste area shall be left in a smooth, neat and drainable condition, as directed by the Engineer.

Top soil for reuse on shoulder shall be stockpiled where it will not interfere with the work.

##### 5.1.3.2 - Measurement and Payment

Measurement for payment for stripping of top soil shall be made on the basis of volume in cubic meters upon completion of the stripping work approved by the Engineer. The rate tendered under this pay item shall be full compensation for furnishing all labor, equipment and materials, except as otherwise provided, necessary to complete the work including the removal of top soil, stockpiling of fertile soil for reuse, and disposal of removed material, in accordance with the drawings, specifications, and as directed by the Engineer.

PAY ITEM	UNIT OF MEASUREMENT
(1) Stripping of Top Soil	m <sup>3</sup>

5.1.4 - Removal of Soft clay and Replacement with Sand

5.1.4.1 - General and Replacing Operations

Soft clay, lying in the embankment foundation, shall be removed and be replaced with sand in accordance with the drawings, and as directed by the Engineer.

The Contractor shall remove it to the directed depth and haul to designated waste area in the airport boundary. Waste area shall be left as specified under "5.1.3.1".

Soft clay where lying under the excavation area shown on the drawings, and the Contractor shall immediately report to the Engineer, and shall dispose of it under the Engineer's strictly soil investigation for the embankment foundation.

When the excavation of soft clay has been completed as directed, the Contractor shall have the Engineer inspect the Site and obtain his approval before commencing backfilling.

The sand material, used for the replacement, shall be free from lumps and balls of clay, organic matter, and other undesirable matter, and be suitable for the purpose. The Contractor shall submit the sample with testing results to the Engineer for approval prior to use, as specified in subparagraph 5.3.2.4.

When ground water is impounded in the excavated portion, backfilling with sand shall be done after the water is drained out sufficiently. Replaced sand shall be compacted sufficiently not to cause future undesirable settlement.

5.1.4.2 - Measurement and Payment

Measurement for payment for the removal of soft clay shall be on the basis of volume in cubic meters of excavation completed and accepted in the work, and it for replacement shall be on the basis of volume in cubic meters of

replacement as shown on the drawings and as directed by the Engineer. Measurement of removal of soft clay and replacement with sand shall include the total volume of materials, computed by average end area method. When measurements can not be done by the above method, the volume of them will be measured as directed by the Engineer.

The rate tendered for the removal of soft clay shall be fully compensated for furnishing all equipment, materials and labor, except as otherwise provided, necessary to complete the work including excavating, loading, hauling, spreading in the designated or approved waste area, shaping and smoothing, and maintained this area in a neat, workmanlike, and drinable condition and other incidental items of work in accordance with the drawings, specification, and as directed by the Engineer.

The rate tendered for the replacement with sand shall be fully compensated for furnishing all equipment, materials and labor, except as otherwise provided, necessary to complete the work including placing, compacting finishing, and other incidental items of work necessary to complete the work in accordance with the drawings, specifications, and as directed by the Engineer.

PAY ITEM	UNIT OF MEASUREMENT
Removal of soft clay	m <sup>3</sup>
Replacement with sand	m <sup>3</sup>

#### 5.1.5 - Excavation

##### 5.1.5.1 - Excavation for Expanded Apron, and Other Facilities

Excavation shall be performed according to the drawings. Excavated or graded soil may be used as embankment material except soft clay or designated unsuitable material. Unsuitable material from excavation shall be removed to the waste area as directed by the Engineer.

In case the volume of the excavated soil exceeds the required volume for the embankment, the excess shall be hauled to the designated waste area in airport boundaries and spread there to about 30 cm thickness.

Waste area shall be left in smooth, neat and drainable condition, as directed by the Engineer.

During the process of excavation, the grade shall be maintained in such condition that it will be well drained at all times. Temporary drains and drainage ditches shall be installed to intercept or divert surface water which may hamper the execution or condition of the work.

Where soft clay or other material unsatisfactory for subgrade is encountered, it shall be excavated to a depth of at least 30 cm, or to such depth as may be directed by the Engineer, below the contemplated surface of the subgrade. Any excess depth so excavated shall be refilled with suitable material as indicated by the Engineer.

The Contractor shall make the excavation as indicated on the drawings. Widening or narrowing of the section and raising or lowering of the grade shall not be permitted. The Engineer will have the right to make minor adjustments or revisions in lines or grades, if found necessary, as the work progresses due to discrepancies in the drawings or for obtaining satisfactory construction.

#### 5.1.5.2 - Excavation of the Portion adjacent to Existing Pavement

Where new pavement work is adjacent to existing pavement which is to remain in use, the excavation shall be carefully done keeping the edges vertical so that the existing paving base is not weakened or undercut.

#### 5.1.5.3 - Ditch Excavation

Ditch excavation shall consist of excavating for permanent drainage ditches as shown on the drawings. The work shall be performed in proper sequence with other construction work. The excavated material may be used in fill except unsatisfactory material which is to be disposed of as directed. All work shall be performed to secure a finish true to line, elevation, and cross section as shown on the drawings.

#### 5.1.5.4 - Measurement and Payment

No direct payment will be made for excavation. However in case excavated materials exceed the required volume for the embankment, or are unsuitable

for embankment material, the excess will be measured and expenses of excavation and disposal shall be paid.

When excavation and embankment construction are completed in accordance with the drawings, specifications, and as directed by the Engineer, the volume of disposal in cubic meters will be measured by subtracting the embankment volume, measured as specified in subparagraph 5.1.6.4, from the total volume of excavation, computed by the average end area method, between the surfaces as established by initial and final cross section of the approved excavation. However, payment shall not be made for the excess excavated soil caused by over excavation.

The rate tendered for disposal of surplus soil shall fully compensate for furnishing all equipment, materials and labor, except as otherwise provided, necessary to complete the work including excavation, loading, hauling, placing, spreading in the designated or approved waste area, shaping and smoothing and maintenance of the areas in a neat, workman-like, and drainable condition and other incidental items of work in accordance with the drawings, specifications, and as directed by the Engineer.

PAY ITEM	UNIT OF MEASUREMENT
Disposal of surplus soil	m <sup>3</sup>

#### 5.1.6 - Embankment

##### 5.1.6.1 - Preparation of Embankment

All depressions or holes in the embankment areas shall be backfilled with suitable material and compacted to the ground surface before embankment.

##### 5.1.6.2 - Formation

Embankment shall be made of satisfactory materials, placed in successive

horizontal layers of not more than 20 cm in compacted depth for the full width of the cross sections and each layer shall be compacted to the specified density by the approved compaction equipment.

The grading operations shall be so conducted and various soil strata shall be placed so as to obtain sufficient soil structure to bear the load. All materials used for the embankment shall be reasonably free from organic matter such as leaves, grass, roots and other objectionable materials. Satisfactory material of extended parallel taxiway in 400 meters, already had been provided by other project, produced as the result of removal of the existing P.S.P. Landing mat is not intended in the work except compaction.

The operations of earthwork shall be suspended at any time when satisfactory result cannot to expect on account of rain or other unfavorable conditions. At all times, the Contractor shall be drag, blade, or slope the embankment to provide proper surface drainage.

#### 5.1.6.3 - Compaction of Embankment

##### (1) Compaction Criteria

Embankment materials within 30 cm below subgrade surface under paved area and shoulder shall be compacted to not less than 95% of maximum density obtained when tested in accordance with JIS A 1211 (Modified A.A.S.H.O.) by rubber-tired roller and other approved equipment. In other fill section, the materials shall be compacted to not less than 90% of maximum density specified herein.

The placement of any layer shall not be commenced until the compaction of preceding layer is completed and approved by the Engineer.

##### (2) Moisture Control for Compaction

The material spread in layers shall be of proper moisture content before rolling to obtain the prescribed compaction. Wetting and drying of the material and manipulation to secure a uniform moisture content throughout the layer shall be required. When too dry, water shall be added by means of the approved sprinkling equipment.

Allowable range of moisture content for each material shall be approved by the Engineer on submitted soil test results.

5.1.6.4 - Measurement and Payment

Measurement for payment for embankment shall be on the basis of volume in cubic meters of embankment as determined on the drawings.

Any additional quantity required to complete the embankment to planned grades and cross sections due to settlement or any other cause will not be measured for payment.

When the embankment is completed in accordance with the drawings, specifications, and as directed by the Engineer, cubic meters of embankment materials will be measured as specified in subparagraph 5.1.5.4, whenever it is possible to apply the average end area method between the surface as established by initial and final cross sections of the embankment.

The rate tendered for embankment shall be the full compensation for furnishing all equipment, materials, and labor, except as otherwise provided, necessary to complete the work including excavating, hauling, placing, spreading in the embankment and subgrade sections of embankment, wetting or drying, compacting, shaping and finishing maintenance of haul roads, and other incidental items of work in accordance with the drawings, specifications, and as directed by the Engineer.

PAY ITEM	UNIT OF MEASUREMENT
Excavation and Embankment	m <sup>3</sup>

5.2 - PREPARATION OF SUBGRADE

5.2.1 - General

The work covered by this item of the specifications consists of furnishing all labor, equipment and materials, and performing all operations in accordance with the preparation of subgrade and maintenance during construction. All work shall be done in strict accordance with the drawings, specifications, and as directed by the Engineer.



#### 5.2.2 - Shaping, Grading and Compacting

The subgrade shall be shaped so that after compaction it will be exactly at the required line, grade, and cross section.

After shaping and grading, the entire subgrade shall be compacted to the required width, using steel roller, rubber tired roller or approved equipment, with the moisture maintained at optimum content range required for maximum compaction, until it has reached the density as specified under subparagraph 5.2.3. herein.

#### 5.2.3 - Degree of Compaction

The dry densities of compacted soil when tested in the presence of the Engineer shall not be less than 95% of the maximum density as specified as 30 cm below subgrade elevation in fill area and as 15 cm below subgrade elevation in cut area.

When the required density cannot be obtained in cut area, the material shall be undercut and replaced with suitable material. The necessity of undercut shall be determined by the Engineer. The material placed to refill the undercut portion shall be handled and compacted as specified under subparagraph 5.1.6.3 for embankment.

#### 5.2.4 - Final Finishing

Should rutting, wearing or other signs of inadequate subgrade support be evident during and after compacting, the Contractor shall correct these conditions to the satisfaction of the Engineer.

For final finish, a grader or approved subgrade planer shall be used so that the smoothness of the surface at all points shall be within 3 cm of designed grade elevation. Any deviation in excess of these amounts shall be corrected by loosening, adding, or removing material, reshaping and recompacting.

#### 5.2.5 - Maintenance

At all times the top of subgrade shall be kept in such condition that it will drain readily and effectively. In handling materials, tools and equipment, the Contractor shall take necessary measures to protect

the subgrade from drain water.

#### 5.2.6 - Measurement and Payment

Measurement for payment for preparation of subgrade shall be based on the area in square meters on which subgrade has been completed and accepted.

The rate tendered under this pay item shall be the full compensation for furnishing all labor, equipment and materials, except as otherwise provided, necessary to complete the work including shaping, grading, wetting and drying, compacting, final finishing, maintenance and other incidental items of work in accordance with the drawings, specifications, and as directed by the Engineer.

When undercutting and replacing are required during preparation of subgrade which are not due to Contractor's fault, payment shall be made for both undercutting and replacing under such applicable pay items as provided in subparagraph 5.1.5.4 and 5.1.6.4.

PAY ITEM	UNIT OF MEASUREMENT
Preparation of subgrade	m <sup>2</sup>

#### 5.3 - MECHANICAL STABILIZED AGGREGATE BASE COURSE

##### 5.3.1 - General

This item shall consist of a base course composed of blended material of coarse granular aggregate and binder sand, constructed on the prepared underlying course in accordance with these specifications and shall conform to the dimensions and typical cross section shown on the drawings and with the lines and grades established by the Engineer.

##### 5.3.2 - Materials

###### 5.3.2.1 - General and Quality Requirements

Base course material shall be a blended material, combined excavated coarse granular material with sand binder material in the weight ratio

4:1. It shall conform to the following quality requirements:

Maximum size	30 mm max.
Plasticity Index for #40 sieve	6 max.
CBR value (soaked, 95% density)	30% min.

5.3.2.2 - Coarse Aggregate

The coarse aggregate for this work shall consist of select borrow material (gravel with clay) obtained from the designated or approved borrow pits and be free from a deleterious amount of clay lumps, organic matter, and any other matter which is deleterious to insure the bearing capacity of base course.

5.3.2.3 - Binder Material

The binder material for this work shall consist of sand, or screenings. It shall be free from a deleterious amount of clay lumps, organic matter and any other matter which is deleterious to insure the bearing capacity of base course.

5.3.2.4 - Approval of Materials

Sample of all aggregates including blended materials and test result thereof shall be supplied by the Contractor not less than 20 days in advance of the time when they will be required in the work, and subject to the Engineer's approval. Tentative approval or disapproval of the sources of the materials will be made on the basis of inspection of the source by the Engineer and of test results of samples submitted by the Contractor from test pits, borings or other excavations, or from samples of current production in case that an existing producer supply material.

5.3.3 - Operation of Pits or Quarries

The operation of pits or quarries shall consist of cleaning and grubbing, stripping, excavating, processing, and blending to produce materials conforming to these specifications. All pocket or strata of unsuitable material overlying or occurring in the deposit shall be

wasted. The methods of operation of the pits or quarries and the processing and blending of the materials may be changed or modified according to the directions of the Engineer without adjustments in the contract unit price when such adjustments are necessary in order to obtain material meeting the specified requirements. Upon completion of the work, the pits or quarries shall be conditioned in the manner as directed by the Engineer.

#### 5.3.4 - Equipment

Equipment, tools, and machines used in the work covered by this item of the specifications shall be maintained in a satisfactory working condition at all times.

Mixing equipment shall have enough capacity to mix thoroughly the materials, to produce a mixture which is homogeneous, uniform, and of the consistency suitable to compaction.

When plant mixing is employed, the mixing plant shall be equipped with weight or volume measuring apparatus capable of measuring the materials exactly to the specified proportion and shall be approved by the Engineer.

The base course shall be compacted with steel-wheeled, vibratory, or pneumatic-tired rollers approved by the Engineer.

#### 5.3.5 - Preparation and Stockpiling of Materials

When the road-mix type equipment is used, the materials shall be transported from the approved borrow sources to the construction site and placed in either uniform windrows or layers prepared on the subgrade. Placing and spreading of the materials shall be done in such a manner as to prevent segregation of coarse aggregate and shall be approved by the Engineer.

When the mixing plant is used, the materials shall be stockpiled separately on the designated cleared and leveled area and in such a manner as to prevent segregation of coarse aggregate.

### 5.3.6 - Mixing and Placing

#### 5.3.6.1 - General

The Contractor shall, as directed or approved, make such adjustments in mixing or placing procedures or in equipment as are necessary to minimize aggregation, and to obtain the lines and grades within allowable tolerances, and to insure a satisfactory stabilized aggregate base course.

#### 5.3.6.2 - Road-Mix

When flat-type mixing equipment including the approved blade graders and bulldozers is utilized, the materials shall be separately spread in the specified quantity for the full width of lane being processed. Where window-type mixing is utilized, the materials shall be deposited in windrows of such proportions that the specified quality requirement will be met.

Mixing shall be accomplished with road-stabilizers, blade graders, harrows, disks, or other approved equipment, so as to produce a uniform mixture. When it is necessary, water shall be added during mixing by approved sprinkling equipment, and mixing operations shall continue until the water is uniformly distributed in the opinion of the Engineer. Following this mixing procedure the approved mixture shall be leveled to the required lines and grades. Unsatisfactory areas shall be removed and replaced with satisfactory material, or the material shall be remixed in the area, as directed by the Engineer.

#### 5.3.6.3 - Plant-Mix

Where mixing plant is used, coarse aggregate and binder material shall be proportioned by weight or by volume in such manner as to produce a uniform mixture satisfactory to the specified quality requirement. If necessary, water measured by weight or volume shall be added during mixing.

The finished mixture shall be hauled to the area to be placed with approved pneumatic-tired vehicles, and shall be placed in a uniform

layer to required lines, grades, and cross sections, and to a loose depth that, when compacted, will produce a layer of the designated thickness. Unsatisfactory areas shall be removed and replaced with satisfactory mixture, or the material shall be mixed in the area, as directed by the Engineer.

### 5.3.7 - Compaction and Finishing

#### 5.3.7.1 - Compaction

Stabilized aggregate base course shall be compacted in each layer not to exceed 15 cm in compacted depth, with steel rollers, rubber-tired rollers and other approved equipment. Water content shall be maintained at optimum moisture range to obtain specified density during compaction. In all places where rollers are not accessible, the mixture shall be compacted with mechanical tampers.

Compaction shall continue until each layer through its full depth is compacted to at least 95% of the maximum density as determined by JIS A 1211 (Modified A.A.S.H.O.). The Contractor shall make such adjustments in rolling or finishing procedures as may be necessary to obtain true grades, to minimize segregations and degradations, and to insure a satisfactory stabilized aggregate base course. Unsatisfactory materials will be re-mixed to produce satisfactory materials.

#### 5.3.7.2 - Finishing

The base course shall be shaped and finished to the lines, grades, and cross sections as shown on the drawings. The finished surface shall not deviate more than 1 cm from a 3 m straight-edge when applied parallel with and at right angles to the centerline. Straight-edge shall be applied by successively overlapping by 1/2 the length of the straight-edge. The difference in deviation from the planned elevation of base course between any two points within 20 m distance shall not exceed 1.0 cm.

The value of the modulus of subgrade reaction (K value) tested by JIS A 1212 on the surface of the completed base course shall not be less than

7 kg/cm<sup>3</sup> for loading plate of 75 cm diameter. When the loading plate of smaller diameter than 75 cm will be used for the plate loading test, the correction of the obtained value for 75 cm diameter plate shall be done as directed by the Engineer. Unsatisfactory areas shall be removed and replaced with satisfactory mixture, or the material shall be recompacted in the area, as directed by the Engineer.

The completed thickness of the base course shall be within plus or minus 10% of the planned thickness. Where it is more than 10% deficient from the planned thickness, it shall be scarified, materials added to provide the planned thickness, mixed, recompacted to the required density, reshaped and finished as directed by the Engineer. Where it is more than 10% greater than the planned thickness, it shall be scarified, material removed, re-compacted to the required density, reshaped, and finished as directed by the Engineer.

5.3.8 - Maintenance

The base course shall be maintained in proper condition during subsequent construction. Any damage shall be repaired to the satisfaction of the Engineer.

5.3.9 - Measurement and Payment

Measurement for payment for base course shall be on the basis of area in square meters of base course completed and accepted.

The unit price under this pay item shall be the full compensation for furnishing all materials and labor, equipment, and for all material processing, mixing, hauling, spreading, wetting or drying, compacting, shaping and finishing, application of asphalt emulsion specified in subparagraph 5.4.3.1, maintenance and other incidental items of work in accordance with the drawings, specifications, and as directed by the Engineer.

PAY ITEM	UNIT OF MEASUREMENT
Base course under pavement and under shoulder	m <sup>3</sup>

## 5.4 - PORTLAND CEMENT CONCRETE PAVEMENT

### 5.4.1 - General

The work under this item shall consist of furnishing all labour, materials and plant and performing all necessary operations for the construction of Portland cement concrete pavement as shown on the drawings and specified herein, or as directed by the Engineer.

Unless specifically provided in these specifications, concrete shall be produced, placed, finished, cured and tested in accordance with the provisions of Japanese Standard Specifications for Concrete and Japanese Industrial Standard which will be referred to as J.S.S.C. and JIS respectively herein.

### 5.4.2 - Materials

#### 5.4.2.1 - Aggregates

##### (1) General

The Contractor shall furnish coarse and fine aggregate for pavement concrete recuperated from sources approved by the Engineer.

##### (2) Coarse Aggregate (Natural Gravel)

The coarse aggregate shall consist of well-shaped, hard, uncoated rock fragments, and shall conform to the provisions 14 to 16 for pavement concrete in J.S.S.C.

The maximum nominal size of the coarse aggregate shall be 40 millimeters and its size group, as batched, shall be well graded and, when tested in accordance with JIS A-1102, shall meet approximately the following gradation.

Sieve Size (mm)	Percentage by weight passing individual sieve
50	100
40	100 - 95
20	70 - 35
10	30 - 10
5	5 - 0



(3) Fine Aggregate

The fine aggregate shall consist of hard dense uncoated rock fragments, and shall conform to the provision 10 to 11 for pavement concrete in J.S.S.C.

The fine aggregate, as batched, shall be well graded from fine to coarse and, when tested in accordance with JISA-1102, shall meet approximately the following gradation.

Sieve Size (mm)	Percentage by weight passing individual sieve
10	100
5	100 - 90
2.5	100 - 80
1.2	90 - 50
0.6	60 - 25
0.3	30 - 10
0.15	10 - 2

5.4.2.2 - Cement

All cement to be used in pavement concrete shall conform to the provisions for normal Portland cement in JISR-5210.

The cement shall be packed in water-proof bags made of 5-ply craft and one waterproof paper of good quality and each bag shall contain 50 kilograms of cement.

5.4.2.3 - Premoulded Joint Material

Premoulded joint material for expansion joints shall meet the requirements of A.S.T.M. D175-65.

5.4.2.4 - Joint filler

The filler shall conform to the Federal Specification for Sealer. In expanded apron, all new taxiways and fillet improvement, the filler conforming to the Federal Specification SS-S-1676 shall be used, as indicated in the drawings. In other pavements specified above, the filler conforming to the Federal Specification SS-S-164 shall be used.

Temperature of application shall be as recommended by the manufacturer.

#### 5.4.2.5 - Dowels and Tie Bars

Dowels shall be of plain, round, mild steel bars conforming to JIS G-3131. Tie bars shall be of deformed mild steel bars conforming to JIS G-3110.

#### 5.4.3 - Construction Method

##### 5.4.3.1 - Conditioning of Underlying Course

Before the concrete is placed, all ruts or depressions on the base course caused during hauling operation or by passage of any construction equipment shall be filled with materials specified for the base course and thoroughly compacted by rolling. An approved multiple pin templet or other approved templet shall be provided and operated on the forms prior to the placing of the concrete. All excess material shall be removed, and if the grade is found to be below the true elevation, the depression shall be filled with approved material and thoroughly compacted to the proper cross section by rolling or tamping with a hand tamper.

The work described above shall constitute the final accurate check of the underlying course.

After conditioning of underlying course (base course) is approved, asphalt emulsion shall be applied by approved self-powered sprayer, as indicated in the drawings.

##### 5.4.3.2 - Forms and Form Setting

The side forms shall be of steel having an approved section. Wood forms may be used subject to the approval of the Engineer. Wood forms shall be well-seasoned, surface plank or plywood, straight and free from warp or bend. Wood forms shall be provided with adequate devices for securing and setting so that when in place, they will withstand, without springing, wearing or setting, the impact and variation of the

placing and finishing operations.

All forms shall be set with exactness to the required grade and alignment, and be supported on thoroughly compacted material for their entire length during the entire operation of placing and finishing of concrete. They shall not at any time show a variation of more than 3 mm in 3-meter length from the true plane of top forms. In the setting of side forms they shall be tested for grade and smoothness by the Contractor, using a 3-meters straight edge, and variations from the above requirements shall be eliminated by resetting the forms. Shimming with loose earth, pebbles, etc. will not be permitted. If a form does not have satisfactory bearing for its full length, it shall be removed, the bearing area of subbase reshaped and compacted and the form replaced. The use of bent or damaged side forms shall not be permitted. All forms shall be cleaned and oiled each time they are used. The alignment and grade of all forms set shall be approved before and immediately prior to the placing of any material against them, and shall not be removed during 60 hours or, when approved, 20 hours after the concrete has been placed. The face of the forms shall not vary more than 6 mm in 3 meters from a true plane.

The Contractor shall set and maintain sufficient forms, and shall otherwise so conduct his operations that the final minor corrections and compaction of grade, together with checking and approval of forms, will not in any way interfere with operations at the concrete site. While the amount of completed and accepted forms required prior to the paving operation will vary with different organization and equipment, this amount shall in no case less than 150 meters (each side).

Adjacent lanes may be used in lieu of forms of supporting finishing equipment provided that proper protection is afforded the concrete of the adjacent lanes from damage, and further provided that the surface of the concrete carrying the equipment does not vary more than 3 mm in a 3 meter length. Adjacent lanes in lieu of forms may not be used

until the concrete is at least 7 days old or may be used with the approval of the Engineer. Flanged or steel wheels of finishing equipment shall not be operated on the concrete surface. The inside edge of supporting wheels of the equipment shall not be operated closer than 10 cm from the edge of the concrete lane.

#### 5.4.3.3 - Handling and Storage of Materials

##### 1) Cement

Immediately upon receipt at the site of the work, cement shall be stored in a dry, weatherright and properly ventilated structure with adequate provisions to prevent absorption of moisture.

Cement shall be stored in such a manner as the "first in" could be "first out" and in such a manner as to permit easy access for inspection and identification.

The Contractor shall store the cement in accordance with the provision 22 for pavement concrete in J.S.S.C., unless otherwise specified above.

##### 2) Aggregates

Aggregate shall be handled and stored at the site in such a manner as to avoid breakage, segregation, or contamination by foreign materials. Site for stockpiles shall be prepared and maintained in such a manner as to preclude the inclusion of foreign materials with the aggregates. Aggregates shall be deposited in and removed from stockpiles in such a manner as to avoid segregation. When segregation is apparent, the aggregate shall be remixed before use. All aggregate shall have reasonably uniform moisture content when delivered to the mixer.

#### 5.4.3.4 - Proportions

The mix to be used is described in the table below. The weights of fine and coarse aggregate and the quantity of water per one cubic meter of concrete shall be determined by trial mixes.

Min. Ult. Comp Str. at 28 days. (kg/cm <sup>2</sup> )	Min. Rupture Modulus at 28 days. (kg/cm <sup>2</sup> )	Weight of Cement per 1 m <sup>3</sup> of Concrete. (kg)	Max. Weight of Water per 1 m <sup>3</sup> of Concrete. (kg)	Max. Size of Coarse Aggreg. (mm)	Max. Slump (cm)
	45	320 - 310	110	40	2.5

Admixtures such as cement-dispersing agent and air-entraining admixture may be used with the approval of the Engineer.

Trial mixes shall be made by the Contractor, under supervision of the Engineer, in the approved testing laboratory. The results shall be reported to the Engineer and the Engineer will determine the proportion of pavement concrete to meet the requirements in the table.

Should the specified strength not be obtained the Contractor will be required to vary the proportions shown in the table, sufficiently to meet the requirements, but the maximum amount of water specified in the table shall not be exceeded.

Three trial mixes shall be made in which the water-cement ratio shall be varied above and below that shown in the table, but using the same cement content and proportions of aggregates in all cases so that a curve may be plotted to determine the effects on strength and workability of variation in the water-cement ratio.

For each trial mix, six cylinders and six test beams shall be made, three of each to be tested at 7 and 28 days respectively. The mix shall be designed so as to produce a concrete with an average strength at 28 days is approximately 15% in excess of design strength specified in the table as determined by these test cylinders and test beams.

During the course of the work, the control of the consistency and workability of the job concrete shall be maintained by measurement of the slumps in accordance with the method of Slump Test, JIS A 1101,

and the concrete strength of job concrete shall be controlled by test cylinders and test beams in accordance with the test methods specified in JISA 1108 and 1106 respectively.

All these tests shall be made by the Contractor under the supervision of the Engineer, and the Contractor shall report on all tests described above.

For any low-strength concrete in the pavement, additional test will be made and any repairs or replacements, deemed necessary to insure the safety of the pavement shall be performed by the Contractor as directed by the Engineer.

#### 5.4.3.5 - Batching

The Contractor shall provide such means and equipment as are required to accurately and automatically or semi-automatically determine and control the amount of each separate ingredients entering the concrete. Batching of each ingredient shall be made by weighing measurement except water which may be determined by volumetric measuring.

The equipment shall be capable of ready adjustment for compensating for the varying weight of any moisture contained in the aggregates and for effecting changes in concrete mix proportions.

The combined accuracy of batching equipment in feeding and measuring the material shall not exceed the following limit.

Water and Admixture	± 1%
Cement	± 2%
Aggregate	± 3%

In the case of using the storage bin and weighing hopper for weighing plant, the Contractor shall provide a visible dial which will register the scale load at any stage of weighing operation from zero to full capacity. The weighing hopper shall be constructed so as to permit the convenient removal of over weight material in excess of the prescribed tolerance. Each dial and each measuring device shall be in full view of the operator.

5.4.3.6 - Mixing

The batched ingredients of concrete shall be so mixed in a mechanical tilting batch mixer or a paving mixer as to produce a homogeneous mass of uniform consistency. The main charge of water and admixture, when used, shall be added prior to, during and following the mixer charging operations. Excessive over-mixing requiring additions of water will not be permitted.

Unless otherwise directed or allowed by the Engineer, the mixing of each batch shall continue not less than the following number of minutes after all gradients except the full amount of water and admixture are in the mixer.

Capacity of mixer (cubic meter)	Time of mixing (minutes)
2 - 1.5	2.0
1.5 or less	1.5

Mixers shall not be loaded in excess of their rated capacity unless specifically authorized. Each mixer shall be equipped with mechanically or electrically operated timing and signaling device which will indicate and assure the completion of required mixing time and the count of the batches.

5.4.3.7 - Transportation

The method and equipment used for transporting concrete shall be such that concrete having the required composition and consistency will be delivered into the work, without objectionable segregation or running short of slump.

If more than 30 minutes has elapsed since discharge from the mixer, the concrete shall not be placed in the work. In case of using a paving mixer, vehicles for transporting materials from the batching plant to the paving mixer shall have bodies and compartments of adequate capacity to carry each batch separate and intact to the mixer.

Batches kept in a vehicle for more than 4 hours before placement shall be wasted.

#### 5.4.3.8 - Placing and Finishing Concrete

##### (1) General

No concrete shall be placed until all formwork, conditioning of underlying course and all embedments, such as tie bars, dowels and other items indicated on the drawings, have been completed by the Contractor, and inspected and approved by the Engineer.

Width of the pavement strips shall be as shown on the drawings or as directed by the Engineer.

All embedded items shall be secured and protected so as not to be disturbed by concrete pouring operations. The underlying course shall be covered with approved waterproof base course papers as indicated in the drawings. The base course papers shall be laid in such a manner as to provide seams with laps of about 10 centimeters.

##### (2) Placing

Concrete shall be deposited in such a manner as to require as little rehandling as possible and shall be distributed so that when consolidated and finished, the slab thickness and surface grade required by the drawings will be obtained at all points. Raking or hoeing of concrete will not be permitted. Concrete shall not be placed when the sun, heat, wind, rain, humidity or limitations of facilities provided by the Contractor prevents proper placement and finishing.

The machine method of spreading shall be employed except where hand method is permitted. Mechanical spreaders shall be power driven, and shall be designed and operated to distribute the plastic concrete evenly between forms. The spread concrete shall conform to the depth and cross section shown on the drawings and shall be performed at such elevations slightly



above grade that, when properly consolidated, the surface of the layer will be at the elevation indicated in the drawings. Necessary hand spreading shall be done with shovels, not with rakes.

In conjunction with the placing and spreading, the concrete shall be thoroughly vibrated along the forms, bulkheads, and joint by means of approved internal vibrators, unless otherwise authorized.

Temperature of concrete when placed shall not be less than 10°C or more than 30°C, unless otherwise directed by the Engineer. When the daily temperature exceeds 30°C, the surface of the newly laid pavement shall be kept damp by means of water fog or moist using the approved spraying equipment until the pavement is covered by the approved curing medium.

### (3) Finishing

Finishing operations shall be started immediately after placement of the concrete. The sequence of operations shall be as follows:

Transverse machine finishing, straightedge finishing, edging and finally brush dragging. The machine method of finishing shall be employed except where hand method is permitted.

The transverse finishing machine shall be powerdriven, and shall be of ample weight and power to produce proper finishing and withstand the roughest treatment anticipated under job conditions. The transverse finishing machine shall be designed and operated to strike off, screed, and consolidate the concrete. It shall be equipped with two screeds readily and accurately adjustable for changes in pavement crown and compensation for wear and other causes.

Screed and float adjustments of these machines shall be checked at the start of each day through paving operations and at any time as required.

Concrete, as soon as placed, shall be accurately struck off to the cross section shown on the drawings and to such an elevation that

when properly consolidated and finished, the surface of the pavement will be free from porous places and at the grade indicated on the drawings. The finishing machine shall make one or two trips over each area of pavement to properly compact the concrete and produce a surface of uniform texture, true to grade. Excessive manipulation which causes bleeding shall not be permitted.

After completion of finishing with the transverse finishing machine, the longitudinal mechanical float shall be operated parallel to the center line of the pavement with a short, quick motion, and shall travel slowly across the pavement, maintaining contact with the surface at all times. If contact with the surface is not made at all points, additional concrete as required shall be placed and struck off, and the float operated over the same area until a satisfactory surface is produced. In advancing the float, each new position shall lap the previous position by not less than one-half of the float length.

After the longitudinal floating is completed, but while the concrete is still plastic, minor irregularities and score marks remaining in the pavement surface shall be eliminated by means of long handled approved floats and straightedges. The long handled float may be used to smooth and fill in open-textured areas in the pavement surface, but the final finish shall be made with straightedges. The use of longhandled float shall be held to a minimum as necessary to correct local surface unevenness not taken care of by the longitudinal float.

Straightedges shall not be less than 3 meters in length and may be operated from bridges, resting on the side forms and spanning but touching the concrete, and from the side of the pavement. A straightedge operated from the side of the pavement shall be equipped with a handle 1-meter longer than one-half the width of the pavement. The surface shall then be tested for trueness with a straightedge, which shall be held in successive positions

parallel and at right angle to the center line of the pavement in contact with the surface and the whole area covered as necessary to detect variations. The straightedge shall be advanced along the pavement in successive stages not more than one-half of its length. Depressions shall be immediately filled with freshly mixed concrete, struck off, consolidated and refinished. The straightedge testing and finishing shall continue until the entire surface, if free from observable departure from the straightedge, conforms to the required grade and contour, and when the concrete is hardened, will conform to the surface requirements specified under 5.4.4.2. Requirements for Smoothness.

After straightedge finishing has been completed, the edges of the pavement, the construction dummy, and expansion joints shall be carefully finished with an edging tool to form a smooth rounded surface of 6-millimeter radius. Corners or edges of the pavement which have crumbled and any areas which lack sufficient mortar for proper edging shall be cleaned by removing loose fragments and soupy mortar, and shall be solidly filled and finished with a mixture of concrete of appropriate consistency. Unnecessary tool marks shall be eliminated and edges shall be smooth and true to line.

When most of water glaze or sheen has disappeared, and before the concrete has become non-plastic, the surface of the pavement shall be dragged transversely with an approved brush drag. The brush dragging shall be carefully done so as to produce a finished surface having a fine granular or sandy texture without disfiguring marks.

No tool marks of any kind shall be present on the finished surface.

After the removal of forms, all honeycombed edges shall be immediately filled with 1 to 2 mortar.

#### 5.4.3.9 - Curing

##### (1) General

Concrete shall be cured by protection against loss of moisture and rapid temperature changes for a period not less than 4 days

from the beginning of the curing operation. Unhardened concrete shall be protected from rain and flowing water. The Contractor shall have all equipment needed for adequate curing and protection of the concrete on hand and ready to install before actual concrete placement begins. Failure to comply with curing requirements shall be the cause of immediate suspension of concreting operations. Protection shall be provided as necessary to prevent cracking of the pavement due to temperature changes during the curing period. The sides of concrete pavement exposed by the removal of forms shall be protected within one hour after removal of forms in order to provide the exposed surface with continuous curing treatment equal to that provided by the method selected for curing the pavement surface, and to prevent injury to the pavement edges.

(2) Initial Curing

Immediately after the finishing operations have been completed and concrete has been set sufficiently to prevent marring of the surface, the forms and entire surface of the newly laid concrete shall be covered with wetted burlap or other approved blanket or mat. The initial moist curing shall be continued for a period not less than 24 hours. The surface of the newly laid concrete shall be kept moist and damp by means of approved fog-spraying equipment until the blanket cover is placed.

(3) Final Curing

Curing of the concrete shall be continued for the duration of the required curing period. Curing blankets or mats shall be thoroughly wet before being applied and shall be kept continuously soaking wet and intimate contact with the pavement surface for the entire duration of the curing period. The blankets or mats shall overlap at least 15 centimeters.

5.4.3.10 - Hand Finishing

Hand finishing will be permitted on variable width section of the

pavement and other places where the use of the finishing machine would be impracticable. Hand finishing shall be accomplished by means of the approved hand-operated strike-off templet or surface vibrator.

Concrete shall be consolidated with the aid of approved hand manipulated vibrators. Immediately following the final finishing of the surface, the pavement shall be floated longitudinally by hand from bridges resting on the side forms.

All other details of the finishing operations shall be as provided in section 5.4.3.7 above.

#### 5.4.3.11 - Joint

##### (1) General

Longitudinal and transverse joints shall be constructed as indicated on the drawings and in accordance with the following. All joints shall be constructed true to line with their faces perpendicular to the surface of pavement. The surface of the pavement adjacent to all joints shall be finished to a true plane and edged to a radius of 6 milli-meters. The surface across the joints shall be tested with a 3-meter straightedge as the joints are finished, and any irregularities in excess of 3 milli-meters shall be corrected before the concrete has hardened. Keyways, when required, shall be accurately formed. Transverse joints shall be at right angle to the centerline of the pavement and shall extend fullwidth of the slab. When the pavement is laid in lanes, the transverse joints in succeeding lanes shall be planed in line with similar joints in the first lane. All joints shall be so prepared, finished or cut as to provide a groove of sufficient width and depth as indicated on the drawings.

Tie bars installed principally in longitudinal joints or as shown on the drawings shall consist of deformed bars as designated on the drawings. Tie bars shall be placed at right angle with the centerline of the concrete slab by chairs when indicated to use chairs and shall be spaced, as indicated on the drawings. They shall be held in position parallel to the pavement

surface and midway between the surface of the slab. These bars shall not be painted, greased or enclosed in sleeves.

Dowel bars shall be placed across transverse or other joints in the manner as shown on the drawings. They shall be of the dimensions and spacings as shown and held rigidly in the middle of the slab depth in the proper horizontal and vertical alignment by the chair shown on the drawings to be left permanently in place. The dowels and the chair shall be rigid enough to permit complete assembly as a unit ready to be placed into position. A metal or other type dowel expansion cap shall be furnished for each dowel bar used with expansion joints. These caps shall be substantial enough to prevent collapse and shall be placed on the ends of the dowels as shown on the drawings. The dowels shall be painted at the site of the work on the free or unbonded end. When the paint is dry, the same end shall be thoroughly coated with a heavy oil immediately before it is placed in position. The expansion cap shall fit the dowel bar snug enough to remain in place, and the closed end shall be watertight. Dowels shall have smooth and true surfaces with the ends free from burrs or other deformities.

(2) Installation

All chairs shall be set to the required positions and lines and shall be securely held in place by stakes, or other means during the placing and finishing the concrete. Dowel and tie bars shall be checked for exact position and alignment as soon as the chairs are staked in place and the chairs tested to determine whether they are firmly supported. Any joint installation not firmly and securely supported shall be reset.

When joints in concrete pavements are sawed, the joint shall be cut as soon as possible after finishing. The equipment used shall consist of a concrete cutting machine comprising a suitable motor driving, a circular cutter with control devices and mounted

on a sturdy frame supported on rubber-tired wheels. The equipment shall be capable of cutting a groove in a straight line. A continuous water supply shall be made available to the cutting element. The circular cutter shall produce a slot at least 6 mm wide. When required by the Engineer, the top portion of the slot or groove shall be widened by means of a second shallower cut or by suitable and approved levelling to provide adequate space for joint sealers. To prevent delay in sawing resulting from mechanical difficulties, sufficient standby equipment shall be provided on the site of the work and shall be kept available for immediate use. Sawing of the joints shall begin as soon as the concrete has hardened sufficiently to permit cutting the concrete without chipping, spalling or tearing. Sawing shall be carried on both during day and night as required. The joints shall be sawed at the required spacing consecutively in sequence of the concrete placement, unless otherwise approved.

(3) Longitudinal Joint

Longitudinal construction joints necessary for lane construction shall be formed against suitable side forms with keyways. Keyways may be made of steel or wood as shown on the drawings. In those instance where the keyed construction joint is not designated, an undoweled thickened-edge expansion joint shall be installed. The edges of joints shall be finished with grooving tools and the edging tools and space of slots shall be formed along the joint of dimensions as indicated. Provisions shall be made for the installation of tie bars as noted on the drawings. before an adjacent slab is constructed against a longitudinal construction joint, the side of the completed slab shall be painted with a heavy coat of petroleum asphalt.

Longitudinal contraction joint shall be constructed between the construction joints as shown on the drawings, and shall be of dummy type. The contraction joints shall be installed by sawing a groove into the concrete surface in accordance with the

details indicated in the paragraph (2) above, and as shown on the drawings. When tie bars are called for, provisions shall be made for the installation of them, as shown on the drawings.

(4) Transverse Joint

(a) Extension

Transverse extension joints shall be installed at the locations and spacing as shown on the drawings, and the joint shall be installed at right angle to the centerline and perpendicular to the surface of the pavement. The joint shall be so installed and finished to insure complete separation of the slabs.

Expansion joints shall be of a premold type conforming to these specifications and the drawings, and shall be spaced as indicated. No section of the joint material shall be shorter than the width of pavement strip between longitudinal joints. The filler shall be placed below the surface as shown on the drawings. All concrete shall be cleaned off the top of the joint material.

For premolded extension joints which require a plate for added rigidity during installation an oiled steel plate cut to the cross section of the pavement and slotted for the dowel bars shall be used to hold the premolded joint material in its proper position until the finishing machine has completed its operation.

When called for, extension joint shall be equipped with dowels of the dimensions and the spacing and location indicated on the drawings.

When dowels are not equipped, the expansion joints shall be of thickened-edge type.

(b) Contraction

Transverse contraction joints shall be installed at the locations and spacing as shown on the drawings. These



joints shall be installed by sawing a groove into the concrete surface after the concrete has hardened. Dowel bar assembly shall be installed, when required, as shown on the drawings.

(c) Construction

Transverse construction joints shall be installed in accordance with the details on the drawings and ordinarily are only needed when it is necessary to suspend the work for a period of more than 30 minutes and when required shall be located at a contraction of expansion joint. If the placing of the concrete has been stopped at any other location it shall not be installed, but the fresh concrete shall be removed back to the previously spaced regular joint.

5.4.3.12 - Filling of Joints

The joints shall be sealed immediately following the curing period or as soon thereafter as whether conditions permit. At the time of application of the sealing compound, the atmospheric and pavement temperature shall be above 10°C, and the weather shall be rainy or foggy.

All equipment necessary for the proper construction of this work shall be as recommended by the manufacturer of the filler and approved by the Engineer before construction is permitted to start.

The heating apparatus for the sealers shall consist of heating kettle or tank, constructed as a double boiler, with space between the inner and outer shells filled with oil, asphalt, or other material for heat transfer. The heater shall be equipped to provide positive temperature control of the sealing material. Direct method of heating shall not be permitted. The material shall not be heated in excess of the temperature recommended by the manufacturer. Once the material has been heated it shall be maintained at an even temperature until placed into the joint.

The joint pouring equipment may consist of a hand pouring pot or a mechanical pouring kettle mounted on wheels with a pouring shoe.

The equipment for cleaning joint openings shall consist of such plows, powered and hand brooms or wire brushes, air compressors, sand blasters, and if necessary joint cleaning and grooving machine, as are necessary to produce a satisfactory clean and dry joint.

Immediately before filling, the joints shall be thoroughly cleaned" of all laitance, curing compound, protrusions of hardened concrete, dirt, dust, and other objectionable material.

When it is necessary to seal random cracks, they shall be cut, grooved and cleaned in a manner satisfactory for seating by methods and equipment similar to those used for the joints.

Sufficient joint sealer shall be placed into the joints so that upon completion of the work, the surface of the sealer within the joint shall be 5 mm below the adjacent pavement surface unless otherwise specified. The Contractor shall "spot up" or refill all unsatisfactory joints before final acceptance. Any excess filler on the surface of the pavement shall be removed, and the surface shall be left in a clean condition.

#### 5.4.4 - Requirements for Thickness and Smoothness

##### 5.4.4.1 - Requirements for Thickness

For pavement slab, the average thickness of which, determined as hereinafter provide, is within 6 mm of the thickness required by the typical cross section shown on the drawings, the contract unit price bid shall be used in payment.

For pavement slab, the average thickness of which, determined as hereinafter provided, is less than the thickness shown on the drawings by more than 6 mm but by less than 13 mm an adjusted unit price shall be used in payment, which price shall bear the same ratio to the contract unit price as the square of the average thickness of the slab bears to the square of the thickness specified on the drawings.

No additional payment over the unit contract price bid will be made for any slab should the average thickness of the pavement, determined as hereinafter provided, exceed the thickness shown on the drawings.

The thickness of the slab shall be determined, at the expense of the Contractor, by average of slab thickness measurements made on cores taken from selected points, under the supervision of the Engineer.

In calculating the average thickness of the slab, measurements which are in excess of the thickness specified on the drawings by more than 6 mm shall be considered as the specified thickness plus 6 mm and measurements which are less than the specified thickness by 13 mm or more shall not be included in the average.

The length of pavement deficient in thickness shall be the distance between the nearest cores of satisfactory thickness and the width shall be the entire width of the paving lane from which the cores are taken.

When the measurement of any core indicates that the pavement is deficient in thickness by 13 mm or more, additional cores will be drilled at 6 meter intervals along the centerline of the lane on each direction from the original deficient core, until two consecutive cores indicate that the deficiency in thickness is less than 13 mm. All pavement areas deficient in slab thickness by 13 mm or more shall be considered defective pavement areas and shall be removed and replaced with pavement of the specified thickness in accordance with all requirements of these specifications, at the Contractor's expense.

#### 5.4.4.2 - Requirements for Smoothness

After the final curing of the concrete and the removal of the covering material, the surface shall be swept clean and tested by the Engineer for smoothness by means of a surface testing machine or mechanical straightedge furnished by the Contractor, which will test one or more lines as determined by the Engineer on each separately poured lane of the pavement. All surface variations, 3 mm or more in 3 meter length must be ground off in an approved manner. In no event shall maximum

deviation of actual pavement surface from the contour shown be in excess of 13 mm.

Section of pavement containing extreme depressions with a depth in excess of 3 mm in 3 meters shall be removed and replaced by the Contractor at his own expense. In no case such section shall be less than the full width of the slab in which the depression occurs and the length between adjacent joints in each direction.

#### 5.4.5 - Measurement and Payment

Measurement for payment for concrete pavement shall be on the basis of area in cubic meters of pavement as specified, in place, completed and accepted, less deductions as hereinabove required for deficient thickness.

The measurement, as provided above, shall be paid for at the rate per square meter tendered for portland cement concrete pavement of the specified thickness which the rate and payment shall constitute full compensation for furnishing all ingredients including cement except as herein specified, and preparation and installation of all materials, including such transverse and longitudinal joints, joint filler, tie bars and dowels, for placing, finishing, curing, for all labor, equipment, tools, and incidentals necessary to complete the item in accordance with the drawings, specifications, and as directed by the Engineer, provided, however, that said rate shall be reduced when and as required hereinabove for deficient thickness.

The rate per cubic meter of pavement shall be based on the quantity of cement per cubic meter of concrete given in the table of Item 5.4.3.4.

If a change in cement content above or below that given in the table of Item 5.4.3.4 is necessary to produce the desired strength, an adjustment for such increase or decrease will be made, providing that the rate per cubic meter of pavement will be revised based upon the difference of changed cement content in the proportion of the table.

When an admixture is used and the cement content decreased below that given in the table, an adjustment will be made, providing that rate

per cubic meter of pavement will be revised based upon the difference of changed cement content and added admixture content in the proportion of the table.

No adjustment of the rate per cubic meter of pavement will be made for reasons other than the changes described hereinabove.

<u>PAY ITEM</u>	<u>UNIT OF MEASUREMENT</u>
Portland cement concrete pavement	
25 cm thick	m <sup>3</sup>
28 cm thick (including the area of thickened edge)	m <sup>3</sup>
15 cm thick	m <sup>3</sup>

#### 5.5 - SHOULDER SODDING

##### 5.5.1 - General

This item shall consist of furnishing, hauling, and placing approved live sod on the prepared areas in accordance with these specifications at the locations shown on the drawings or as directed by the Engineer.

##### 5.5.2 - Materials

###### 5.5.2.1 - Top-soil

The top-soil used for sod-bed shall be suitable for the growth of sod and free from deleterious amount of gravel, or organic matter, and shall be approved by the Engineer.

###### 5.5.2.2 - Sod

The sod used for sodding shall be of superior quality obtained from sources approved by the Engineer, or cultivated on fertile soil, and free from tree roots and woods. It shall have the size of about 30 cm x 30 cm and shall have well developed roots.

#### 5.5.2.3 - Fertilizer

Fertilizer shall be commercial product of available plant food elements, and shall conform to requirements as indicated by the Engineer. It shall be packed in a bag or other convenient standard container, each fully labeled with manufacturer's guaranteed analysis. Standard quantity of fertilizer per square meter to be used for shoulder sodding shall not be less than 70 gr.

#### 5.5.3 - Sodding

##### 5.5.3.1 - Preparation of Sod-bed

Top-soil used for sod-bed shall be placed and spread so smoothly that, after sodding, shoulder surface will be exactly at the required line, grade, and cross section as shown on the drawings. After topsoil spreading, half of the specified fertilizer quantity shall be applied. Any area which has become compacted by the process of sod-bed construction shall be scarified to a depth of at least 3 cm by employing the approved method.

##### 5.5.3.2 - Sodding Operation

Sodding shall be performed in suitable season, especially a voiding dry season.

Sod shall be haled and stored in such a manner that it will be protected against direct sunshine, provided with good ventilation, and drying avoided.

After the sod-bed has been prepared as specified in subparagraph 5.5.3.1, sod will be placed in block pattern, with sod covering 70% of the required area. Sod block shall be placed in smooth finish and be compacted firmly in contact with sod-bed by tamping or rolling with approved equipment. Following compaction, cover soil with the remaining half of the fertilizer shall be uniformly spread on the entire surface for sodding.

##### 5.5.3.3 - Watering

The sod shall be watered as soon as it evidences drying. Sufficient water will be applied to wet sod completely. Watering shall be done

in such a manner as to prevent erosion due to application of excessive quantity.

5.5.4 - Finishing

After the sodding operation has been carried out, the edges of all sodded areas shall be kept smooth and shall conform to the cross sections shown on the drawings. At junction with pavement, the surface of the sodded shoulder shall be within plus or minus 1 cm of the fixed elevation surface.

5.5.5 - Repairs

In any case of erosion or damage to the sodded areas prior to their acceptance, the Contractor shall make the necessary correction. Faulty and incomplete work shall also be repaired or corrected by the Contractor.

5.5.6 - Measurement and Payment

Measurement for payment for shoulder sodding shall be on the basis of area in square meters of sodding, completed and accepted.

The rate tendered under the pay item of shoulder sodding shall be the full compensation for furnishing all labor, equipment and materials, except as otherwise provided, necessary to complete the work including preparation of sod-bed, sodding, watering, finishing, maintenance, and other incidental items of work in accordance with the drawings, specifications, and as directed by the Engineer.

<u>PAY ITEM</u>	<u>UNIT OF MEASUREMENT</u>
Shoulder sodding	m <sup>2</sup>

5.6 - GRADED AREA SEEDING

5.6.1 - General

This item shall consist of furnishing and seeding on the graded areas in accordance with these specifications at the locations shown on the drawings or as directed by the Engineer.

5.6.2 - Material

5.6.2.1 - Seed

The seed used for graded area seeding shall be of superior quality obtained from reliable growers approved by the Engineer. The minimum percentage of pure live seed of each species in each lot of the field test shall be more than the percentage indicated by the Engineer. Seeds which have become wet, moldy, or otherwise damaged in transit or storage will not be acceptable.

5.6.2.2 - Fertilizer

Fertilizer shall conform to the requirements specified in subparagraph 5.5.2.3.

5.6.3 - Seeding

5.6.3.1 - Preparation of ground surface

Prior to seeding, the ground surface to be seeded shall be harrowed to a depth of 3 to 5 cm by approved equipment, and any unsuitable surface for the growth of seed shall be covered with fertile top-soil in a depth about 3 cm, as directed by the Engineer.

5.6.3.2 - Seeding operation

Standard quantity of materials per square meter to be used for seeding are as follows:

Seed	15 gr.
Fertilizer	70 gr.

Seeding shall be performed in suitable season, especially avoiding



dry season. When the weather is not windy or rainy, the materials specified above shall be uniformly applied on the prepared surface. After seeding, and before the weather conditions change unfavorably, the seeded surface shall be lightly compacted for holding the seeds and lightly sprinkled with water.

#### 5.6.3.3 - Watering

The seeded area shall be watered as soon as it bears evidence of dryness which would prevent the seeds from growing. Additional applications for curing shall be made as directed by the Engineer. Watering shall be done in such a manner as specified in subparagraph 2.5.3.3.

#### 5.6.4 - Finishing

The seeded graded area shall conform to the cross sections, grades as shown on the drawings.

#### 5.6.5 - Repairs

In any case of erosion or damage to the seeded areas prior to their acceptance, the Contractor shall make the necessary correction. Faulty and incomplete work shall also be repaired or corrected by the Contractor.

#### 5.6.6 - Measurement and Payment

Measurement for payment for graded area seeding shall be on the basis of area in square meters of seeding, completed and accepted.

The rate tendered under this pay item of graded area seeding shall be the full compensation for furnishing all labor, equipment and materials, except as otherwise provided, necessary to complete the work including preparation of ground surface, seeding, watering, finishing, maintenance, and other incidental items of work in accordance with the drawings, specifications and as directed by the Engineer.

<u>PAY ITEM</u>	<u>UNIT OF MEASUREMENT</u>
Graded area seeding	m <sup>2</sup>

## 5.7 - MARKING

### 5.7.1 - General

This item shall consist of the markings and stripes on the surface of apron, over-run and taxiways applied in accordance with these specifications and at the locations shown on the drawings or as directed by the Engineer.

### 5.7.2 - Materials and Equipment

#### 5.7.2.1 - Materials

Paint shall be well ground, shall not settle, cake or thicken in the container, shall be well broken up with a paddle to a smooth consistency, and shall show easy brushing and spraying properties. All paint materials shall be delivered to the site in the manufacturer's original containers.

Over-run marking shall be white reflective paint, conforming to the requirement of Federal Specification TT-P-0085. Apron and taxiways marking shall be yellow non-reflective paint, conforming to the requirement of Federal Specification TT-P-115 or JIS K 5491.

Bituminous surface sealer shall be a vinyl resin based material recommended by the paint maker for this purpose.

#### 5.7.2.2 - Equipment

Any equipment to be used for painting shall be suitable for this work, and shall be approved by the Engineer.

### 5.7.3 - Painting

#### 5.7.3.1 - Preparation of Surface

Surface to be painted shall be thoroughly cleaned of scale, dirt, oil, grease or other foreign materials before painting. Where existing markings protrude beyond the new markings, the protrusion shall be obliterated with the paint of a color closely matching that of the concrete surface, or shall be cleaned off with suitable solvent.

Surface of concrete joints in the area to be painted shall be coated carefully with the specified bituminous sealer.

5.7.3.2 - Painting Operations

All painting work shall not be done when the pavement is wet or damp, nor in rain, or dust storms are forecast or are likely to occur during the time required for the paint to dry sufficiently to loss its tack. Paint shall be applied with approved equipment or shall be spread carefully with suitable paint brush by hand at the rate of 0.5ℓ per square meter. When marking is painted by hand, painting shall be done in two layers, first and final, as directed by the Engineer.

At the completion of the work on any marking, all areas will be cleaned of paint spots, dribbles and overspray so as to show a clean, sharp, even edge.

5.7.4 - Protection and Repairs

Newly painted surfaces shall be protected against damage by vehicles or foreign matter during the time required for the paint to be sufficiently dry to withstand traffic. Any damage to newly painted marking due to the failure on the part of the Contractor to protect this work shall be repaired and to corrected by the Contractor.

5.7.5 - Measurement and Payment

The measurement for payment for marking shall be on the basis of area in square meters of marking, completed and accepted.

The rate tendered under this pay item of marking shall be the full compensation for furnishing all labor, equipment and materials, except as otherwise provided, necessary to complete the work including preparation of surface, painting, protection, repairs and other items of work in accordance with the drawing, specifications and as directed by the Engineer.

<u>PAY ITEM</u>	<u>UNIT OF MEASUREMENT</u>
Apron marking	m <sup>2</sup>
Taxiway marking	m <sup>2</sup>
Over-run marking	m <sup>2</sup>

## 5.8 - CONCRETE CULVERTS

### 5.8.1 - General

The work covered by this item of the specifications consists of furnishing all labor, equipment and materials, and the performance of all work necessary to construct reinforced concrete culverts, headwalls and modified culvert No.2 with P.C.C. repavement which is removed existing concrete block.

All works shall be done strictly in accordance with the drawings, specifications, and as directed by the Engineer.

### 5.8.2 - Unclassified Excavation

Trenches and foundation pits for structures or structure footings shall be excavated to the lines and grades or elevations shown on the drawings or as directed by the Engineer.

The excavation shall be of sufficient size to permit the placing of the full width and length of the structure or structure footings shown.

The elevations of the bottoms of footings, as shown on the drawings, shall be considered as approximately only, and the Engineer may order, in writing, changes in dimensions or elevations of footings necessary to secure a satisfactory foundation.

After each excavation is completed, the Contractor shall notify the Engineer to that effect, and concrete or reinforcing steel shall be placed after the Engineer has approved the depth of the excavation and the character of the foundation materials.

### 5.8.3 - Backfilling

After a structure has been completed, backfilling with approved materials shall be accomplished by applying the fill in horizontal layers not to exceed 30 cm in loose depth, under paved area and shoulder shall be compacted to not less than 95% of maximum density obtained when tested in accordance with JIS A 1211 (Modified A.A.S.H.O.)

In other fill section, the materials shall be compacted to not less than 90% of maximum density.

5.8.4 - Gravel fill for Structure Bed

The Contractor shall supply the gravel of quality and grading approved by the Engineer and shall place and compact the gravel in a manner satisfactory to the Engineer.

5.8.5 - Concrete

5.8.5.1 - Materials

(a) Aggregates

The Contractor shall furnish the coarse and fine aggregates for structural concrete from any sources approved or directed by the Engineer, and such aggregates shall be natural gravel and sand.

The aggregates shall have a reasonably uniform and stable moisture content.

(1) Coarse Aggregate

The coarse aggregate shall be separated into nominal sizes and shall be graded as follows:

<u>Designation of size</u>	<u>Nominal size range</u>	<u>Minimum percent retained on screen indicated</u>
20 mm aggregate	5 to 20 mm	50 percent on 10 mm screen
40 mm aggregate	20 to 40 mm	50 percent on 25 mm screen

(2) Fine Aggregate

The fine aggregate, as batched, shall be well graded and shall conform to the following limits:

<u>Screen designation</u> Mean opening (mm)	<u>Individual percent by weight retained on screen</u>
10	0
5	0 - 5
2.5	5 - 15
1.2	10 - 25
0.6	10 - 30
0.3	15 - 35
0.15	12 - 20
Pass	3 - 7

(b) Cement

All cement used for structural concrete shall conform to the provisions for normal Portland cement in JIS R-5210.

5.8.5.2 - Construction Methods

All machinery and equipment owned or controlled by the Contractor, which he proposes to use on the work, shall be of sufficient sizes to meet the requirements of the work, and shall be such as to produce satisfactory work, all work shall be subject to the inspection and approval of the Engineer.

(a) Concrete Proportion

The mix to be used is as described in the table below.

<u>Item</u>	<u>Mix designation</u>
Minimum compressive strength age 28 days: (kg/cm <sup>2</sup> )	240
Maximum size of aggregate: (mm)	40
Cement content: (kg/m <sup>3</sup> )	290
Air entrained: (%)	4 - 5
Mixing water:	From 50 to 75% of the weight of cement
Max. slump: (cm)	8.0

The amount of cement content above shown are not final but the Engineer may change the above amounts of cement content according to the future test results of concrete.

(b) Forms

Concrete shall not be placed until all the forms and reinforcements have been inspected and approved by the Engineer.

Forms shall be of suitable material and shall be the type, size, shape, quality, and strength suited to build the structure as designed on the drawings.

The forms shall be true to line and grade and shall be mortar-tight and sufficiently rigid to prevent displacement and sagging between supports.

The Contractor shall bear responsibility for their adequacy.

The surfaces of forms shall be smooth and free from irregularities, dents, sags, and holes. The internal ties shall be arranged so that, when the forms are removed, no metal will show in the concrete surface or discolor the surface when exposed to weathering. All forms shall be wetted with water or with a nonstaining mineral oil which shall be applied shortly before the concrete is placed.

The forms shall not be removed before the expiration of at least 30 hours from vertical faces, walls, slender columns, and similar structures, forms supported by falsework under slabs, beams, girders, arches, and similar construction shall not be removed until tests indicate that at least 60% of the design strength of the concrete has developed.

(c) Placing Reinforcement bars

All reinforcement bars shall be accurately placed, as shown on the drawings or specified by the Engineer, and shall be firmly held in position during concreting. Bars shall be fastened together at intersections. The reinforcement bars shall be supported by approved metal chairs.

Shop drawings, lists, and bending details shall be supplied by the Contractor when required.

(d) Placing Concrete

All concrete shall be placed during daylight, unless otherwise approved. The concrete shall not be placed until the depth and character of foundation, the adequacy of forms and falsework, and the placing of the steel reinforcing have been approved.

Concrete shall be placed as soon as practicable after mixing and in no case later than 1 hour after water has been added to the mix.

The method and manner of placing shall be such as to avoid segregation and displacement of the reinforcement.

The concrete shall be compacted with suitable mechanical vibrator operating within the concrete. When necessary, vibrating shall be supplemented by hand spading with suitable tools to assure proper and adequate compaction.

Vibrators shall be manipulated so as to work the concrete thoroughly around the reinforcement and into corners and angles of the forms.

The vibration at any joint shall be of sufficient duration to accomplish compaction but shall not be prolonged to such an extent since segregation.

(e) Construction joints

When the placing of concrete is suspended, necessary provisions shall be made for joining future work before the placed concrete takes its initial sets.

For the proper bonding of old and new concrete, such provisions shall be made for grooves, steps, keys, dovetails, reinforcing bars or other devices as may be prescribed. The work shall be arranged so that a section begun on any day shall be finished during daylight of the same day.

Before depositing new concrete on or against concrete which has hardened, the surface of the hardened concrete shall be cleaned with a heavy steel broom, roughened slightly, wetted, and covered with a neat coating of cement paste or grout.

(f) Curing and Protection

All concrete shall be properly cured and protected by the Contractor. The work shall be protected from the elements, flowing water, and from defacement of any nature during the building operations.



The concrete shall be cured as soon as it has sufficiently hardened by covering with an approved material. Water-absorptive coverings shall be thoroughly saturated when placed and kept saturated for a period of at least 3 days.

All curing mats or blankets shall be sufficiently weighted or tied down to keep the concrete surface covered and to prevent the surface from being exposed to currents of air. Where wooden forms are used, they shall be kept wet at all times until removed to prevent the opening of joints and drying out of the concrete. Traffic shall not be allowed on concrete surfaces for 7 days after the concrete has been placed.

#### 5.8.6 - Measurement and Payment

##### (a) Measurement

- (1) Measurement for payment for unclassified excavation shall be the number of cubic meters, measured in original position, of material excavated in accordance with the drawings, or as directed by the Engineer.
- (2) Measurement for payment for preparing gravel bed for structure and for backfilling shall be the number of cubic meters measured in place placed and compacted in accordance with the specifications.
- (3) Measurement for payment for concrete shall be the number of cubic meters of concrete, complete in place and accepted. In computing the metric volume of concrete for payment, the dimensions used shall be those shown on the drawings or ordered by the Engineer.
- (4) Measurement for payment for reinforcing steel shall be the calculated theoretical number of weight placed as shown on the drawings, complete in place and accepted.

(b) Payment

Payment will be made at the contract unit price per cubic meter for unclassified excavation for structures, at the contract unit price per cubic meter for gravel fill for structure bed, at the contract unit price per cubic meter for concrete for the structures, at the contract unit price per weight for reinforcing steel, and at the contract unit price per cubic meter for backfilling.

These prices shall be the full compensation for furnishing all materials and for all preparation, excavation, and placing the materials and for all labor, equipment, tools, and incidentals necessary to complete the structure.

<u>PAY ITEM</u>	<u>UNIT OF MEASUREMENT</u>
(1) Unclassified excavation	m <sup>3</sup>
(2) Gravel fill	m <sup>3</sup>
(3) Structural concrete	m <sup>3</sup>
(4) Reinforcing steel	ton
(5) Backfilling	m <sup>3</sup>

5.9 - REMOVAL OF EXISTING FENCE AND LANDING MAT

5.9.1 - General

This work shall comprise all labor, materials and plant, and the performance of all work necessary for the removal, transportation and salvage of existing fence and P.S.P. landing mat as shown on drawing, and as directed by the Engineer.

5.9.2 - Fence & Landing Mat

Fence and landing mat to be removed, shall be barbed wire fence with concrete posts, anchor and strainers, and pierced steel plank.

The barbed wire fence already constructed in expanded apron area shall be salvaged and cleaned. And the pierced steel plank installed on extended parallel taxiway area shall be salvaged and stockpiled with cleaned.

### 5.9.3 - Measurement

Measurement for payment for removal of existing fence and landing mat, shall be on the basis of the length in meters of existing fence, and the basis of an extent in m<sup>2</sup> of existing landing mat, satisfactorily salvaged and cleaned.

## 5.10 - DEFORESTING AND GRUBBING

### 5.10.1 - General

The work shall comprise all labor, materials and the performance of all work necessary for the deforesting and grubbing.

### 5.10.2 - Trees

The forest, a thicket of assorted trees where located on northwest side of the airport, shall be deforested grubbed, cleaned and disposed of as directed by the Engineer.

### 5.10.3 - Measurement

Measurement for payment of deforesting and grubbing, shall be on the basis of an extent in m<sup>2</sup> of the existing forest area.

## 5.11 - INSTALLATION OF DISTANCE SIGN BOARD

### 5.11.1 - General

This work shall comprise labor, materials and the performance of all work necessary for providing of new boards, painting and setting.

### 5.11.2 - Distance sign board

All distance sign board shall be installed along shoulder, northeast side of the existing runway, conform to the details as shown on drawing.

### 5.11.3 - Measurement

Measurement for payment of installation shall be on the basis of all boards.

## 5.12 - ASPHALT SURFACING

### 5.12.1 - General

The work required for "Vehicle Entrance" between expanded unpaved access road from gas supply facility and expanded apron, located north side of the existing terminal building. This work shall comprise all labor, material, plant, equipment and the performance of all work necessary to construct "Vehicle Entrance". All work shall be done in accordance with the drawing, and as directed by the engineer.

### 5.12.2 - Surface Course

This work shall consist of a surface course composed of mineral aggregate and bituminous, the surface course shall be constructed in two or more courses, each course shall be constructed to the depth, typical section, or elevation required by plans and shall be rolled, finished, and approved before the placement of the next course.

### 5.12.3 - Prime Coating

The coating shall consist of an application of bituminous material on the prepared base course, the type of bituminous material to be used shall be selected by the engineer.

### 5.12.4 - Tack Coating

The coating shall consist of supplying and applying bituminous material to a previously prepared, bonded and or bituminized binder, leveling or base course.

### 5.12.5 - Measurement

The unit of measurement for the surfacing and the coating shall be in ton, whichever is specified in the bid schedule, and the tonnage to be paid shall be the number of tons of surfacing material used as ordered in the accepted work.

## 5.13 - ELECTRICAL INSTALLATIONS

### 5.13.1 - General

#### 5.13.1.1 - Scope

This item covers the manufacture, tests before shipment, transport to site, erection and test at site, and electrical equipment and materials for airport illumination accompanying the existing taxiway and extended taxiway as follows:

- (a) Runway edge lights for the intersections between existing runway and new runway exit taxiways.
- (b) Taxiway edge lights of the following items:-
  - (1) Existing and extended apron
  - (2) Existing access taxiway No.4
  - (3) Some parts of the existing access taxiway No.2
  - (4) Existing and extended parallel taxiway
  - (5) New runway exit taxiway No.1 and No.3
- (c) Unserviceability lights for the end of extended parallel taxiway
- (d) Detour of the main cable duct and hand holes
- (e) Alteration of the existing wind cone
- (f) Constant current regulator
- (g) Flashing equipment of the flashing beacon
- (h) Main power distribution panel
- (i) Change-over switch
- (j) Power receiving equipment
- (k) Cable systems for illumination and others
- (l) Others

#### 5.13.1.2 - Applicable Standards

- (a) Design, manufacture, tests and inspection of the equipments and materials shall be according to the standards of Japan Civil

Aviation Bureau (JCAB), and the standards and recommendations of ICAO.

For equipment not described in the standards of the JCAB, reference shall be made to the undermentioned Public Standards in Japan.

- (1) Japan Industrial Standards (JIS)
- (2) Standards of Japan Electrical Machinery Manufacturers' Association (JEM)
- (3) Standards of Japan Cable and Wire Manufacturers' Association (JCS)
- (4) Electrical Standards of the Institute of Electrical Engineers, Japan (JEC)

- (b) The Installation works at site shall be in accordance with the regulation of Electrical Code in Japan, or equivalents.

#### 5.13.1.3 - Existing Installations

In performance of the work, special care shall be taken not to damage the existing installations, and in case any damage should occur, the repair work shall be carried out at the responsibility of the Contractor in accordance with the direction of the Engineer.

#### 5.13.1.4 - Cable Markers

The concrete marker slabs shall be placed at the following locations according to the direction of the Engineer.

- Cable connections
- Curves of cable run
- Points 100 m apart in straight cable run

#### 5.13.1.5 - Duct Markers

The duct markers shall be placed in accordance with DWG. No.50 and 60 of the Contract Drawings at the following locations.

- Cross ducts for extended parallel taxiway
- Cross ducts for access taxiway No.4 which is the extension portion
- Cross ducts for new runway exit taxiway No.1 and No.3

#### 5.13.1.6 - Ground Markers

Where the grounding positions are necessary the ground markers shall be placed in accordance with the Engineer's direction.

#### 5.13.1.7 - Paint Finish

All metal parts shall be painted with one coat of anticorrosive paint, and two coats of finishing paint.

#### 5.13.1.8 - Removal of Installations

The removal of unnecessary installations shall be carried out at the responsibility of the Contractor in accordance with the Engineer's direction.

#### 5.13.1.9 - Temporary Installations

In the process of the work, temporary installations shall be made in such a way that they do not interfere with the operation of the airport, in accordance with the Engineer's direction.

#### 5.13.1.10 - Test at Site

After the completion of this work, at the indication of the Engineer, following tests shall be carried out by the Contractor.

- (1) Inspection
- (2) Load test
- (3) Operation test
- (4) Insulation resistance measurement
- (5) High voltage test (Existing 6.6 kV/380-220V Power receiving equipment and New 22/6.6kV Power receiving equipment, etc.)
- (6) Ground resistance measurement

#### 5.13.2 - Specifications for Equipment

##### 5.13.2.1 - Runway Edge Lights

###### (a) High Intensity Marker Lights

Runway edge lights for the intersections between existing runway and new runway exit taxiway No.1 and No.3 are to be of flush type, type III, in accordance with the revised edition-2 of

Specifications No.179 "H-8 Type High Intensity Marker Lights" of Japan Civil Aviation Bureau (JCAB).

The color of lights shall be white-white and yellow-white.

(b) Light Bases

Light bases are designed for the type A-1 in accordance with the revised edition of Specifications No.211 "Flush type Light Base" of JCAB as shown on the DWG.No.59 of Contract Drawings.

(c) Insulating Transformers

Insulating transformers shall be of the type LT-200 (6.6 Amp., 200 Watt, 50 Hz and AC) in accordance with the revised edition-4 of Specifications No.99 "Rubber Insulating Transformer utilized in Series Lighting Circuit" of JCAB.

(d) Adapters

Adapters shall be of the type A-5 and B-5 (5,000 V, 25A) in accordance with the revised edition of Specifications No.188 "Adapter utilized in Airport Illumination" of JCAB.

(e) Quantities of the Equipment

(1) Runway lights (white-white)	200 W	8 ea.
(2) Runway lights (Yellow-White)	200 W	1 ea.
(3) Insulating transformers	6.6A, 200 W	9 ea.
(4) Light bases		9 ea.
(5) Adapters	Type A-5 and B-5	9 ea.
(6) Spare Parts		
Lamps	AF 6.6A 200 WGR	30 ea.
High intensity edge lights	type H-8-III	2 ea.
Insulating transformers	type LT-200	2 ea.
Adapters	type A-5 and B-5	10 ea.
Packings for upper and lower of lighting fixture		20 ea.



5.13.2.2 - Taxiway Edge Lights

(a) Medium Intensity Marker Lights

Taxiway edge lights for the new runway exit taxiway No.1 and No.3, existing and extended parallel taxiway, some part of the existing access taxiway No.2, existing access taxiway No.4, and existing and extended apron shall be surface type, and shall be designed in accordance with the revised edition-3 of Specifications No.143 "Type M-1 Medium Intensity Marker Lights" of JCAB.

The color of light shall be blue.

(b) Light Bases

Light bases are designed for the type A-1 in accordance with the revised edition of Specifications No.211 "Flush Type Light Base" of JCAB as shown on the DWG.No.59 of Contract Drawings.

(c) Insulating Transformers

Insulating transformers shall be of the type LT-60A (6.6 Amp., 60 Watt, 50 Hz and AC) in accordance with the revised edition-4 of Specifications No.99 "Rubber Coated Insulating Transformers utilized in the Series Lighting System" of JCAB.

(d) Adapters

Adapters shall be of the type A-3 and B-3 (3,000V, 25A) in accordance with the revised edition of Specifications No.188 "Adapter utilized in Airport Illumination" of JCAB.

(e) Quantities of the Equipment

(1) Taxiway Lights	blue, 45W	202 ea.
(2) Insulating Transformers	6.6A, 60W	202 ea.
(3) Light Bases		202 ea.
(4) Adapters	Type A-3 and B-3	202 ea.
(5) Spare Parts		
Lamps	AF 6.6A 45W	400 ea.
Blue Prismatic Globe Lens		50 ea.

Breakable Couplings		50 ea.
Medium Intensity Marker Lights	Type M-1	25 ea.
Insulating Transformers	Type LT-60A	25 ea.
Adapters	Type A-3 and B-3	25 ea.
Light Bases		5 ea.

5.13.2.3 - Unserviceability Lights

(a) Medium Intensity Marker Lights

Unserviceability Lights for the end of extended parallel taxiway shall be surface-type designed in accordance with the revised-3 of Specifications No.143 (Type M-1 Medium Intensity Marker Lights) of JCAB.

The color of light shall be red.

(b) Light Bases

Light Bases are designed for the type A-1 in accordance with the revised edition of Specifications No.211 "Flush type Light Base" of JCAB as shown on the DWG.No.59 of Contract Drawings.

(c) Insulating Transformers

Insulating Transformers shall be of the Type LT-60A (6.6 Amp., 60 Watt, 50 Hz and AC) in accordance with the revised edition - 4 of Specifications No.99 "Rubber Coated Insulating Transformers utilized in the Series Lighting System" of JCAB.

(d) Adapters

Adapters shall be of the Type A-3 and B-3 (3,000 V, 25A) in accordance with the revised edition of Specifications No.188 "Adapter utilized in Airport Illumination" of JCAB.

(e) Quantities of the Equipment

(1) Unserviceability Lights	red, 45W	5 ea.
(2) Insulating Transformers	6.6A,60W	5 ea.
(3) Light Bases		5 ea.
(4) Adapters	Type A-3 and B-3	5 ea.

(5) Spare Parts

Lamps	AF 6.6A 45W	10 ea.
Red Prismatic Globe Lenses		10 ea.
Breakable Couplings		5 ea.
Medium Intensity Marker Lights	Type M-1	5 ea.
Insulating Transformers	Type LT-60A	5 ea.
Adapters	Type A-3 and B-3	5 ea.

5.13.2.4 - Wind Cone

(a) Wind Cone

Lower parts of the wind cone shall be designed in accordance with the rivised edition-2 of Specifications No.90 "Type-I Wind Cone" of JCAB, as shown on the DWG.No.58 of Contract Drawings.

Upper part of the existing wind cone shall be used in this contract.

Step down transformer (1ϕ, 220/110V, 1500VA), transformer cabinet and others shall be according to the Contract Drawings.

(b) Quantities of the Equipment

(1) Lower parts of the wind cone		1 set
(2) Stop-down transformer	220V/110V 1800VA	1 ea.
(3) Wind sockes		2 ea.

5.13.2.5 - Constant Current Regulator

(a) Constant current Regulator

The constant current regulator shall be according to the rivised edition-2 of Specification No.208 "Type CR Constant Current Re-gulator" of JCAB, as shown on the DWG. No.54 of Contract Drawings.

(b) Principal Specifications

(1) Type:	CR-20
(2) Output Rating:	20 KVA, 6.6A
(3) Dimensions:	Height 1900
(mm)	Width 1700
	Depth 900

- (4) Input Voltage: 380 Volts, 50 Hz  
single phase
- (5) Input Transformer  
Voltage Tapping: 400V, 380V, 360V, 340V
- (6) Arresters: Valve type Arrester 2 ea.
- (7) Current Recording  
System: Direct operation system

(c) Quantities of the Equipment

- (1) Type CR-20, Constant Current Regulator 1 ea.
- (2) Spare Parts
  - Lamps 20 ea.
  - Signal lamp covers (red and green) 1 lot
  - Fuses 1 lot

5.13.2.6 - Flashing Equipment of the Flashing Beacon

(a) Flashing Equipment

New flashing equipment of the flashing beacon shall be installed at the same position.

Flashing equipment shall be equipped with complete fittings for AC 220 volt, 50 Hz source and two 600 W lamps.

(b) Quantities of the equipment

- (1) Flashing equipment 1 ea.
- (2) Lamp 220V, 600W 20 ea.

5.13.2.7 - Main Power Distribution Panel

(a) Main Power Distribution Panel

A main power distribution panel shall be installed newly to replace instead of the existing main power panel at the same position. Power for the constant current regulator (Type CR-20 and CR-30), distribution panel, lighting panel, radiator fan of engine generator, terminal building, lighting of apron and others is distributed from the Main Power Distribution Panel.

(c) Principal Specifications

- (1) Outer Dimensions
 

Height	1,950
(mm)	Width
	1,000
	Depth
	600

(2) Construction

The cabinet shall be indoor type.

A voltmeter and a selection switch for voltmeter shall be mounted on the front panel.

The panel shall be of dead front, no-fuse circuit breaker type, and suitable for operation on AC 380-220 volt, three-phase, four-wire system, 50 Hz as shown on the DWG. No.55 of Contract Drawings.

(3) Main Devices

(i) Main	3P	400AF/400AT	1 ea.
(ii) Branch	3P	150AF/150AT	2 ea.
	3P	100AF/100AT	1 ea.
	3P	30AF/30AT	3 ea.
	2P	225AF/225AT	1 ea.
	2P	100AF/100AT	3 ea.
(iii) Square-type voltmeter		500V	1 ea.
(iv) Selection switch for voltmeter			1 ea.

(c) Quantity of the equipment

Main power distribution panel 1 ea.

5.13.2.8 - Change-over Switch

(a) Change-Over Switch

A new change-over switch shall be installed to replace the existing switch at the same position.

Its function is to change-over the power supply system for the city power to the existing emergency use diesel generators and vice versa. This switch shall be provided with magnet contactors, as shown on the DWG. No.55 of Contract Drawings.

(b) Construction

The magnet switch shall be mounted inside the steel cabinet of

front door type and wall mounted model, and may be wired from the bottom side.

The control panel of change-over switch shall be of steel cabinet of front door type and wall mounted model.

(c) Quantities of the equipment

- |  |       |
|--|-------|
| (1) Change-over switch panel (magnet switch, 3 pole-double-throw, 600A)                    | 1 ea. |
| (2) Control panel of change the power supply system between city power and emergency power | 1 ea. |
| (3) Spare parts<br>Signal lamps (red and green)  | 5 ea. |

5.13.2.9 - Power Receiving Equipment

(a) Power Receiving Equipment

22KV power receiving equipment is installed outdoor at the left side of the existing 6.6 KV power receiving cubicle as shown on the DWG. No.56 of Contract Drawings.

(b) 250 KVA Transformer

The transformer shall be designed with the following specifications:-

(1) Type and Ratio:

The transformer shall be of three phase, self-cooled, oil-immersed, outdoor type with radiators and shall be provided with such measures as required to isolate the oil from the atmospheric air. The no-load ratio of delta-delta connection shall be 23F-22F-21R-20F kV to 69F-66R-63F of three-phase three-wire system. The connection shall be arranged in accordance with vector symbol Dy Ddo of JEC-168 (1966) or B.S.171: 1959.

The transformer shall also be provided with a skid base and locked after positioning on its foundation by means of appropriate devices.

(2) Insulation

All windings shall have full insulation.

The basic insulation level of primary winding (22 kV side) shall be of 150 kV.

(3) Temperature Rise

The maximum temperature rise shall not exceed the following value at the rated output.

Oil (by thermometer)	50°C
Winding (by resistance)	50°C

(4) Frequency

The transformer shall be designed for a frequency of 50 Hz.

(5) Tap Changer

A convention externally operated tap changer, operable under no-voltage, shall be provided on the 22 kV side.

(6) Bushing

The bushings shall be of solid type and the color of bushing shall be brown.

(7) Insulating oil

Insulating oil shall be of non-sludging and of medium viscosity, characteristics of which shall be stated in the tender.

(c) Fusible Disconnecting Switches

Fusible disconnecting switches shall be of outdoor, single pole, hook operated type, 24 kV, 20A and 250 MVA r.m.s. symmetrical rupturing capacity, adequate for downward oblique installation on the pole structure as shown on the Contract Drawings.

Each fusible disconnecting switch shall be provided with a spare fuse element and adequate two clamp type terminals.

A hook stick for operating fusible disconnecting switches shall be of adequate design and provided with a guard ring with earthing chains.

(d) Lighting Arresters

Lighting arresters shall be of outdoor use, 28 kV, 10 KA discharge current rating and suitable for mounting on the pole structure. Each arrester shall be provided with an adequate clamp type terminal and an earthing rod.

(e) Metering Outfit

A three-phase metering outfit shall be supplied for measuring electric energy for power trading.

A watthour meter (1.0% class) for power trading shall be mounted at the position where a watthour meter for 6.6 kV circuit exists in the 6.6 kV cubicle by replacing the existing meter.

The metering outfit shall be of oil-immersed, outdoor type and the rating shall be as follows:-

Rated voltage	22 kV
Voltage ratio	22 kV/110 V
Current ratio	10/5A
Rated burden	PT 2 x 15 VA
	CT 2 x 15 VA
Accuracy class	0.5% class

(f) Other Materials

Concrete poles, arms, arm tie, stay wires, pin type insulator, conduit, cement and others of approved design and quality by the Engineer shall also be supplied. To complete the dead and structure as given in the Contract Drawings.

(g) Quantities, accessories and spare parts of the equipment

Transformer 1 ea.

(i) The following accessories shall be provided for the transformer:-



- a) One name plate showing maker's name, serial number, year of manufacture, type, capacity and other main characteristics.
  - b) One diagram plate
  - c) Drain and inlet valves
  - d) Line side clamp type terminals and earthing terminal
  - e) Explosion vent (if any)
  - f) Oil level gauge (if any)
  - g) Hand hole
  - h) Silicagel dehydrating breather (if necessary)
  - i) Dial type thermometer with alarm contact
  - j) Pressure gauge with alarm contact (if necessary)
  - k) Any additional accessories of the manufacturer's standard.
- (ii) The following spares shall be supplied for transformer:-
- a) One set of gaskets
  - b) Other necessary spare parts recommended by the Contractor.

Fusible disconnecting switches	3 ea.
Fuses for above	9 ea.
Lightning arresters (including spare)	9 ea.
Metering outfit	1 ea.
Wathour meter	1 ea.
Other	1 lot.

5.13.2.10 - Wires, Cables and Others

(a) Types and Approximate Quantities

Wires and cables shall be as specified below but their quantities are approximate values for reference only. Necessary quantities for this work shall be supplied by the Contractor at his own cost. No adjustment of the Contract Price is made on account of increase or decrease of the quantity.

(1)	Cable for airport illumination, 3 kV butyl rubber insulated and chloroprene-sheathed cable (Power supply for the taxiway lights)	8 sq.mm x 1 c	8,600 m
(2)	Cable for airport illumination, 5 kV butyl-rubber insulated and chloroprene sheathed cable (Power supply for the runway lights)	8 sq.mm x 1 c	1,700 m
(3)	Cable for wind cone (from vault room to the wind cone)	600 V BN 8 sq.mm x 2 c	850 m
(4)	Ground-wire, bare annealed copper	8 sq.mm	720 kg
(5)	Power Cable (from the pole to the 250 kV transformer)	HDCC 38 sq.mm	30 m
(6)	Power Cable (from the change-over switch to the main power distribution panel)	600 V RN 200 sq.mm x 3 c 600 V RN 200 sq.mm x 1 c	20 m 20 m
(7)	Power Cable (from the generator panel to the change- over switch)	600 V RN 100 sq.mm x 1 c x 4	30 m
(8)	Power cable for apron illumination (from the knife switches for apron illumination to the main power distribution panel)	600 RN 38 sq.mm x 3 c 600 RN 38 sq.mm x 1 c	15 m 15 m

(9)	Power Cable (from the main power distribution panel to the CR-20 CCR)	RN 14 sq.mm 2 c	15 m
(10)	Cable for control (from the distribution panel to Type CR-20 CCR)	CVV 5.5 sq.mm x 2 c CVV 3.5 sq.mm x 2 c	10 m 10 m
(11)	Power Cable (from the new 250 kVA trans- former to the existing receiving cubicle)	6.6 kV BN 14 sq.mm x 3 c	10 m
(12)	Power Cable (from the existing receiv- ing cubicle to the change- over switch)	600 V RN 200 sq.mm x 3 c 600 V RN 200 sq.mm x 1 c	35 m 35 m

Power cables of item (11) and (12) above-mentioned have been stored in vault room since first stage.

(b) Methods of Connection

Unless specified otherwise, wires and cables shall be connected with compression connectors.

(c) Cable Head

6 KV BN 14 sq.mm x 3 c cable head 1 set

(d) Other Materials

(1)	Adapter, Type A-3	10 ea.
(2)	" , Type B-3	10 ea.
(3)	" , Type C-3	30 ea.
(4)	" , Type A-5	5 ea.
(5)	" , Type B-5	5 ea.
(6)	" , Type C-5	10 ea.
(7)	" , for RN Cable 8 sq.mm x 2 c	5 ea.
(8)	Grounding Rod 14 mm $\phi$ x 1,500 mm	30 ea.

#### 5.13.2.11 - Miscellaneous Materials

Asbestos cement pipe, conduit tubes, paint, cement, and other items deemed necessary for this work, shall be supplied and comply with the high grades specified in relevant standards.

#### 5.13.2.12 - Electrical Instrument

The following items shall be supplied for maintenance use.

- |   |       |
|---|-------|
| (1) Circuit tester (YEW L-22T or Equivalent)          | 1 set |
| (2) Insulation tester (500 V, 100 Megohm)<br>(Megger) | 1 set |

#### 5.13.2.13 - Tests

The following tests shall be carried out before shipment:

- (a) Fixtures, insulating transformers, light bases, adapters, cables, constant current regulator and flashing equipment, etc. shall be carried out in accordance with the Clause 5.13.1.2 "Applicable Standards".
- (b) Transformer
  - (i) Dimension check
  - (ii) Ratio and polarity
  - (iii) Characteristics
  - (iv) Measurement of insulation resistance
  - (v) High voltage test
  - (vi) Impulse voltage test
  - (vii) Temperature rise test
- (c) Fusible disconnecting switches
  - (i) Construction
  - (ii) Measurement of resistance
  - (iii) High voltage test
  - (iv) Impulse voltage test
  - (v) Operation test

- (d) Lightning arresters
  - (i) Measurement of insulation resistance
  - (ii) Power frequency flashover voltage test
  - (iii) Impulse flashover voltage test
- (e) Metering outfit:
  - (i) Ratio and phase error test
  - (ii) High voltage test
  - (iii) Impulse voltage test
- (f) Main power distribution panel and change-over switch panel
  - (i) Inspection of construction
  - (ii) High voltage test
  - (iii) Measurement of Insulation resistance
  - (iv) Calibration test for meters
  - (v) Characteristics test for relays
  - (vi) Checking of connection

(g) Miscellaneous Materials

The tests stated in the applied standards or maker's routine test shall be carried out before shipment.

5.13.3 - Specifications for Work

5.13.3.1 - Installation Works for the Runway and Taxiway Edge Lights, etc.

- (a) Outline
  - (1) The works include the installation, piping and wiring of the runway lights, taxiway lights and unserviceability lights.
  - (2) Arrangement of all lighting equipment and cable connections is performed as shown on the DWG. No.50, 51, 52 and 53 of Contract Drawings.
- (b) Removal works of the Existing Lights and Cables  
Removal works of the existing lights, cables, insulating transformers, and light bases shall be performed in accordance with the Engineer's directions.

(c) Installation of the Lighting Equipment

- (1) All lighting fixtures are mounted on individual bases together with their insulating transformers. The works shall be done in accordance with the Contract Drawings.
- (2) Light bases are of concrete placed at site, and the lights shall be installed horizontally (within  $\pm 2^{\circ}$ ).
- (3) The item number of the lights is marked in red paint on the surface of the light bases in accordance with the Engineer's directions.
- (4) The secondary terminals of the insulating transformers are connected with chloroprene-sheathed cable (600 V 2C x 35 sq.mm).
- (5) The connections between the primary terminals of the insulating transformers for runway lights and rubber-insulated chloroprene-sheathed cable (5 kV 1C x 8 sq.mm) shall be connected with the adapter (Type A-5, B-5).
- (6) The connections between the primary terminals of the insulating transformers for taxiway lights and rubber-insulated chloroprene-sheathed cable (3 kV 1C x 8 sq.mm) shall be connected with the adapter (Type A-3, B-3), and also unserviceability lights.

(d) Laying of Cable

- (1) Cables for runway lights shall be of butyl-rubber insulated chloroprene-sheathed, 5 kV 1C x 8 sq.mm cable defined in the revised edition-3 of Specification No.111 of JCAB.
- (2) Cables for taxiway lights and unserviceability lights shall be of butyl-rubber insulated chloroprene-sheathed 3 kV 1C x 8 sq.mm cable defined in the revised edition-3 of Specifications No.111 of JCAB.

- (3) Both ends of the cable shall be connected with the airport lighting adapter, defined in the revised edition of Specifications No.188 or JCAB.
- (4) After measurement at site, the length of the cable may be adjusted as necessary and then buried directly in accordance with the Engineer's direction.
- (5) The cable portions to be buried directly, shall be laid using vinyl pipe protection (V.P.-50).
- (6) The cable portions for the runway lights to be buried underground the new runway exit taxiway No.1 and No.3 shall be laid using carbon steel pipe (SGP-50A) protection.
- (7) On connection of cables, adhesive tape shall be wound twice round and then vinyl tape shall be wrapped once round and finished.

(e) Laying of Ground Wire

- (1) 8 sq.mm bare annealed copper wire shall be used as the ground wire.
- (2) A copper-clad, ground rod, size 14 mm $\phi$  x 1.5 m, shall be used in grounding.
- (3) The work shall be done in accordance with the Contract Drawings.

(f) Arrangement of Color

- (1) The runway edge lights shall be fixed lights showing variable white-white. Those installed from the runway end to the 600 m point are to be made white-yellow, yellow-white.
- (2) The taxiway edge lights shall be fixed lights showing blue.
- (3) The unserviceability lights shall be fixed lights showing red.

(g) Ducts for Crossing of Taxiway-

- (1) Ducts for crossing of new runway exit taxiway No.1, new runway exit taxiway No.3 and extended parallel taxiway shall be constructed, and span of ducts shall be as indicated on the Contract Drawings.
- (2) Ducts for crossing of access taxiway No.4, which is the extension portion, shall be extended from the existing duct.
- (3) Handholes shall be constructed in accordance with the Contract Drawings when the cables pass through in the ducts.

5.13.3.2 - Constructions of the Main Cable Duct and Handholes

(a) Outline

The work includes the construction of the main cable duct and handholes for the cable for existing runway lights, runway threshold lights stopway lights and turning pan taxiway lights, and for extended taxiway lights, unserviceability taxiway lights, runway lights, and wind cone.

(b) Removal of the Existing Main Cable Duct

Removal work of the existing main cable duct, handholes and cable shall be performed in accordance with the Engineer's directions.

- (c) Constructions of the Detour of the Main Cable Duct and Handholes  
Construction works of the detour of the main cable duct and handholes shall be performed in accordance with the Contract Drawings and Engineer's directions.

5.13.3.3 - Alteration Works of the Wind Cone

(a) Outline

This work includes the installation and wiring of the wind cone.

(b) Installation of the Wind Cone

- (1) The wind cone is to be installed on the concrete base made in accordance with the DWG. No.50 and 58 of the Contract Drawings.



- (2) A circular-zone of concrete structure shall be installed encircling the wind cone, the surface of which shall be covered with white mortar and asphalt.

The work shall be done according to the Contract Drawings.

- (3) Upper part of the existing wind cone shall be used.

(c) Laying of Cables

- (1) Butyl-rubber insulated chloroprene-sheathed 2c x 8 sq.mm 600 V cable is to be used.
- (2) After survey at site, the cable shall be adjusted to the necessary length and laid, according to the Engineer's direction.

The length of directly buried portion is about 280 m, and the length of cable laid in duct is about 570 m.

- (3) The portion of new laid cable, which is to be buried directly, shall be laid using vinyl pipes (V.P.50) exclusively to protect the cable.
- (4) The connection of cable shall be made at hand holes, any connection not at a hand hole shall not be adopted.
- (5) A Carbon Steel pipe of 13 meters long and 50 mm in diameter shall be installed under the circular-section as a cable duct, and the conduit pipe of 36 mm dia. for cable shall be buried in the wind cone base.
- (6) For the ground wire, 8 sq.mm bare annealed copper wire is used, and the grounding rod shall be 14 mm $\phi$  x 1.5 m copper-clad connecting rod grounded somewhere around the circular zone.
- (7) As a principle, the cable laying shall be carried out utilizing the main cable duct as shown on the Contract Drawings.

#### 5.13.3.4 - Installations of the Constant Current Regulator

(a) Outline

This work includes the installation and wiring of the constant current regulator in the vault room.

(b) Installation of the Equipment

20 KVA constant current regulator shall be installed according to the Contract Drawings.

(c) Cable Trench for Wiring

The trench for wiring shall be installed in the vault room as shown on the Contract Drawings.

#### 5.13.3.5 - Installation of the Electrical Equipment for Power Source

(a) Outline

The electrical loads of the equipment including existing ones shall be adjusted to give a fully balanced 3-phase load. Existing pole including transformers are removed, and an outdoor switchgear shall be installed, with all piping and wiring. The work shall be performed according to the Contract Drawings and Engineer's directions.

(b) Removal of the Existing Pole Transformers and Wiring, etc.

- (1) The existing pole including three pole transformers (single phase, 50 Hz. 37.5 KVA), arresters, cutout switches, and the wiring from the primary of the transformers to the cutout switches shall be removed.
- (2) The conduct wiring from the pole transformer to the change-over switch in the vault room shall be removed.
- (3) The safety switch (3p, 100A), change-over knife switch (3p, DT, 500A), main power panel and airfield panel in the vault room shall be removed.

(c) Installation of the Equipment

- (1) The 22/6.6 kV power receiving equipment shall be installed on the left side of the existing 6.6 kV/380 - 220 V power receiving cubicle as shown on the Contract Drawings.
- (2) The change-over magnet switch (3P, DT, 600A) shall be installed to replace the existing change-over knife switch at the same position.
- (3) The main power distribution panel shall be installed to replace the existing main power panel at the same position.
- (4) The flashing equipment shall be installed to replace the existing flashing equipment at the same position, and the existing wire shall be used.

(d) Piping and Wiring

- (1) For the wiring from the 22/6.6 kV transformer to the existing 6.6 kV/380-220 V power receiving cubicle, 6 kV BN 14 sq.mm x 3C cable shall be used. When protections for the cable are necessary, the wiring shall utilize rigid steel pipes shall be used.
- (2) For the wiring from the 6.6 kV/380-220V power receiving cubicle to the change-over magnet switch, 600 V RN 200 sq.mm x 3C and RN 200 sq.mm x 1C cable shall be used. The wiring shall utilize the existing concrete troughs shall be used in such wiring.
- (3) For the wiring from the change-over magnet switch to the main power distribution panel, 600 V RN 200 sq.mm x 3C and RN 300 sq.mm x 1C cable shall be used, and shall utilize the existing cable trench.
- (4) For the wiring from the change-over magnet switch to the control panel of the engine generator, 600 V RN 100 sq.mm 1C x 4 cable shall be used, and shall utilize the existing cable trench.

- (5) For the exposed wiring from main power distribution panel to the knife switches for airport illuminations (mercury lamps), 600 V RN 38 sq.mm 3C x 1 and 1C x 1 cable shall be used.
- (6) The wiring from the main power distribution panel to the CR-20 type CCR shall be single-phase, 380 V, 2-wire system with 600 V RN 2C x 14 sq.mm cable.
- (7) Wiring for the ground wire shall be performed adequately.

#### 5.13.3.6 - Balancing of the Equipment Load

At main power distribution panel, the load connection shall be adjusted so as to give a balanced 3-phase load.

SECTION 6

FORM OF TENDER

SECTION 6

FORM OF TENDER

Note: The Tenderer's name and residence must be inserted here, and, in the case of joint ventures, the name and address of each firm participating must be inserted.

Royal Government of Laos

Gentlemen:

This tender is submitted by .....  
residing at (or place of business) .....  
and .....  
residing at (or place of business) .....  
and .....  
residing at (or place of business) .....  
and .....  
residing at (or place of business) .....  
comprising the firm of .....  
of .....  
a company duly incorporated under the laws of .....  
.....  
The company's head office is located at .....  
it will be hereinafter called the "Tenderer".

This tender is made by the Tenderer without any connection, knowledge, comparison of figures, or arrangement with any other person or persons making a tender for the same work and is in all respects fair and without collusion or fraud.

The Tenderer has carefully examined the Contract Documents comprising

the Instructions to Tenderer, General Conditions, General Specifications, Detailed Specifications, Form of Tender, including Appendices, Form of Agreement, Form of Performance Bond, Drawings, and Addenda Nos. ... \* to ... \*, inclusive, all relating to the Contract for EXTENSION PROJECT-II of Wattay airport, and the Tenderer accepts and agrees to the same as forming, inter alia, part and parcel of the said Contract.

The Tenderer hereby tenders and offers to enter into a Contract to supply and do all that which is set out or called for in the Contract Documents, on the terms and conditions and under the provisions set out or called for in the Contract Documents.

Note: If any of the following Schedules are insufficient, the Tenderer shall amplify them.

\* The Tenderer shall insert here the numbers of the Addenda that he has received.

FORM OF TENDER

SCHEDULE OF QUANTITIES AND PRICE

1. Each individual item in the Schedule of Quantities and Prices shall be priced and the tender will not be considered valid unless a price is affixed to each item. The unit price set down against each item shall not be subject to revision on account of discrepancies or modifications in the quantities or for any other reason, except otherwise specified.
2. The quantities given in the Schedule of Quantities and Prices shall be regarded as approximate only, and the Tenderer shall satisfy himself in regard to the general accuracy of the indicated quantities.
3. The unit prices for Item A, B, C, D and E shall exclude the transportation charge and the depreciation cost of the construction plant or equipment, which shall be priced in Item F. The details of the construction plant or equipment proposed by the Tenderer shall be stated in Appendix "A" and "B" of this tender.





Item No.	Description	Unit	Quantity	Foreign Currency (Yen)		Local Currency (Kip)		Applicable Clause No. of Detailed Spec.
				Unit Price	Amount	Unit Price	Amount	
B	Expanded Apron & Fillet Improvement							
B-1	Stripping of topsoil (by dump truck)	m <sup>3</sup>	6,100					5.1.3.2.
B-2	Removal of soft clay with un-suitable material	m <sup>3</sup>	13,800					5.1.4.2.
B-3	Replacement with sand, 50 cm thickness	m <sup>3</sup>	5,700					5.1.4.2.
B-4	Cutting and filling	m <sup>3</sup>	900					5.1.5.4. 5.1.6.4.
B-5	Embankment (borrowing & subgrading)	m <sup>3</sup>	16,800					5.1.6.4. 5.2.6.
B-6	Base Course, 30 cm thickness (borrowing & grading)	m <sup>3</sup>	6,900					5.3.9.
B-7	Concrete Pavement, 28 cm thickness	m <sup>3</sup>	4,600					5.4.5.
B-8	Concrete pavement, 38 cm thickness	m <sup>3</sup>	130					5.4.5.
B-9	Concrete pavement, 20 cm thickness	m <sup>3</sup>	840					5.4.5.
B-10	Concrete Pavement, 38 cm thickness	m <sup>3</sup>	230					5.4.5.
B-11	Shoulder, sodding	m <sup>2</sup>	5,500					5.5.6.
B-12	Graded area, seeding	m <sup>2</sup>	2,300					5.5.6.
Subtotal B								

Item No.	Description	Unit	Quantity	Foreign Currency		Local Currency		Applicable Clause No. of Detailed Spec.
				Price	Amount	Unit Price	Amount	
				(Yen)		(Kip)		
C.	<u>Drainage, Concrete Culvert &amp; Earth Open Ditch</u>							
C-1	Unclassified' excavation & rejection	m <sup>3</sup>	800					5.8.2.
C-2	Macadam stone for structure bed	m <sup>3</sup>	110					5.8.4.
C-3	Structural Concrete (Box Culv. No.1)	m <sup>3</sup>	241					5.8.6.
C-4	Structural Concrete (Box culv. No.2)	m <sup>3</sup>	222					5.8.6.
C-5	Structural Concrete (Box Culv. No.3)	m <sup>3</sup>	116					5.8.6.
C-6	Reinforcing steel bar	ton	56					5.8.6.
C-7	Backfilling, sand & gravel	m <sup>3</sup>	880					5.8.3.
C-8	Excavation, earth open ditch	m <sup>3</sup>	2,600					5.1.2.2.
C-9	P.C.C. repavement, taxiway slab, 28 cm thickness	m <sup>3</sup>	78					5.4.5.
C-10	Break-down, conc. slab & block (taxiway slab & box culvert)	m <sup>3</sup>	253					5.8.6.

Item No.	Description	Unit	Quantity	Foreign Currency (Yen)		Local Currency (Kip)		Applicable Clause No. of Detailed Spec.
				Unit Price	Amount	Unit Price	Amount	
D	<u>Electrical Installations</u>							
D-1	Runway edge lights	ls	1					5.13
D-2	Taxiway edge lights	ls	1					5.13
D-3	Unserviceability lights	ls	1					5.13
D-4	Detour of the main cable duct and hand holes	ls	1					5.13
D-5	Alteration of the existing wind cone	ls	1					5.13
D-6	Constant current regulator	ls	1					5.13
D-7	Flashing equipment of the flashing beacon	ls	1					5.13
D-8	Main power distribution panel	ls	1					5.13
D-9	Change-over switch	ls	1					5.13
D-10	Cable systems for illumination	ls	1					5.13
D-11	Cable systems for illumination and others	ls	1					5.13
D-12	Other	ls	1					5.13
	<u>Subtotal D</u>							

Item No.	Description	Unit	Quantity	Foreign Currency (Yen)		Local Currency (Kip)		Applicable Clause No. of Detailed Spec.
				Unit Price	Amount	Unit Price	Amount	
E	<u>Miscellaneous Works</u>							
E-1	Asphalt surface, vehicle entrance, 20 cm thickness	m <sup>2</sup>	120					5.12.5.
E-2	Concrete pavement, sidewalk, 10 cm thickness	m <sup>3</sup>	22					5.8.6.
E-3	Distance sign board, runway	sets	9					5.11.3.
E-4	Marking, all taxiways & apron	m <sup>2</sup>	1,130					5.7.6.
E-5	Deforesting & grubbing	m <sup>2</sup>	163,000					5.10.3
	<u>Subtotal E</u>							

Item No.	Description	Unit Quantity	Foreign Currency (Yen)		Local Currency (Kip)		Applicable Clause No. of Detailed Spec.
			Unit Price	Amount	Unit Price	Amount	
F	<u>Construction Plant and Equipment</u>						
F-1	Transportation charge of construction plant and equipment	1s 1					
F-2	Depreciation cost of construction plant and equipment	1s 1					
	<u>Subtotal F</u>						
	<u>Grand total A+B+C+D+E+F</u>						

FORM OF TENDER

APPENDIX "A"

SCHEDULE OF CONSTRUCTION FACILITIES

Tenderer shall state herein the items of construction facilities proposed to be provided by him and quoted in the Schedule of Quantities and Prices, giving detailed descriptions.

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FORM OF TENDER

APPENDIX "B"

SCHEDULE OF CONSTRUCTION PLANT

Tenderer shall state herein the items of construction plant proposed to be provided by him and quoted in the Schedule of Quantities and Prices, giving detailed descriptions.

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FORM OF TENDER

APPENDIX "C"

SCHEDULE OF PROPOSED SUBCONTRACTORS

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FORM OF TENDER

APPENDIX "D"

PROPOSED CONSTRUCTION METHOD  
AND TIME SCHEDULE

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FORM OF TENDER

APPENDIX "E"

LIST OF NAMES OF SENIOR FIELD STAFFS  
TO BE ENGAGED IN THE WORK UNDER THE CONTRACT

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FORM OF TENDER

APPENDIX "F"

PROPOSED LAYOUT OF WORKING AREAS  
AND CAMP FACILITIES

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