

5.3 Technical Specifications

TECHNICAL SPECIFICATIONS

FOR

THE MODEL INFRASTRUCTURE WORKS

FOR

THE DAIRY FARMING DEVELOPMENT PROJECT

IN

THE CENTRAL REGION OF THE KINGDOM OF THAILAND

JAPAN INTERNATIONAL COOPERATION AGENCY

THAILAND OFFICE

TECHNICAL SPECIFICATIONS

PART 1 SPECIAL PROVISION

1-01. APPLICATION

This specification is applicable to "Model Infrastructure Works for the Dairy Farming Development Project in the Central Region of the Kingdom of Thailand". Main work quantities are stipulated in Section I of the Terms and Conditions of the Contract. Specifications entered in the drawing shall be treated in reference to this technical specifications.

1-02. THE ENGINEER

"The Engineer" means the engineer who was appointed to supervise the works by the JICA.

1-03. SITE REPRESENTATIVE OF THE CONTRACTOR

Site representative of the Contractor shall be well qualified in construction or have enough experience of construction. The Contractor shall submit career history of a site representative to the Engineer for his approval.

1-04. REVIEW OF LAWS

The Contractor shall review the laws related to preservation of public safety and public health etc. and shall make efforts to prevent accident during the execution of the Works.

1-05. UTMOST CARE

The Contractor shall exercise utmost care so that his construction operations will not damage any existing structure except such structures as specified to be dismantled. Any damages on such existing structure or facilities shall be made good by the Contractor at his expense.

1-06. Temporary water way

If it is necessary in the prosecution of the works to interrupt or obstruct the flow of existing water supply pipe, the flow of artificial drains and the drainage of the surface, the Contractor shall provide for the same during the progress of the works in such a way that no damage shall result to either public or private interest. For any neglect to provide for either natural or artificial pipeline or drainage which he may interrupt, he shall be held liable for all damages which may result there from during the progress of the works.

1-07. SITE VISITING OF THE CONTRACTOR

The Contractor is expected to visit the location of the work and make his own estimate of the facilities needed for the work. In the successful execution of the construction, the Contractor is expected to familiarize himself with local conditions, availability of labor, transportation facilities, water and electric supply, uncertainties of weather and other contingencies. From investigations, made at site, it is believed that topographical conditions are approximately as shown on the drawings, but the nature of the materials and the depth of satisfactory foundations, are not guaranteed. It is expressly understood that the JICA will not be responsible for any deduction, interpretation, or conclusions made by the Contractor. The JICA does not guarantee that other materials will not be encountered or that the proportions of the several materials will not vary from those indicated by the drawings.

1-08. BENCHMARKS

Elevations referred to the datum plane are to be determined from benchmarks established by the JICA or the Engineer at the site of the work.

1-09. SETTING-OUT

The Contractor shall entirely be responsible for accurate setting-out the works including staking of centerlines for pipeline and roads, etc. based on the information supplied on the Drawings and the instructions given by the Engineer.

All stakes, benchmarks, etc., placed by the Engineer in laying out the works shall be carefully guarded and preserved by the Contractor, and in such case stakes or marks are misplaced or rendered useless through the carelessness or negligence of the Contractor or his agents, employees or workmen, they shall be replaced by the Contractor at this expense.

The Contractor shall execute the works to the lines and grades given by the drawings and/or the Engineer. The Contractor shall, at his own expense, furnish all stakes, templates, pattern, platforms and labor that may be required in setting or laying out any part of the work.

The costs to conform to the requirements of this Clause shall be entered in the Lump Sum Price of the Mo-demobilization cost in the Bill of Quantities.

1-10. DRAWINGS TO BE FURNISHED BY THE CONTRACTOR

The Contractor shall submit the drawings of centerline survey results and longitudinal section in two copies for the construction of pipeline and roads farm pond, etc.

Contraction of any part of the above works shall not commence until the Drawings have been approved by the Engineer, and there after no change shall be made to any drawing so approved without permission of the Engineer.

In Addition to the above, during the working execution, the Contractor shall at his own expense prepare shop drawings based on the Drawings supplied by the JICA at needed for performance of the works, and shall submit them to the Engineer for approval.

Upon completion of the works, the Contractor shall draw up the as-built drawings in accordance with the instructions given by the Engineer, and shall submit them to the Engineer.

All costs incurred by the Contractor in complying with the requirements of this Clause shall be deemed to be included in the item of the Mo-demobilization cost in the Bill of Quantities.

1-11. ASSISTANCE TO ENGINEER'S STAFF

The Contractor shall render all necessary assistance to the Engineer and shall provide as required by and for use of the Engineer, sufficient quantities of pegs, poles, straight edges, stagings, moulds, templates, profiles and all other requisites for checking the Contractor's setting out and the measurement of the Works.

The cost of all labor and materials required by the Engineer for the said purposes shall be borne by the Contractor. All cost incurred by the Contractor in complying with the requirements of this Clause shall be deemed to be included in the Mo-demobilization cost of the Bill of Quantities.

1-12. REPORTS

The Contractor shall submit weekly reports to each work item to the Engineer.

The report shall contain, but not limited to, the following data: Weather conditions, staff and labor force employed on the Works materials used, work in progress, work in preparation, laboratory test data, accidents, photographs progress of each work, total progress and all other information relevant to the progress of the Works.

The payment of all costs incurred by the Contractor in complying with requirements of this Clause shall be deemed to be included in the Mo-demobilization cost of Bill of Quantities.

1-13. FIELD TEST AND INSPECTION

The field tests in accordance with the specifications and the demands from the Engineer shall be the responsibility for the Contractor. The charges for such fields test excluding the pumping tests for the deep well works and the running test of the irrigation water distribution facilities shall be included in the item of the Mo-demobilization cost of the Bill of Quantities.

1-14. CLEARANCE OF THE WORK SITE

Upon completion of the works, the Contractor shall clear the site within period of construction.

1-15. DOUBTS AND SLIGHT ALTERATIONS

If there are any difference in the contents of drawing the specification unless clearly stated, all shall be according to the instructions of the Engineer.

1-16. MO-DEMobilIZATION

The Contractor shall price the Mo-demobilization in the Bill of Quantities covering all costs and expenses for preparatory works, temporary works and other common works such as:

- Mobilization and demobilization of equipments and materials (Cause 2-03 and 2-05)
- Maintenance of temporary access road and Construction of haul road (Clause 2-02)
- Land hiring for the Contractor's yard
- Construction, maintenance and subsequent removal of office, stores, workshops, staff quarters and labor camps with fencing (Clause 2-03)
- Installation, operation, maintenance and subsequent removal of water and electric supply system for the Contractor's offices, workshops, staff quarters and labor camps (Clause 2-03)

- **Centerline survey and furnishing of drawings (Clause 1-09 and 1-10)**
- **Assistance to the Engineer's staff for certificates (Clause 1-11)**
- **Setting out pipeline, roads and structures and staking of reference pegs (Clause 1-09)**
- **Field tests including provision of testing apparatus, testing engineer, labor and consumables (Clause 1-13)**
- **Submit of periodical reports and color photographs (Clause 1-12)**
- **Other works but not limited to.**

PART 2 TEMPORARY FACILITIES

2-01. SCOPE

This part covers the construction and/or maintenance of access roads, setting up of Contractor's camp facilities, providing camp security and the disposition of the Contractor's various facilities at the end of the Contract.

2-02. ROADS

(a) The Contractor shall improve, repair and widen, if necessary, existing roads to satisfactory meet his haulage requirements. He shall also construct all other roads within the construction area which he deems necessary in the prosecution of his work. The improving, widening and maintaining of existing roads and constructing and maintaining new roads shall be made by the Contractor at his expense, and same shall be the responsibility of the Contractor during and up to the completion of all construction work under the Contract.

2-03. CONTRACTOR'S CAMP FACILITIES

(a) If the Contractor deems necessary, he shall grade his camp site; construct his office, employee's housing, warehouses, machine and repair shops, fuel storage tanks; and provide such other facilities that the Contractor deems necessary for maintaining health, peace and other in the camps and work areas.

(b) The location, construction, operation and maintenance of such camps and facilities within the areas of the A.I. Center shall be subject to the approval of the Engineer. At least ten (10) calendar days prior to the date on which the Contractor desires to begin to work on in feature of camp construction, the Contractor shall

submit for the approval of the Engineer drawings and specifications in sufficient detail to permit determination of suitability of the construction in compliance with these specifications, and no camp construction of any kind shall be undertaken until such drawings and specifications have been approved by the Engineer.

2-04. CAMP SECURITY

The Contractor shall provide his own security force to the extent that he deems necessary for maintaining peace and order in the camps and work areas and to safeguard materials and equipment including fencing.

2-05. DISPOSITION OF CAMP AND CONSTRUCTION FACILITIES

After the completion of the work covered by the Contract, the entire camp of the Contractor, including its water supply system, quarters, warehouses, shops and other facilities therein; and all other temporary installations at work areas shall be removed by the Contractor and the site shall be cleared.

2-06. PAYMENT

There will be no separate payment for complying with the requirements of this part. The expenses incurred by the Contractor shall be included in the item of Mobilization and demobilization as indicated in the Bill of Quantities.

PART 3 CARE OF WATER DURING CONSTRUCTION

3-01. SCOPE

In accordance with specifications contained in this part, the Contractor shall care the water during construction so that construction work can be performed in areas free from water. Care of water during construction shall include provision for drainage and pumping system for dewatering foundation areas and the construction of temporary bulkheads necessary for the protection of construction operations from encroachment by water.

3-02. DRAINAGE AND PUMPING

The Contractor shall be responsible for dewatering the foundation areas so that work may be carried on in a suitably dry condition, draining and/or pumping all water during the process of construction until its completion. The contractor shall construct drainage ditches, holes, or culverts; furnish, operate, and maintain at his own expense all necessary pumps, to keep all work areas in ample dry condition, and prior to final acceptance of the work by the Contracting officer, the Contractor shall remove, fill or plug all temporary drainage structures and pumping equipment at his expense.

3-03. PAYMENT

No separate payment shall be made for the care of water during construction. But the cost of furnishing, constructing, operating, maintaining, and removal of temporary drainage structures, canals, and pumping system necessary to keep construction operations free from water shall be included in the item of the Mo-demobilization as indicated in the Bill of Quantities.

PART 4 EXCAVATION AND FOUNDATION PREPARATION

4-01. SCOPE

In accordance with the Specifications contained in this part, and as shown on the drawings, or otherwise directed by the Engineer, the Contractor shall perform all required excavation and foundation preparation pertinent to the works.

4-02. EXCAVATION

(a) General

Excavation under these Specifications consists of the removal, hauling, dumping, and satisfactory disposal of all materials from required excavations for the works. Excavation shall be performed to the lines and grades shown on the drawings or established by the Engineer. The Engineer may modify slopes of excavation to fit conditions encountered during construction. Such changes or modifications shall not be considered by the Contractor as a basis for additional compensation over and above the unit prices bid. All necessary precautions shall be taken to preserve the ground outside the specified lines and grade in the soundest possible condition.

(b) Classification of Excavation

For the purposes of payment, excavation shall be classified as "Rock Excavation" and "Common Excavation". "Rock Excavation" shall include all solid rock in place and/or detached pieces of rock of more than 1 cubic meter in volume which cannot be removed unless loosened by any one or combination of blasting, barring, wedging, and dozing or hauling with machinery. Solid rock in this class is distinguished from soft or disintegrated rock, which may also require blasting before removal, in that it is of such hardness as may be loosened or broken down by manual tools.

"Common Excavation" includes all materials other than rock classified as above, including but not restricted to earth, gravel, soft rock and also detached pieces of rock less than 1 cubic meter in volume.

(c) Foundation in Loose Material

When the surface of excavation upon or against which concrete or liner for lining or embankment fill is to be placed consist of loose materials, the said loose materials shall be removed or replaced with suitable materials and compacted in a manner satisfactory to the Engineer. The cost of removing the loose materials shall be paid for under the pertinent bid items for excavation. The cost for the replacement with suitable materials and the compaction of the same shall be paid for under the pertinent bid items for fill.

4-03. DISPOSITION OF EXCAVATED MATERIALS

The contractor shall submit for the approval of the Engineer locations, areas, drawings, and other necessary specifications of spoil area which the Contractor proposes to use for the work under the Contract, and any kind of disposition shall not be undertaken before obtaining the said approval. Excavated material not suitable for fill or otherwise not needed shall be wasted in approved spoil areas. Spoil piles shall be constructed to the stable slopes of the material being wasted. Any spoil pile exceeding two (2) meters in height shall not be performed. Soil material shall be spread and graded so that surface drainage will not be concentrated and will not create and/or accelerate undesirable erosion in spoil areas.

4-04. DEMOLITION, REMOVAL and DISMANTLING

When specified in the drawing or the Engineer, existing concrete and/or stone masonry structures, such as concrete masses, stones, etc., shall be demolished and disposed of accordingly.

4-05. Foundation preparation

(a) Fill on Earth

All horizontal and sloped earth surfaces, upon which embankment material is to be placed or other foundation surfaces whose locations are specifically indicated by the Engineer, shall consist of undisturbed or compacted material and shall be clean, damp, free from standing or running water and free from organic matter; and shall be suitable as a foundation for the material to be placed upon them.

(b) Concrete

All horizontal and sloped earth surfaces upon which concrete is to be placed shall be undisturbed or of approved compaction, clean and damp, free from standing or running water, and shall be otherwise suitable as a foundation for the concrete to be placed upon them.

4-06. MEASUREMENT FOR PAYMENT

A survey of the areas to be excavated shall be made by the Contractor prior to the commencement of the work under the Contract, and all measurements of excavation shall be based on this survey without regard to any change that may occur during the prosecution of the work. All such surveys shall be the subject to check and approval by the Engineer. Volumes will be computed and shall be the amount between the original ground determined by the survey and the slopes, lines and grades shown on the drawings or established by the Engineer.

PART 5 FILL AND BACKFILL

5-01. SCOPE

In accordance with the specifications contained in this part and as shown in the drawings or otherwise directed by the Engineer the Contractor shall furnish and place the earth fill for the works, backfill for related structures. Any work of fill and backfill shall not be commenced without prior approval of the Engineer. The slope of the embankment shall be finished to the designed gradient by providing fixed rules.

5-02. BACKFILL

Backfill, as used herein, is defined as refill for structures. The materials used for backfill for structures shall be free from roots stones of more than five (5) centimeters in diameter, and other objectionable materials and subject the approval of the Engineer. Backfill materials shall be placed in layers, each layer being not more than twenty (20) centimeters thick before compaction, thoroughly compacted by means of power tampers or other means of approved by the Engineer.

5-03. FILL

(a) Lines and Grades

The fills shall be constructed to the lines, grades and cross sections indicated on the drawings, unless otherwise directed by the Engineer. The Engineer may increase or decrease the slopes of the fill or make such other change in the design as may be deemed necessary to produce a stable structure. Change in quantities of materials, resulting from prescribed changes in section, shall not make cause for claims for increased unit prices. Generally, a tolerance of plus or minus 0.05 meter from the slope lines and grades shown on the drawings will be allowed in the finished

surfaces of the embankments except that the tolerances shall not be continuous over an area greater than twenty (20) square meters.

(b) Conduct of the Work

The contractor shall maintain and protect the fills in a satisfactory condition all times until final completion and acceptance of all work under the Contract. Any approved fill material which is rendered unsuitable after being placed in the fills shall be replaced by the Contractor and no additional payment will be made there.

The Contractor shall excavated and remove from the fills any material which the Engineer considers objectionable and shall also dispose of such material and refill the excavated as directed, all at no additional cost to the JICA. The Contractor may be required to remove at his own expense any fill material placed outside of prescribed slope lines.

When the excavation of suitable fill material from required excavation and approved borrow sources progresses at a faster rate than placement in the fills, such excavated materials may be stockpiled at approved locations until use is authorized.

No separate payment will be made for stockpiling or reloading and hauling of this material to its place in the fills and all costs in connection therewith shall be included in the applicable contract unit price for the fill materials.

(c) Materials

The Contractor shall submit for the approval of the Engineer locations, areas, drawings and other necessary specifications of borrow area which the Contractor proposes to use for obtaining fill material. Materials for fills shall be secured from required excavations and from the borrow areas as approved. There is no guarantee that all the materials in any borrow area will be suitable for use in the fills and the Contractor shall move or modify his operations to avoid unsuitable material. The Contractor shall

maintain and operate sufficient excavating and hauling equipment so that an adequate amount of fill material from all source is available as required. Operations in borrow areas shall not be on danger roads, building, or structures. Borrow areas shall be graded to provide drainage from all parts of the excavated areas. When operations in a borrow area have terminated, the area shall be dressed to a neat and orderly appearance, as approved by the Engineer. Any additional material needed shall be obtained from sources approved by the Engineer.

Materials containing brush, roots, sod or other perishable material will not be considered suitable for fills. The suitability of the materials shall be subject to the approval of the Engineer.

(d) Placement

No fill material shall be placed on any part of the fill foundations until such areas have been inspected and approved by the Engineer and until after completion of foundation preparation as specified in PART 4. The gradation and distribution of materials shall be such that the fills will be free from lenses, pockets, and streaks.

The fill material shall be dumped spread in horizontal layers having an uncompacted thickness of not over 20 cm. When material is spread, chunks larger than 10 cm in size shall be broken down by approved means or removed.

(e) Compaction

After a layer of fill material has been dumped and spread, it shall be compacted by hand operated mechanical tampers or by other compaction machine approved by the Engineer, to a density more than 90 percent of the maximum dry density of the material or to a density specified by the Engineer.

Fill placed around structures shall be compacted by hand operated mechanical tampers or by man power to a density equal to that specified for the other earth fill.

(f) Additional compaction

If in the opinion of the Engineer, the desired compaction of portion of the embankment is not secured, additional compacting operation shall be made over the surface area of such designated portion until the desired compaction has been obtained, without additional cost to the JICA.

(g) Quality Control

If it is required, tests for moisture content and density, and other all necessary tests will be made by the Engineer, and from these tests, corrections, adjustments, and modifications of methods, materials, and moisture contents may be made in order to secure satisfactory density of the fill materials. The Contractor shall provide necessary unskilled labor in obtaining and preserving samples.

5-04. MEASUREMENT FOR PAYMENT

(a) Fill

1) Measurement

Measurement for payment of fill will be calculated on the number of cubic meters of material placed between the foundation lines as determined on the basis on drawings or a survey made after completion of the excavation and foundation preparation and the lines, grades and slopes shown on the drawings. No allowance will be made for foundation or embankment settlement.

2) Payment

Payment shall constitute full compensation for all work in connection with the excavation from borrow areas including clearing, grubbing and stripping of borrow areas, hauling, stock-piling, rehandling, foundation preparation, placing,

spreading, sprinkling, drying, breacking up, compacting, removal of objectionable material, and all other work required for the construction, protection and maintenance of the fills.

No adjustment in payment will be made for substitution of materials and for additional compaction.

(b) Backfill

Measurement for payment of backfill shall be calculated on the number of cubic meters of materials placed among the original ground line, or designated line of backfill and the structure and the neat pay lines of excavation shown in the drawing. Payment will be made on the unit price bid per cubic meter of backfill.

PART 6 CONCRETE WORKS

6-01. SCOPE

In accordance with the Specifications contained herein and as shown on the detail drawings or otherwise directed, the Contractor shall.

- (a) Furnish all materials, and manufacture, transport, place finish, protect and cure concrete;
- (b) Furnish, construct, erect and dismantle forms;
- (c) Construct expansion and construction joints and furnish and place waterstops, joint fillers, and sealing compound, if required; and
- (d) Prepare, clean, cut, bend and place steel reinforcement.

6-02. CEMENT

(a) General

Cement for mortar and concrete work shall be Portland Cement which conforms to the requirements of the Standard Specifications for Portland Cement (A.S.T.M. Designation C150-69).

(b) Storage

Cement shall be stored in a dry, weather tight and properly ventilated warehouse with adequate provisions for the prevention of absorption of moisture. All storage facilities shall be subject to approval and shall be such as to permit easy access for inspection and identification. Cement which has been stored for more than one month or which is suspected to be damp shall not be used unless otherwise approved by the Engineer.

6-03. FINE AGGREGATE

(a) Composition

Fine aggregate shall be natural sand not including organic matter and other foreign substances.

(b) Quality and Grading

1) Quality: Fine aggregate shall consist of hard, tough, durable, uncoated particles. The shape of the particles shall be generally rounded or cubical and reasonable free from flat or elongated pieces. The fine aggregate shall conform to the following specific requirements:

2) Grading: Fine aggregate shall be well graded from fine to coarse and the gradation shall conform to the following requirements as delivered to the mixers:

Sieve Designation U.S.Std. Square Mesh	Cumulative Percentage by Weight Passing
No. 4	95 - 100
No. 16	60 - 75
No. 100	2 - 10

In addition to the grading limits shown above, the fineness modulus shall be in the range from 2.30 to 3.00.

(c) Storage

Fine aggregate shall be stored in such a manner as to avoid the inclusion of any foreign material in the concrete. Sufficient live storage shall be maintained at all times to permit continuous placement of concrete at the rate specified.

6-04. COARSE AGGREGATE

(a) Composition

Coarse aggregate shall consist of gravel, crushed gravel or rock, or a combination of gravel and crushed gravel or rock.

(b) Quality and Grading

1) **Quality:** Coarse aggregate shall consist of hard, tough, durable, clean and uncoated particles. All foreign materials and dust shall be removed by adequate processing. The particle shape of the smallest size of crushed coarse aggregate shall be generally rounded or cubical, and the coarse aggregate shall be reasonably free from flat and elongated particles in all sizes.

2) **Grading:** The coarse aggregate shall be well graded from fine to coarse. The grading of the aggregate as delivered to the mixer shall be as follows:

<u>Sieve Designation U.S. Std. Square Mesh</u>	<u>Per Cent by Wt. Passing Individual Sieves 3/4" Max.</u>
1"	100
3/4"	90 - 100
3/8"	20 - 50

3) **Size:** Unless otherwise directed, the maximum sizes of coarse aggregate to be used in the various parts of the work shall be 3/4 inch.

4) **Storage:** Storage of coarse aggregates shall be as that specified in Paragraph 6-03 (c) for fine aggregates.

6-05. AGGREGATE SAMPLES

Samples of the aggregate shall be furnished at a point designated by the Engineer for his approval at least ten (10) days in advance of the time when the placing of concrete is expected to begin.

6-06. WATER

Water used in mixing concrete shall be fresh, clean and free from injurious amount of oil, acid, alkali, salts, or organic matter.

6-07. PROPORTIONING OF CONCRETE

(a) The contractor shall design the mix proportion for every class of concrete placing for the approval of the Engineer. The Contractor shall carry out the mix test in case of being requested by the Engineer. The test is to be made at the expense of the Contractor.

(b) The compressive strength of the age of 28 days shall be as follows and desirable mix proportion is also indicated.

<u>Class</u>	<u>Minimum 28 days Compressive strength</u>	<u>Mixing proportion by volume cement : fine aggregates : Coarse aggregates</u>
A(Reinforced concrete)	210 kg/cm ²	1:2:4
B(Plain Concrete)	160 kg/cm ²	1:3:6
C(Concrete layer)	135 kg/cm ²	1:4:6

Other proportions for mixing design may be indicated by the Engineer at the site of work, if it is necessary.

6-08. MIXING

(a) Equipment

Concrete shall be mixed by portable concrete mixer unless otherwise approved by the Engineer.

(b) Measurement

The measurement of every ingredient of concrete shall be made in weight. Nevertheless, the measurement in volume is admitted subject to the approval of the Engineer.

(c) Mixing Time and Method

The mixing time of concrete shall be more than two (2) minutes and less than five minutes. Over mixing, requiring the introduction of additional water to preserve the required consistency, will not be permitted. The mixer shall be completely emptied before receiving the materials for the succeeding batch and shall be kept clean and washed out after stopping work at the end of each shift.

On commencing work, the first batch shall contain sufficient excess of cement, sand and water to coat the inside of the drum to avoid the reduction of the required mortar content of the mix.

6-09. CONVEYING

(a) General

Concrete shall be conveying from mixer for forms, as rapidly as practicable, by methods which will prevent segregation or loss of ingredients. There shall be no vertical drop greater than 1.5 meters except where suitable equipment is provided to prevent segregation and where specifically authorized. Belt conveyors, chutes or other similar equipment in which the concrete is delivered to the structure in a thin, continuously exposed flow, will not be permitted except for very limited or isolated sections of the

work. Such equipment shall be arranged to prevent objectionable segregation.

6-10. PLACING

(a) Approval

Approval of the Engineer shall be obtained before starting any concrete pour.

(b) General

Concrete shall be worked into the corners and angles of the forms and around all reinforcement and embedded items without permitting the material to segregate. Not more than three (3) cubic meters shall be deposited in one pile for compaction. Free water shall be collected in depressions away from the forms and removed by bailing prior to placement of additional concrete. All concrete placing equipment and methods shall be subject to approval.

(c) Cooling of Aggregates

The aggregate shall be cooled by wetting if it is drier than the condition known as saturated, surface dry.

(d) Concrete on Earth Foundation

All concrete shall be placed upon clean, damp surface free from standing or running water. Prior to placing concrete, the earth foundation shall be satisfactorily compacted in accordance with approved methods.

(e) Concrete on Other Concrete

Surface upon or against which concrete is to be placed shall be clean, free from oil, standing or running water, mud, drummy rock, objectionable coatings, debris, and loose, semidetached or unsound fragments. To insure a firm and tight bond between fresh concrete and other concrete, concrete surfaces, wherever necessary, shall be chipped or roughened as directed by the Engineer. All surfaces shall be wetted thoroughly to keep them in a completely moist condition before placing concrete. All approximately horizontal surfaces shall be covered with a layer of mortar of the same cement-sand ration as used in the concrete mix before the concrete is placed.

6-11. FORMS

(a) General

Forms shall be used, wherever necessary, to confine the concrete and shape it to the required lines, or insure against contamination of the concrete. Forms shall have sufficient strength to withstand the pressure resulting from placement and vibration of the concrete, and shall be maintained rigidly in correct position. Forms shall be sufficiently tight to prevent loss of mortar from the concrete. Forms for exposed surfaces against which backfill is not to be placed shall be lined with a form grade plywood or sheet steel. Steel panel forms may also be used.

(b) Cleaning and Oiling of Forms

At the time concrete is placed in the forms, the surfaces of the forms shall be free from encrustations of mortar, grout, or other foreign material that would contaminate the concrete or interfere with the fulfillment of the Specifications' requirements relative to the finish of formed surfaces. Before concrete is placed, the surfaces of the forms shall be oiled with a commercial form oil that

will effectively prevent sticking and will not stain the concrete surfaces.

(c) Removal of Forms

Forms shall be removed as soon as practicable in order to avoid delay in curing and to make possible earliest practicable repair of surface imperfections, but in no case shall they be removed before approval. Any needed repair or treatment shall be performed at once, and shall be followed immediately by the specified curing. Forms shall be removed with care so as to avoid injury to the concrete, and any concrete so damaged shall be repaired.

6-12. CURING AND PROTECTION

(a) General

All concrete shall be moist cured for a period of not less than seven (7) consecutive days by an approved method or combination of methods applicable to local conditions, except that the curing period may be reduced to three days for concrete made with high-early-strength cement. 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.

(b) Water Curing

Concrete shall be kept wet by covering with an approved, watersaturated material or by a system of perforated pipes or mechanical sprinklers or by any other approved method which will keep all surfaces continuously (not periodically) wet. Water for curing shall be generally clean and free from any element which might cause objectionable staining or discoloration of the concrete.

6-13. REPAIR OF CONCRETE

Repair of imperfections in formed concrete shall be completed within twenty four (24) hours after removal of forms at no additional cost to the JICA. Fins shall be neatly removed from exposed surfaces. Concrete that is damaged or honeycombed must be removed to sound concrete and replaced with drypack mortar, or concrete as hereinafter specified. Where large bulges and abrupt irregularities protrude, the protrusions shall be reduced by bush-hammering and grinding. Drypack filling shall be used for holes left by the removal of fasteners from the ends of form tie rods.

6-14. DRYPACK MORTAR

Drypack shall consist of a mixture (by dry volume or weight) of one (1) part cement to 2-1/2 parts of sand conforming to paragraph 6-03. Fine Aggregate, except that, in gradation, 100 % shall pass a No. 16 sieve. Only enough water shall be used to produce a mortar which, when used, shall stick together on being molded into a ball by a slight pressure of the hands, and shall not extrude water but will leave the hands damp.

6-15. STEEL REINFORCEMENT

(a) General

The Contractor will furnish all steel reinforcement in accordance with the drawings and the these specifications. The Contractor shall prepare, clean, cut, bend and place all reinforcements, as shown on the detail drawings or as otherwise directed. The Contractor shall furnish all chains, supports and ties. All reinforcement shall be reasonable free from loose, flaky rust and scale, and free from oil, grease and other coating which might destroy or reduce its bond with concrete.

(b) Concrete Covering

The distance from the edge of the main reinforcement to the concrete surface shall be 5 cm except such portions as shown in the drawings. The concrete covering the stirrups, spacer bars, and similar secondary reinforcement may be reduced by the diameter of such bars, unless otherwise indicated.

(c) Lapping

Lapping length at joints of the reinforcing bar shall be at least thirty times of the diameter of bar and shall be bound by steel wire.

(d) Supports

All reinforcements shall be secured in place by use of metal or concrete supports, spacers or ties. Such supports shall be of sufficient strength to maintain the reinforcement in place throughout the concreting operation. The supports shall be used in such a manner that they will not be exposed or contribute in any way to the discoloration or deterioration of the concrete.

6-16 MEASUREMENT FOR PAYMENT

(a) Concrete

- 1) Measurement for payment for plain or reinforced concrete, will be based on the volume of concrete in place within the lines and grades shown on the drawings.
- 2) No deduction will be made for rounded or bevelled edges, or space occupied by metal work, or embedded items such as supports, spacers or ties. The cost of construction joint treatment with the attendant loss of material shall be included in the unit price bid per cubic meter of concrete.
- 3) Payment at the unit prices bid shall constitute full payment for all costs for concrete work. The costs of any dewatering required to maintain dry conditions during the pouring of concrete,

furnishing materials, and installing and removing formwork, shall be included in the unit cost.

(b) Steel Reinforcement

Measurement for payment for furnishing, preparing bar cleaning, cutting bending, and placing steel reinforcement by the Contractor will be based on the number of kilograms placed in accordance with the detail drawings or as otherwise directed. Payment will be made for steel in laps as shown on the drawings; where bars are welded, payment will be made as if they were lapped. Payment will not be made for steel in laps or used which are solely for the convenience of the Contractor. Payment will be made at the unit price bid for steel reinforcement. No separate payment will be made for steel reinforcement supports, and the cost thereof shall be included in the unit price bid.

PART 7 DEEP WELL WORKS

7-01. SCOPE

The Contractor shall construct two (2) deep wells as specified herein. One shall be constructed in the Pathum Thani AI Center and the other one shall be provided in Chai Badan Dairy Farming Demonstration Center. The detailed locations of the wells shall be as shown in the drawings or as directed by the Engineer.

7-02. GENERAL

This specification covers construction of deep wells including electric prospecting, drilling, bore electric logging, installation of well casing and screen, gravel shrouding, development, pumping test, installation of submergible pump, etc. The requirements for execution of work shall be as follows:

	<u>Pathum Thani</u>	<u>Chai Badan</u>
Well Depth:	300 m	80 m
Drilling Dia:	φ200 mm	φ300 mm
Casing:	ASTM casings sch 40 φ100 mm	ASTM casing sch 40 φ150 mm
Depth of Pump:	Approx. 70 m	Approx. 30 m
Design Discharge:	42 l/min	250 l/min

The deep well of Pathum Thani giving less than 42 l/min discharge and the deep well of Chai Badan giving less than 180 l/min discharge will not acceptable.

7-03. ELECTRIC PROSPECTING

The contractor shall conduct an electric prospective survey and arrange a qualified and approved engineer to perform the electric prospecting for water-engineer to perform the electric prospecting for water-bearing

stratum around the point of deep well to be drilled in the Chai Badan Dairy Farming Demonstration Center.

7-04. DRILLING

- (a) The borehole site to be drilled shall be directed by the Engineer.
- (b) The contractor shall provide at the sites all necessary construction equipment and deep well materials for construction and installation of well except the Supplies by the JICA, and shall transport the Supplies and other equipments or materials necessary to the sites.
- (c) The contractor must keep technically qualified representative at work site with authority to manage and direct the work. The Contractor shall execute the works in accordance with the specifications and under the directions of the Engineer.
- (d) The contractor shall keep in accurate drilling log of each borehole, including a description of all materials encountered and their location in the bore hole in a manner and form as approved by the Engineer. The contractor shall deliver to the Engineer the original of all records and such records shall become the property of the JICA.
- (e) The detailed information such as depth of stratum, color etc. Must be noted as the drilling progresses and supplied in the form of bore logs. For each well the Contractor is required to supply one sample of each different stratum encountered in a sample containers. Where no noticeable change of strata is indicated, sample is to be collected at a maximum of 10' depth intervals. The sample containers shall be polyethylene bags or plastic jars.
- (f) The Contractor shall conduct a bore electric logging immediately after drilling in order to decide the length and depths of the screen. The Contractor shall arrange a qualified and approved engineer to perform the bore electric logging.

7-05. CASING PIPE AND SCREEN

(a) General

The actual lengths of each size of screen and casing pipes to be installed will be determined through the sampling and the bore electric logging in the field by the Contractor with the approval of the Engineer. It shall be Contractor's responsibility to schedule the work and maintain liaison with the Engineer as required to permit the Engineer to render timely decisions in these matters.

(b) Screen

The depths at which screen will be installed will be determined in consultation with the Engineer in the field. The Engineer will also see that the screen is placed at the proper depths. The screen shall be stainless screen coiled with stainless steel wire or approved by the Engineer.

(c) Casing

The length of casing pipe to be installed shall be decided in consultation with the Engineer at the site. Casing pipe shall be ASTM (A-120) and installed using screwed joints or field welding with fixture to keep the joints straight.

The bottom of the casing shall be provided with a bail plug.

(d) Gravel shrouding

The annular space between the outside of the casing pipe and the wall of the drilled hole shall be gravel shrouded by the Contractor from the bottom up to the level determined in consultation with the Engineer by pouring gravel with constant circulation of water through a hopper fitted at the top of 1 1/2" pipe having sufficient length to be lowered to the bottom of bore hole.

After completion of the gravel shrouding, the remaining annular space above the top of the gravel shrouded shall be filled by clay and the top portion of annular shall be sealed by cement concrete.

Filter gravel for shrouding the annular space between tubewell fixtures and borehole.

The gravel for the filter shall consist of the best natural materials available. It shall be washed clean, preferably rounded hard siliceous materials containing no iron pyrites, coal, mica, shale or similar laminated flaky or frangible particles and shall conform to the following grading or such grading as may be ordered by the Engineer.

<u>B.S.410 Sieve No.</u>	<u>Percentage passing</u>
1/4	100
1/8	75 - 95
16	15 - 37
25	5 - 20
36	0 - 8

7-06. DEVELOPMENT

Immediately after the casing and packing of borehole were completed, the bore shall be developed by means of jetting, surging by water or air, and water lifting by air as instructed by the Engineer.

The development shall be continued until the lifted water is judged to be free from sand.

7-07. PUMPING TEST

The pumping test shall be conducted on the completed borehole, unless otherwise instructed by the Engineer, employing the submersible motor pump and/or other devices. The Engineer will select any appropriate constant discharge rate after consideration of the result of development or a preliminary pump test. The air-left device may be employed when the Engineer judges that the appropriate discharge rate for the test is

too small against the applicable rate of the submersible pump. The discharge rate for the test shall be those which maintain the water in the borehole for three hours or more.

The discharged water may not return into the borehole. The water level in the borehole shall be measured from time to time in the courses of drawdown as well as recovery after the water pumping is stopped using the water-level detector. The interval of water-level measurement shall be as below:

- Every one minute for the first 10 minutes;
- Every two minutes for the period of sequent 10 to 20 minutes;
- Every five minutes for the period of sequent 20 to 60 minutes;
- Every ten minutes for the period of sequent 60 to 120 minutes;
- Every twenty minutes for the period over 120 minutes;

The water-pumping may be stopped when the water-level comes to stable or as instructed by the Engineer.

The recovery test may be terminated at 60 minutes after the water pumping has stopped.

The best effort shall be made to keep the discharge rate as constant as possible. The rate shall be measured by any appropriate device approved by the Engineer. The temperature, electric conductivity and pH of pumped water shall be also measured at every 60 minutes during water pumping.

7-08. SAMPLING OF WELL WATER

The water sample shall be collected at the Borehole Test for water quality analysis.

An on-site sample water quality test shall be conducted for the newly drilled wells and a laboratory test using WHO standards shall be conducted for an average of 1 in 3 deep wells.

Water analysis at the laboratory shall be made on collected water sample covering the following items;

Turbidity, Color, Odor, Residual Content,

Potassium per manganate demand, pH value,
Nitrite - Nitrogen, Ammonium, Chlorine,
Hexavalent Chromium, Total Iron, Copper, Total hardness,
Chloride, Total Contents of micro-organisms, Coliform germ.

7-09. PUMP INSTALLATION

Submersible Pump shall be installed firmly onto the borehole directed by the Engineer.

The detail of installation shall be subject to the prior approval by the Engineer through the shop drawings prepared and submitted by the Contractor.

7-10. CONSTRUCTION OF APPURTENANT FACILITIES

The borehole platform and other facilities shall be constructed on the site as instructed by the Engineer in accordance with the shop drawings approved by the Engineer.

7-11. SUBMERSIBLE PUMP

(a) General

One unit of submersible pump for the deep well in the Pathum Thani AI Center shall be supplied by the Contractor. The pump for the deep well in the Chai Badan Dairy Farming Demonstration Center will be supplied by the JICA.

(b) Description and Specifications

The submersible pump to be supplied by the Contractor shall be as follows or its equivalent approved the Engineer.

Capacity : 42 l/min (50 Hz)

Head : 100 m

Material : Bowl - Cast iron
 Impeller - stainless steel
 Shaft - stainless steel

Discharge size : 32 mm

Motor output : 2.2 kw

Accessories

Riser pipes : ϕ 32 mm x 70 m with flanges

Discharge elbow : ϕ 32 mm x 1 no.
 With a mountings for compound

Check valve : ϕ 32 mm x 1 no.
 With companion flanges

Gate valve : ϕ 32 mm x 1 no.
 With companion flanges

Compound gauge : 1 no.

Automatic air vent valve : 1 no.

Well cover : 1 set

Submergible cable : 75 m

Low water level electrode : 1 set

Control panel : 1 set (with phase protector)

The unit of submersible pump to be supplied by the JICA is as described in PART 12.

7-12. MEASUREMENT FOR PAYMENT

Borehole drilling shall be performed according to depth as specified in this specifications or as directed by the Engineer. Measurement for payment shall be made at the unit price per meter for length of drilling which exceeds ten percent of required design depth. If the extra depth is less than 10 % the Contractor shall carry out the works at his own expenses. If the actual depth is less than the design depth, payment will be reduced proportionately.

PART 8 ROADWORKS

8-01. SCOPE

Following works shall be carried out by the Contractor.

(a) In Pathum Thani AI Center

L1 road shall be composed of preparation of sub-base and construction of road-base and surface course on the existing road, and improvement of road bed in a part of the road.

R4 road and R9 road shall be composed of improvement of road bed and filling with laterite.

(b) In Chai Badan Dairy Farming Demonstration Centre

Main road and Approach roads shall be composed of construction of sub-base, road-base and surface course.

Under this item the Contractor shall supply materials and perform the work necessary to construct the above roads.

8-02. PREPARATION OF SUB-BASE SURFACE

Prior to construction of the roadbase, the previously prepared subgrade shall be cleaned of all foreign substances. Any roots, or soft yielding spots which occur in the subbase, any and having inadequate compaction, or any deviations of surface from the requirements specified, shall be corrected by scarifying, removing and/or adding approved material. Appreciable irregularities in the surface of the subbase shall be corrected by blading and rolling.

8-03. SUB-BASE

The term of sub-base refers to the layer above the sub-grade.

(a) Material

The sub-base shall be constructed over the sub-grade existing road surface prepared for the sub-base as shown in the drawings or as directed by the Engineer. The crusher-run stone approved by the Engineer shall be used for the sub-base.

(b) Placing and spreading

Placing and spreading shall be provided and laid to the lines, levels and cross-section shown on the Drawings or as directed by the Engineer.

During spreading or material, precautions shall be taken to avoid segregation. If segregation occurs, the Contractor shall remix the material by a method to be approved by the Engineer.

Where it is necessary to add water to adjust the moisture content, the water shall be added by an approved mechanical sprinkler and mixed into the full depth of the loose material by means of a harrow or other mixing equipment approved by the Engineer.

(c) Compaction

Each layer shall be compacted until the entire depth of the course is at least 90 percent of the maximum dry density. Additional water shall be applied to the material during the rolling operations in amounts as required to obtain the specified density and the optimum moisture content. In all places not accessible to the rolling equipment the material shall be compacted thoroughly with approved mechanical tampers. The surface of the sub-base course shall be finished by grading and by rolling with pneumatic tire rollers, until the surface is tight and free from irregularities, and is true to grade and cross-section.

8-04. ROAD BASE

The term of road base refers to the layer above the sub-base.

(a) Materials

The Contractor shall construct the road base over the sub-base as shown on the drawings or as directed by the Engineer. The graded crushed stone for the road base shall be furnished by the Contractor. The graded crushed stone shall consist of hard, dense, durable rock fragments of nominal size of 40 mm and 20 mm.

The material shall conform to the following gradation limits:

<u>Sieve (m)</u>	<u>Passing per cent by weight</u>
50	100
40	95 - 100
20	50 - 80
5	15 - 40
2.5	5 - 25

The gradation as used in the work shall not vary from the low limit on one sieve to the high limit on the adjacent sieve but shall be uniformly graded.

(b) Placing and Spreading

The material shall be placed to a loose thickness of 30 mm by hand or from self spreading vehicles. This must be compacted as for the sub-base, about six passes by roller may be sufficient. After approval has been obtained for satisfactory compaction, another layers shall be deposited and compacted as before till specified thickness.

(c) Compaction

Rollers weighing from 8 to 10 tons with smooth wheel type shall be used. Rolling shall commence longitudinally at the sides and work towards the center of the pavement overlapping on successive trips by at least half the width of roller while starting and the overlapping may be reduced to one foot while finishing. The number of passes by roller to obtain required compaction and grade shall be approved by the Engineer.

8-05. SURFACE COURSE

This consists of giving prime coat over the road base, and placing, spreading and compaction of Hot-Mixed Asphalt for the road in Pathum Thani AI Centre. The surface course for the roads in Chai Badan Dairy Farming Demonstration Centre shall be Asphalt Penetration Macadam surface.

(a) Materials

Prime coat shall be asphalt emulsion or cutback asphalt. Straight asphalt shall be asphaltic cement 80 - 100 penetration grade and be heated to a temperature of 160 - 170°C. Asphalt emulsion, cutback asphalt shall be approved by the Engineer.

Hot-mixed Asphalt to be used shall be approved by the Engineer.

Aggregate for the Asphalt Penetration Macadam surface shall consist of hard, dense, durable rock fragments of nominal size of 20 mm to 5 mm.

Bitumen for the Asphalt Penetration Macadam surface shall be asphaltic cement with 80 - 100 penetration grade.

(b) Prime Coat

On the completed road base, the prime coat shall be applied over the road-base at a rate of 1.2 liters per square meter.

(c) Construction of Hot-mixed Asphalt Surface

On the road base given prime coat, Hot-mixed Asphalt shall be placed and spread by a motor-grader. Immediately after spreading, the hot-mixed asphalt shall be compacted by roller. The number of passes by roller to obtain required compaction and grade shall be approved by the Engineer.

(d) Construction of Asphalt Penetration Macadam Surface

On the road base given prime coat, aggregate shall be placed, spread and laid to the lines, levels and cross-section shown on the Drawings or as directed by the Engineer. Thereafter, straight asphalt shall be applied at a rate of 2.0 liters per square meter, over the layer of aggregate and blended with the aggregate.

The aggregate blended with asphalt shall be shaped and graded by motor grader and compacted by roller. While the aggregate blended with asphalt is still hot it should be covered with stone chipping of which size is 5 mm to 10 mm or coarse clean sand at a rate of about 0.01 cu.m per square meter to give smooth finish. A roller should be used.

8-06. IMPROVEMENT OF ROAD BED

Where the foundation of L1 road and R4 road is weak, existing soil of 50 cm in depth from surface shall be removed and Laterite imported shall be filled to improve of the road bed. Compaction of the laterite shall conform to PART 8-04.

8-07. LATERITE ROAD

(a) Material

The filling material for Laterite Road shall be Laterite obtained from outside of the work site. The filling material shall be free from organic matters, boulders, lumps etc.

Dry density of filling material at the optimum moisture content shall be 8.4 % (desirable). Prior to filling work, the material to be used shall be approved by the Engineer.

(b) Construction

Before the filling Existing top soil shall be removed for the prescribed depth as directed by the Engineer in order to remove organic matters, loose stones and objectionable matters.

The filling materials shall be placed in layers of uniform thickness. Layer thickness generally shall not exceed 200 mm after compaction, but the thickness shall be decided depend upon the foundation conditions at the site by the Engineer. The water content of the material shall be maintained during the placement of 8.4 % (desirable) of the optimum moisture content of the material.

Each layer shall be thoroughly compacted by a sufficient number of passes of a tire roller to achieve 90 % of maximum dry density.

The roller used for compaction shall be 8 - 10 ton in capacity as the grade lines and camber as shown on detail drawing. The surface of the compacted material shall be finished.

8-08. FORMATION OF SHOULDERS

This term refers to the space between the edge of the embankment or the edge of the road platform and the edge of the sub-grade on both sides of the carriageway.

(a) Material

The shoulders shall be filled with laterite above the unrolled level of the sub-grade. The filling material shall be same as the filling material for laterite road.

(b) Placing and Compaction

Placing and compaction of fill material in the shoulders shall be done after preparation of sub-grade and placing of material in sub-base but before compaction of sub-base material. Filling material in shoulders shall be moistened sufficiently, tamped and compacted to the level of the unrolled sub-grade by manual or other means approved by the Engineer.

8-09. SUPPLYING, LAYING AND JOINTING PRE-CAST CONCRETE PIPES FOR CULVERTS

The pre-cast concrete pipes used for pipe culverts, turnouts etc. Shall be reinforced spun concrete pipes which are satisfactory to the Engineer. Vertical case pipes may be used subject to approval of the Consultant.

The pipes shall be installed in foundations with specified bed and shall be laid truly in a straight line without vertical or horizontal offsets and to the alignment, levels and gradient shown on the drawings or as directed.

The pipe shall withstand the external loading given below.

Internal Diameter in mm	Minimum Nominal Shell thickness in mm	Minimum Hoop reinforcement in mm for pipe of circular section	Strength test requirements in KV/Lin. metre of pipe, -edge bearing method, load to produce 0.25 mm crack
300	50	215	32.5
375	50	255	38.0
450	55	320	43.5
600	65	425	43.5
750	70	595	49.0
900	80	935	59.0
1050	95	1060	68.5
1200	105	1315	78.5

8-10. MEASUREMENT FOR PAYMENT

Measurement for payment of preparation of sub-grade surface, sub-base, road base and surface course for road works will be made on the finished surface areas as shown on the drawing or as directed by the Engineer.

Payment for them will be made at the rate per square meter in the Bill of Quantities.

These rate shall include the cost of furnishing, transporting, processing, wetting and compacting, etc. Required of above works.

PART 9 PIPING WORKS

9-01. GENERAL

The contractor shall furnish all materials exclusive of the materials which will be supplied by the JICA, as described in PART 12, for this works, and shall install all piping and fitting as specified herein and shown on the Drawings or directed by the Engineer.

9-02. INSTALLATION OF PIPE UNDERGROUND

(a) General

Proper instruments, tools and facilities satisfactory to the Engineer shall be provided and used by the Contractor for the safe and convenient performance of the work. All pipe, fittings, and valves shall be carefully put into the trench piece by suitable tools or equipment, in such manner as to prevent pipe and protective coatings from damage. Under no circumstances pipe and other materials shall be dropped or dumped into the trench.

(b) Inspection before Installation

All pipe and fittings shall be carefully examined for damages and other defects while suspended above the trench immediately before installation in final position.

(c) Cleaning of Pipe and Fittings

The outside of the joint end the inside of the joint shall be wiped clean, dry and free from oil and grease before the pipe is laid.

(d) Laying of Pipe

Every precaution shall be taken to prevent foreign material from entering the pipe while it is being placed in the line. During laying operations, no debris, tools, clothing, or no other materials shall be placed in the pipe.

The pipe shall be secured in place with approved backfill material tamped under it except at the joint. Precautions shall be taken to prevent dirt from entering the joint space.

At times when pipe laying is not progress, the open ends of pipe shall be closed.

(e) Cutting of Pipe

The cutting of pipe for inserting tees or valves shall be done in a neat and workmanlike manner without damage to the pipe.

(f) Installation and Connection

(1) Installation of pipe shall be carefully conducted so as not to be concussed pipe.

(2) As for means of connection between steel pipes, screwed type socket or welding connection shall be basically adopted for the pipe with less than 150 mm diameter, and more than 200 mm diameter, respectively. However, welding connection may be adopted even for the pipe less than 150 mm diameter with the Engineer approval.

(3) Welded surface of pipe shall be kept clean avoiding adhesion of refuse, soil, etc. And shall be painted by zinc coating approval by the Engineer.

9-03. INSTALLATION OF VALVES AND ACCESSORIES

The valves, taps, accessories, raiser pipes and caps shall be placed and assembled to the pipeline in the above specified way for pipeline cleaning and laying, and as shown on the drawings. The placement of them shall be approved by the Engineer.

9-04. FILLING WATER TEST AND RUNNING TEST

After completion of installation of pipe and backfilling, filling water test shall be taken in each certain interval, in order to ensure the leakage of water within allowable range by the method approved by the Engineer. Testing pressure shall be taken by normal design water pressure at the site. After the filling water test, the irrigation water distributing system shall be done test running as direction by the Engineer.

PART 10 LINING WORKS

10-01. SCOPE

This part covers the works for lining of the farm pond for the irrigation facilities in the Chai Badan Dairy Farming Demonstration Centre.

The Contractor shall furnish all materials, labor, equipment and tools necessary to complete the works and shall arrange a well qualified engineer who has enough experience of supervision of the lining works and shall be satisfactory to the Engineer.

10-02. MATERIALS

Liner to be used shall be flexible PVC membrane liner of 1.2 mm in thick. Sample of the liner shall be furnished to the Engineer for his approval at least seven (7) days in advance of the time when the works are expected to begin.

10-03. CONSTRUCTION

Prior to commencement of the works, the Contractor shall submit shop drawings and work schedule to the Engineer for his approval.

The soil surface on which the liner is to be lined shall thoroughly be free from vegetation such as weeds, grass, roots and other herbaceous vegetation, and loose stones, rubbish of all sorts and soft or objectionable matters.

The soil surface shall be sufficiently compacted and made smooth as the preparatory work for the lining works. Completion of the preparatory work shall be inspected by the Engineer for his approval. The lining works shall be carried out by the Contractor in accordance with the Drawings and shop drawings approved by the Engineer or otherwise directed by the Engineer.

10-04. MEASUREMENT FOR PAY

No separate payment will be made for the works referred to above cost of these works shall be include in the respective items given in the Bill of Quantities.

PART 11 OTHER WORKS

YAN JIN TECHNOLOGY CO., LTD.

THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE PROVISION OF ALL MATERIALS AND LABOR REQUIRED FOR THE WORKS.

11-01. GENERAL

The works include all required works which are given in the Bill of Quantities and/or shown in the Drawings but are not specified herein.

11-02. MATERIALS

Exclusive of the supplies described in PART 12, all materials for the works shall be furnished by the contractor and shall be approved by the Engineer.

11-03. CONSTRUCTION

The contractor shall carry out the works in accordance with the Drawings or the instructions given by the Engineer, and shall submit the shop drawings to the Engineer for his approval before commencement of the works at needed for performance of the works.

PART 12 SUPPLIES

Following supplies viz. pumps, pipes etc. for the irrigation facilities in the Chai Badan Dairy Farming Demonstration Centre will be supplied by the JICA.

	<u>Contents/Specification</u>	<u>Quantity</u>
A. Supplies for Deep Well		
A1.	Submersible pump for Deep Well	1 set
	Capacity: 250 l/min	
	Total head: 30 m	
	Well dia: \varnothing 150 mm	
	Discharge size: \varnothing 50 mm	
	No. Of stage: 5 stages	
	Motor output: 2.2 KW (50 HZ, 3 x 380 V)	
	Operation water level: GL - 25 m	
	Lowest water level: GL - 30 m	
	(EBARA MODEL 50 BHS 5.2.2 or equivalent)	
	With: Riser pipes (31 m), Submersible cable (35 m), Well cover, Discharge elbow, Low water-level electrode, Automatic air vent valve, Compound gauge and Control panel	
A2.	Check Valve \varnothing 50 mm for the above pump with companion flange	1 set
A3.	Sluice Valve \varnothing 50 mm for the above pump with companion flange	1 set
A4.	Galvanized steel pipe \varnothing 50 mm with a short elbow 90° & a short elbow 30°	10 m
A5.	Tee pipe 50 mm x 50 mm with flanges	1 no.
A6.	Gate Valve (Brass) \varnothing 50 mm	1 no.
B. Supplies for Pumping Facilities		
B1.	Volute Pump (Single type) with Motor	1 unit
	Capacity: 750 l/min	
	Total head: 70 m	
	Suction size : \varnothing 80 mm	
	Discharge size : \varnothing 65 mm	
	Motor output : 22 KW(50 HZ, 3 x 380 V)	
	(EBARA MODEL 80 x 65 FS 2J522 or equivalent)	
	With: Base and Control unit	
B2.	Foot Valve for the above (100 mm)	1 no.
B3.	Reducer for suction 100 mm x 80 mm	1 no.
B4.	Reducer for discharge 100 mm x 65 mm	1 no.
B5.	Galvanized steel pipe 80 mm with flanges and a short elbow 90°	6 no.
B6.	Gate Valve (steel) \varnothing 100 mm with companion flange	1 set

C. Supplies for Pipeline

C1. Galvanized steel pipe ϕ100 mm with couplings	210 m
C2. Galvanized steel pipe ϕ80 mm with couplings	480 m
C3. Short elbow 90° ϕ100 mm	5 nos.
C4. Short elbow 90° ϕ80 mm	6 nos.
C5. Cross pipe 100 mm x 80 mm	1 no.
C6. Tee pipe 80 mm x 100 mm x 100 mm	2 nos.
C7. Tee pipe 100 mm x 80 mm x 80 mm	1 no.
C8. Tee pipe (for the raiser pipe) 80 mm x 50 mm	6 nos.
C9. End pipe with tee (for raiser pipe) 80 mm x 50 mm	6 nos.
C10. Sluice Valve 80 mm	6 nos.
C11. Sprinkler	3 nos.
Water quantity: 340 l/min	
Radius : 35 - 40 m	
Full rotating	
(Rain Bird Model 102 EHM or equivalent)	
C12. Expandible raiser pipe ϕ50 mm	12 sets
Length : 1.5 m	
With a quick raiser coupler and a tripod	
C13. Quick socket ϕ50 mm	12 nos.
C14. Protector (plate type, to be attached to raiser pipe)	1 no.
C15. Raiser plug 50 mm	12 nos.

APPENDIX A

Table of Tolerances

Tolerances for the Works to be executed are as follows:

Road Works

Sub-base thickness of Road	+ 20 mm - 10 mm
Base-course of road	40 mm (minimum)
Formation of road	± 50 mm
Formation for structure	± 10 mm (Filled with crushed stone)
C.B.R. values on the Sub-grade Surface	Minimum 8 %
C.B.R. values on the Sub-base and Wearing Course of Gravel Road	Minimum 20 %

Concrete

Length	± 20 mm
Level of concrete	± 6 mm

Reinforcement

Maximum departure in required bar spacing	25 mm
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5.4 Bill of Quantities

BILL OF QUANTITIES
FOR
THE MODEL INFRASTRUCTURE WORKS
FOR
THE DAIRY FARMING DEVELOPMENT PROJECT
IN
THE CENTRAL REGION OF THE KINGDOM OF THAILAND

CONSTRUCTION COST

(1/2)

unit:in Baht

Description	Quantity	Unit	Remarks/Reference
1. Direct Cost			
A. Construction Works in Pathum Thani AI Centre			
A1. Water Supply Facilities Works	1	L.S.	A-1
1) Deep well works	1	L.S.	A-1-1
2) Elevated water tank works	1	L.S.	A-1-2
3) Water supply pipe works	1	L.S.	A-1-3
A2. Paddock Works	1	L.S.	A-2
A3. Manure Deposit Shed Works	1	L.S.	A-3
A4. Road Deposit Shed Works	1	L.S.	A-4
1) Approach to the milking cow shed	70	m	A-4-1
2) Approach to the bull shed of semen processing building	44	m	A-4-2
3) Approach to the manure deposit shed	148	m	A-4-3
Sub-total(A)			

CONSTRUCTION COST

(2/2)
unit: in Baht

Description	Quantity	Unit	Remarks/Reference
B. Construction Works in Chai Badan Dairy Farming Demonstration Centre			
B1. Irrigation Facilities Works	1	L.S.	B-1
1) Deep well works	1	L.S.	B-1-1
2) Farm pond works	1	L.S.	B-1-2
3) Pipeline works	1	L.S.	B-1-3
B2. Road Works	1	L.S.	B-2
1) Approaches to the project buildings	180	m	B-2-1
2) Main road	294	m	B-2-2
3) Lateral road junctions	15	m	B-2-3
Sub-total(B)			
2. In-direct Cost			
1) Mo-dewebilization & Site Expenses	1	L.S.	10% of (1)
2) Overhead cost	1	L.S.	10% of (1)
<hr/>			
Total(1+2)			
<hr/>			
3. V.A.T	1	L.S.	7% of (1+2)
<hr/>			
Total (1+2+3)			
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Breakdown of Water Supply Facilities Works

No. A-1

Description	Quantity	Unit	Remarks/Reference
1. Deep well works	1	L.S.	A-1-1
2. Elevated water tank works	1	L.S.	A-1-2
3. Water supply pipe works	1	L.S.	A-1-3
Total			

Breakdown of Deepwell Works

No. A-1-1

Description	Quantity	Unit	Remarks/Reference
1. Deep well work Preparation work	1	L.S.	
2. Drilling of deep well	300	m	ø200 mm
3. Electrical logging	1	L.S.	
4. Casing pipe	288	m	GSPø100 mm
5. Screen	12	m	Stainless steel pipe ø100 mm
6. Development	1	L.S.	
7. Pumping test	1	L.S.	
8. Submersible pump	1	unit	ø32mm 2.2kw 42L/min, H=100m
9. Submersible cable	100	m	
10. Riser pipe	71	m	GSPø32mm
11. Pump accessories	1	set	Gate valve, Air valve Elbow, etc
12. Control box	1	set	
13. Installation works	1	L.S.	
Sub-total			
14. Miscellaneous	1	L.S.	
<hr/>			
Total			

Breakdown of Elevated Water Tank Works

No. A-1-2

Description	Quantity	Unit	Rate	Amount	Remarks/Reference
1. Elevated water tank (champagne type,)	1	set			v=5m ³ H=1.8m
2. P.C.piles	16	nos			I-.22x.22x14.0m
3. Pile-driving	16	nos			
4. Excavation	37.0	m ³			
5. Backfilling	31.0	m ³			
6. Crushed stone	1.1	m ³			
7. Leveling concrete	0.5	m ³			
8. Reinforced concrete	4.6	m ³			
9. Reinforcement bar					
ø6 mm	60	kg			
ø9 mm	120	kg			
ø12 mm	120	kg			
10. Anchor bolt ø25mm	55.5	kg			1200mmx12
11. Form work	20	m ²			
Sub-total:					
12. Miscellaneous	1	L.S.			
Total					Baht

Breakdown of Water Supply Pipe Works

No. A-1-3

Description	Quantity	Unit	Rate	Amount	Remarks/Reference
1. Galvanized steel pipe ø1.5"	60	m			
2. GSP Elbow ø1.5"	10	nos			
3. GSP Tee ø1.5"×0.75"	1	no.			
4. Gate Valve ø1.5"	1	no.			
5. Gate Valve ø0.75"	2	nos			
6. Water tap ø0.75"	1	no.			
7. P.V.C Pipe ø0.75"	56	m			
8. Piping GSP ø1.5"	60	m			
9. Piping PUCP ø0.75"	56	m			
Sub-total					
10. Miscellaneous	1	L.S.			
Total					Baht

Breakdown of Paddock Works

No. A-2

Description	Quantity	Unit	Rate	Amount	Remarks/Reference
<u>Earth Works</u>					
1. Grading & Leveling	760.0	m ²			
2. Filling	47.5	m ³			
3. Filling with laterite	180.0	m ³			
<u>Pavement Work</u>					
4. Surface concrete	457.6	m ²			t=100mm
5. Steel mesh	460.0	m ²			ø6mm- 200mm×250mm
6. Crusher run base cause	460.0	m ²			t=150mm
7. Curbstone(concrete)	30.0	m			100mm×250mm
<u>Drainage Work</u>					
8. Side ditch(concrete)	100.0	m			U-400×300mm
9. Grating	4	nos			L-25×25 ×450×1,000m
10. Catch basin	1	place			RCP-ø1,000mm
<u>Facilities for operation</u>					
11. Manger & Water Vessel	1	no.			Concrete
12. Fence A type	134.0	m			GSP ø2", ø1.25"
13. Fence B type	12.0	m			GSP ø2", ø1.25"
14. Planting(Pterocarpens)	11	nos.			ø10~20cm
Sub-Total					
15. Miscellaneous	1	L.S.			
Total					Baht

Breakdown of Manure Deposit Shed Works

No. A-3

<u>Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Rate</u>	<u>Amount</u>	<u>Remarks/Reference</u>
<u>Earth work</u>					
1. Grading & Compacting	172.2	m ²			
2. Filling	220.0	m ³			
3. Filling with laterite	163.0	m ³			
<u>Pavement work</u>					
4. Surface concrete	122.0	m ²			t=100mm
5. Steel mesh	122.0	m ²			ø6mm- 200x150mm
6. Crusher run	122.0	m ²			base course
<u>Drainage Wor</u>					
7. Side ditch (Concrete)	9.6	m			U-150x150mm
8. Side ditch (Concrete)	10.0	m			U-200x200mm
9. Side ditch (Concrete)	11.2	m			U-400x300mm
10. Earth ditch (crushed stone)	12.0	m			600x200mm
11. Pipe culvert	9.0	m			RCP-ø200mm
12. Connection box	1	no.			500x500x1000 mm
13. Superstructure 10.0m x 5.0m	1	L.S.			A-3-1
Sub total					
14. Miscellaneous	1	L.S.			
Total					Baht

Breakdown of Superstructure Works for
Manure Deposit Shed

No. A-3-1

Description	Quantity	Unit	Rate	Amount	Remarks/Reference
<u>Earth work</u>					
1. Excavation	52.3	m3			
2. Backfilling	37.0	m3			
3. Disposal of surplus soil	15.3	m3			
4. Crushed stone	4.4	m3			
<u>Structure works</u>					
5. Leveling concrete	1.5	m3			
6. Reinforced concrete	23.0	m3			
7. Form work	176.6	m2			
8. Reinforcement bar	3.5	t			
9. Steel flame	1.78	t			
10. Steel flame work	1.78	t			
sub-total					
<u>Finishing works</u>					
11. Roofing	87.0	m2			corrugated slate
12. - do -	12.0	m2			curve slate
13. Steel OP	80.0	m2			
14. Trowelled concrete finish	50.0	m2			
Sub-total					
<hr/>					
Total					Baht
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Breakdown of Road Works

No. A-4

Description	Quantity	Unit	Amount	Remarks/Reference
1. Approach to the milking cow shed	1	L.S.		A-4-1
2. Approach to the bull shed of semen processing building	1	L.S.		A-4-2
3. Approach to the manure deposit shed	1	L.S.		A-4-3
Total				Baht

Breakdown of Works for Approach to the Milking Cow Shed

No. A-4-1

Description	Quantity	Unit	Rate	Amount	Remarks/Reference
<u>Earth Work</u>					
Excavation	40.0	m ³			
Filling with laterite	24.0	m ³			
<u>Pavement work</u>					
					W=4.0m L=70.0m
Asphalt surdace	281.0	m ²			T=40mm Hot-mixed asphalt
Road base (Graded crushed stone)	281.0	m ²			t=100mm
Subbase (Crusher run)	80.0	m ²			t=150mm
Filling	12.7	m ³			
Sub-total					
Miscellaneous	1	L.S			
Total					Baht

Breakdown of Works for Approach to the
Bull shed of semen Processing Building

No. A-4-2

Description	Quantity	Unit	Rate	Amount	Remarks/Refence
Laterite road					W=3.5m L=44.3m
1. Excavation	55.4	m ³			
2. Filling with laterite	65.3	m ³			
sub-total					
3. Miscellaneous	1	L.S.			
Total					Baht

Breakdown of Works for Approach
to the Manure Deposit Shed

No. A-4-3

Description	Quantity	Unit	Rate	Amount	Remarks/Refence
Lateerite road					W=5.0m L=148.0m
<u>Earth work</u>					
Lovelling and striping	740.0	m ²			
laterite	444.0	m ³			
<u>Drainage works</u>					
Earth ditch	65.0	m			d=30cm
Pipe culvert	7.0	m			RCP-ø400mm
Catch basin	1	place			Rcp-ø1000mm
Sub-total					
Miscellaneous	1	L.S.			
Total					Baht

Breakdown of Irrigation Facilities Works

No. B-1

Description	Quantity	Unit	Amount	Remarks/Reference
1. Deep well works	1	L.S.		B-1-1
2. Farm pond works	1	L.S.		B-1-2
3. Distribution facilities works	1	L.S.		B-1-3
Total				Baht

Breakdown of Deep Well Works

No. B-1-1

Description	Quantity	Unit	Rate	Amount	Remarks/Reference
1. Preparation work	1	L.S.			
2. Electric prospecting	1	L.S.			
3. Deep well drilling ø12"					
1) Soil layer	30	m			
2) Soft rock layer	25	m			
3) Hard rock layer	25	m			
4. Electric logging	1	L.S.			
5. Casing ø6"	70	m			GSP
6. Screen ø6"	10	m			stainless steel
7. Development	1	L.S.			
8. Pumping test	1	L.S.			
9. Installation of submergible pump	1	L.S.			supply
10. Materials for installation	1	L.S.			
11. Power line	170	m			
Sub- total					
12. Miscellaneous	1	L.S.			
Total					Baht

Breakdown of Farm Pond Works

No. B-1-2

Description	Quantity	Unit	Rate	Amount	Remarks/Reference
<u>Earth works</u>					
1. Excavation/soil	1,975	m ³			
2. Excavation/stone, hard rock	1,019	m ³			
3. Filling	1,580	m ³			
4. Filling with laterite	705	m ³			
5. Disposal of surplus soil	1,019	m ³			
6. Slop trimming	1,142	m ²			
7. Bed trimming	1,600	m ²			
8. Sodding	1,847	m ²			
<u>Lining work</u>					
9. Lining t=1.2mm	3,118	m ²			Flexible PVC membrane liner
<u>Stairs work</u>					
10. Crushed stone	0.9	m ³			
11. Reinforced concrete	0.3	m ³			
12. Reinforcement bar	10	kg			
13. Form work	12.4	m ²			
Sub total					
Miscellaneous	1	L.S.			
Total				Baht	

Breakdown of Distribution Facilities Works

No. B-1-3

Description	Quantity	Unit	Rate	Amount	Remarks/Reference
<u>Earth works</u>					
1. Filling	100	m ³			
2. Sodding	80	m ²			
<u>Related structure</u>					
3. Crushed stone	0.9	m ³			
4. Leveling concrete	0.3	m ³			
5. Reinforced concrete	0.8	m ³			
6. Reinforcement bar	26.3	kg			
7. Form work	1.4	m ²			
8. Concrete block	13.8	m ²			
9. Slate roofing	6.8	m ²			
<u>Equipent work</u>					
10. Installation of pump	1	L.S.			Supply
11. Piping of GSP 80A	6	L.S.			- do -
12. Piping of GSP 100A	210	m			- do -
13. Piping of GSP 80A	480	m			- do -
14. Excavation	350	m ³			
15. Back fill	350	m ³			
16. Miscellaneous for piping	1	L.S.			
17. Valve box	6	nos.			
18. Running test	1	L.S.			
Sub-total					
19. Miscellaneous	1	L.S.			
Total					Baht

Breakdown of Road Works

No. B-2

Description	Quantity Unit	Amount	Remarks/Reference
1. Approaches to the project buildings	1 L.S.		B-2-1
2. Main road	1 L.S.		B-2-2
3. Lateral road junctions	1 L.S.		B-2-3
Total			Baht

Breakdown of Works for Approaches to the Project Buildings

No. B-2-1

Description	Quantity	Unit	Rate	Amount	Remarks/Reference
1. Leveling	720.0	m ²			
2. Filling	216.0	m ³			
3. Asphalt surface t=40mm	726.0	m ²			W= 4 m L=180 m Penetration makadam
4. Graded crushed stone t=80mm	726.0	m ²			Road base
5. Crusher-run t=120mm	726.0	m ²			Sub-base
6. Filling	172.8	m ³			
Sub total					
7. Miscellaneous	1	L.S.			
Total					Baht

Breakdown of Works for Main Road

No. B-2-2

Description	Quantity	Unit	Rate	Amount	Remarks/Reference
1. Asphalt surface t=40mm	1,469.5	m ²			W= 5.0 m L=293.9 m Penetration makadam
2. Graded crushed stone t=80mm	1,469.5	m ²			Road base
3. Crusher-run t=120mm	1,465.5	m ²			Sub-base
4. Filling	352.7	m ³			
Sub total					
5. Miscellaneous	1	L.S.			
Total					Baht

Breakdown of Works for Lateral Road Junctions

No. B-2-3

Description	Quantity	Unit	Rate	Amount	Remarks/Referenxe
1. Asphal surface t=40mm	63.0	m ²			W=4.0m L=5.0mx3 Penetration makadam
2. Graded crushed stone t=80mm	63.0	m ²			Road base
3. Crusher-run t=120mm	63.0	m ²			Sub-base
4. Filling	18.0	m ³			
Sub total					
5. Miscellaneous	1	L.S.			
Total					Baht

