

8.2 Specification Document (Draft)

TECHNICAL SPECIFICATIONS
ON
CONSTRUCTION WORK OF THE
MODEL INFRASTRUCTURE IMPROVEMENT WORKS
FOR
THE LAND AND WATER CONSERVATION CENTER PROJECT
IN
THE EAST OF THAILAND

JAPAN INTERNATIONAL COOPERATION AGENCY

THAILAND OFFICE

TECHNICAL SPECIFICATIONS

PART I SPECIAL PROVISION

1-01 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, or will not cause the disturbances on the personal cultivation land of the other project. Any damages on the such existing structure or facilities shall be made good by the Contractor at his expense.

1-02 If it is necessary in the prosecution of the work to interrupt or obstruct the drainage of the surface, the flow of artificial drains and the flow of irrigation canal, the contractor shall provide for the same during the progress of the work 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 irrigation or drainage which he may interrupt, he shall be held liable for all damages which may result therefrom during the progress of the work.

1-03 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 contract, the Contractor is expected to familiarize himself with local conditions, availability of labor, transportation facilities, uncertainties of weather, and other contingencies. From investigation, made at site, it is believed that topographical conditions are approximately shown on the drawings, but the nature of the materials and the depth of satisfactory foundations, are not guaranteed. It is expressly understood that JICA will not be responsible for any deduction, interpretation, or conclusions made by the Contractor.

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.

1-04 Elevation referred to the datum plane are to be determined from bench marks established by JICA or the Inspection Committee at the site of the work.

1-05 The Inspection Committee will establish the necessary survey monuments and bench marks at convenient points in the area covered by this contract for use of the Contractor in laying the lines and grades required for the proper conduct and execution of the work. All stakes, bench marks, etc., placed by the Inspection Committee in laying out the work, 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 will be replaced by the inspection Committee at the expense of the Contractor.

1-06 The Contractor shall execute the work to the lines and grades given by the drawings and/or the Inspection Committee. The Contractor shall, at his own expense, furnish all stakes, templates, patterns, platforms and labor that may be required in setting or laying cut any part of the work.

PART 2 GENERAL CONSTRUCTION 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 satisfactorily 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 without cost to JICA, and same shall be made on 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 order in the camp and work area.
- (b) The location, construction operation and maintenance of such camps and facilities within the areas of the site shall be subject to the approval of the Inspection Committee. At least ten (10) calendar days prior to the date on which the Contractor desires to begin to work in feature of camp construction, the Contractor shall submit for the approval of the Inspection Committee drawings and

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

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.

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 cleaned.

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 Common Temporary Works as indicated in the Priced Bill of Quantity.

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 the 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 suitable 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 amply dry condition, and prior to final acceptance of the work by the Contracting office, the Contractor shall remove, fill or plug all temporary drainage structures and pumping equipments 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 item of Common Temporary Works.

PART 4 OPEN 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 Inspection Committee, the Contractor shall perform all required open excavation and foundation preparation pertinent to the construction of reservoir, farm, road, irrigation pipe-line, drainage canal, and other construction work where open excavations are to be made.

4-02 OPEN EXCAVATION

(a) General

Open excavation under these Specifications consists of the removal, hauling, dumping, and satisfactory disposal of all materials from required excavations for reservoir, farm road, drainage canals and miscellaneous excavations for other structures included under this contract. Open excavation shall be performed to the lines and grades shown on the drawings or established by the Inspection Committee. The Inspection Committee 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 grades in the soundest possible condition.

(b) **Foundation in Loose Material**

When the surfaces of excavation upon or against which concrete or embankment fill is to be placed consist of loose material, the said loose materials shall be removed or replaced with suitable materials and compacted in a manner satisfactory to the Inspection Committee. The cost of removing the loose materials shall be paid for under the pertinent bid items for open 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**

(a) **Spoil Areas**

The Contractor shall submit for the approval of the Inspection Committee locations, areas, drawings and other necessary specifications of spoil area which the Contractor proposes to use for the work under this 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 area. 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. Spoil 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 Inspection Committee, existing concrete structures, such as concrete masses, stones, etc., shall be demolished and disposed for 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 Inspection Committee, 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.

4-06 MEASUREMENT FOR PAYMENT

(a) Open Excavation

A survey of the areas to be excavated shall be made by the contractor prior to the commencement of the work under this 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 subject to check and approval by the Inspection Committee. 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 Inspection Committee.

(b) Foundation Preparation

No separate payment will be made for all foundation preparation specified under Paragraph 4-05 (a). The entire cost of foundation preparation for 4-05 (a), shall be included in the unit price for the pertinent item of embankment or fill in the Bill of Quantity. The cost of foundation preparation specified under Paragraph 4-05 (b), shall be paid for under the pertinent item shown in the Bill of Quantity, and the measurement shall be made by the acceptable method to the Inspection Committee.

(c) Demolition, Removal and Dismantling

Demolition, removal and dismantling work will be measured by the acceptable method to the inspection Committee and paid for under the items shown in the Bill of Quantity.

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 Inspection Committee the Contractor shall furnish and place the earth fill for dam, farm road embankment and for ground embankment backfill for related structures. Any work of fill and backfill shall not be commenced without prior approval of the Inspection Committee. 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 Inspection Committee. 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 Inspection committee.

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 Inspection Committee. The Inspection Committee 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

- 1) 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 Inspection Committee considers objectionable and shall also dispose of such material and refill the excavated as directed, all at no additional cost to JICA. The Contractor may be required to remove at his own expense any fill material placed outside of prescribed slope lines.
- 2) 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.

5-04 MATERIALS

(a) Sources

The Contractor shall submit for the approval of the Inspection Committee 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 sources 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 Inspection Committee. Any additional material needed shall be obtained from sources approved by the Inspection Committee.

(b) Suitability

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 Inspection Committee.

5-05 PLACEMENT

(a) General

No fill material shall be placed on any part of the fill foundations until such areas have been inspected and approved by the Inspection Committee 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.

(b) Earth Fill

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.

5-06 COMPACTION

(a) General

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 Inspection Committee, to a density more than 85 percent of the maximum dry density of the material or to a density specified by the Inspection Committee.

(b) Fill on or against Culverts and Concrete Structure

No fill shall be placed on or against concrete surface before a period of fourteen (14) days has elapsed after placing the concrete. Before passage of hauling equipment over the top of culverts or other structures will be permitted, the depth

of fill over the concrete shall be sufficient to permit such passage without harmful stresses or vibrations in the structure. Fill placed around and over culverts or other 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.

5-07 ADDITIONAL COMPACTION

If in the opinion of the Inspection Committee, 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 JICA.

5-08 QUALITY CONTROL

If it is required, tests for moisture content and density, and other all necessary tests will be made by the Inspection Committee, 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 labour in obtaining and preserving samples.

5-09 MEASUREMENT FOR PAYMENT

(1) Fill

(a) 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.

(b) Payment

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

(2) 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 Inspection Committee.

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 reasonably 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 modules shall be in the range form 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 :

Sieve Designation U.S.Std. Square Mesh	Per Cent by Wt. Passing Individual Sieves 3/4" Max.
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 Inspection Committee 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 Inspection Committee. The Contractor shall carry out the mix test in case of being requested by the Inspection Committee. 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 : 3
B (Plain concrete)	160 kg/cm ²	1 : 2 : 4
C (Concrete layer)	135 kg/cm ²	1 : 3 : 4

Other proportions for mixing design may be indicated by the Inspection Committee 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 Inspection Committee.

(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 Inspection Committee.

(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 Inspection Committee 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 Inspection committee. 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 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) Relationship or Reinforcement to Concrete Surfaces

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 DRAINAGE CANAL

7-01 GENERAL

Drainage canal shall be constructed at the locations shown on the drawings or as directed by the Inspection Committee. Protecting the soil erosion, gradient of slop shall be gentle as shown on the drawings. Also in order to slow down the velocity of flow drops shall be constructed in several points of the canal. The Contractor shall execute these to the location and elevation as shown on the drawing and/or indication by the Inspection Committee.

7-02 GABIONADE

Gabionade shall consist of wire-net boxes packed with gobble stones. Wire-net box shall be made by galvanized wire-mesh (#11, 2"). Gabionade shall be fixed by the pile of iron bar ($\phi 25$) inserted to the hole drilled by hand auger ($\phi 100$) and filled by mortar. Upper part of the pile on the ground shall be cased with PVC pipe and filled by mortar.

7-03 SLOPE PROTECTION

Protecting the slope sod facing shall be executed at the top of slope in width of 1m. The time of sod facing shall be indicated by the Inspection Committee.

7-04 PIPE WORK

7-04-1 General

The Contractor shall install all piping and fittings as specified herein and shown on the Drawings or as directed by the Inspection Committee.

The intention of the Specifications is to cover all types of pipe. Any pipe of a material not specifically mentioned in this Chapter shall be installed in the same manner as the closest listed pipe.

7-04-2 Installation of Pipe Underground

(1) General

Proper instruments, tools, and facilities satisfactory to the Inspection Committee 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 piece by suitable tools or equipment, in such manner as to prevent pipe and protective coatings from damage. Under no circumstances shall pipe and other materials be dropped or dumped into the trench.

(2) Inspection before Installation

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

(3) Cleaning of Pipe and Fittings

All lumps, blisters, and excess coating shall be removed from the end of each pipe. The outside of the joint end and the inside of the joint shall be wiped clean, dry and free from oil and grease before the pipe is laid.

(4) 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 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 in progress, the open ends of pipe shall be closed.

(5) 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.

(6) Installation and Connection

- a) Installation of pipe shall be carefully conducted so as not to be concussed pipe.
- b) 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 Inspection Committee's approval.
- c) Welded surface of pipe shall be kept clean avoiding adhesion of refuse, soil, etc. and shall be painted by zinc coating approval by the Inspection Committee.

7-04-3 Filling Water-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.

Testing pressure shall be taken by normal design water pressure at the site, and 25 lit/day per 1 km length and 1 cm diameter of pipe shall be set up as a standard.

7-04-4 Installation of Valves and Accessories

The valves, taps, accessories, stoppers 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 tap placement shall be approved by the Inspection Committee.

PART 8 FARM ROAD

- (a) The farm road shall be constructed by using earth materials near the site and be completed by compaction with tire roller after a layer of laterite has been dumped and spread.
- (b) The surface of farm road shall be finalized by constructing middle portion of the road higher in height than each side of the road, of which the cross sectional gradient is shown in the drawings.

- (c) During the period of construction for farm road, the Contractor will always pay attention on drainage of rain water to prevent the surface of road from becoming muddy.

PART 9 RUN-OFF PLOT

Gradient of the part of run-off passage in the flame will be two kinds: one is 5% slope and the other is 9% slope. It depends on the direction of the Inspection Committee which gradient shall the Contractor choose in process of construction.

PART 10 FINISHED OF FIELD

The Contractor shall execute finishing of the field after all earth moving works have been over. Finishing of the field involves leveling the small uneven part of the field face and spreading the spoiled soil on the field. It does not mean to modify the natural gradient of the field by cutting and banking the soil.

PART 11 BUILDING WORK

11-01 GENERAL

- (1) This Part shall cover the construction work of the Field Laboratory.
- (2) Prior to commencement of any building work of the farm facilities and pump house, the Contractor shall provide and furnish shop drawings for the Inspection Committee's approval. The shop drawings shall include temporary works and dimension of structures in accordance with the Drawings and Specifications provided hereinafter.
- (3) The Contractor shall provide all labor, plant, materials, tools and equipment and other facilities necessary to complete all operations under this division including excavation, backfilling, filling, and grading in accordance with the Drawings and as specified herein or as directed by the Inspection Committee.

(4) Stakes and Batter Boards

- 1) Stake out the building accurately and establish grade lines as shown on the Drawings or as directed by the Inspection Committee.
- 2) Erect batter boards and basic references as directed by the Inspection Committee at such places where they will not be disturbed during construction.
- 3) Storage of materials and work shall be conducted in such a manner as to preserve all reference marks set by the Contractor. The Contractor shall reestablish all lines and grade that get dislocated at his expense.
- 4) The Contractor shall construct two (2) permanent bench marks of previously known elevation near or within the site of construction for the purpose of determining any settlements that may occur during the progress of construction.

11-02 EARTH WORK

11-02-1 Excavation

- (1) The Contractor shall make all necessary excavations for foundations to grades indicated on the approved drawings. Excavations shall include leveling the bottom of the footing, compacting and tamping of same.
- (2) Excavate rock, earth and other materials of every nature, or description encountered in obtaining indicated lines and grades, which, in the Inspection Committee's opinion can be loosened, removed by hand with hand tools or power shovels.
- (3) The Contractor shall excavate all trenches to a neat size, leveled to a line at the bottom ready to receive foundations. Remove all loose rock, dirt and debris prior to pouring concrete.
- (4) No footing shall rest on fill. Where excavations reveal that footing will rest on fill, the Contractor shall carry excavations deeper until desired stratum is reached for safe bearing power of soil.
- (5) Make all excavations with proper allowance for floor slabs, forms and centers. Bottom of foundations shall be approximately level and clear of loose materials and lower sections true to size.

- (6) If the required bearing power is not obtained at the excavation, the excavation shall be continued until such safe bearing power is obtained, with piers and walls being lengthened accordingly to suit the conditions for which the Contractor shall be paid at the unit price bid for excavation.
- (7) When the nature of soil is such that foot bearing (safe bearing) is found to exist at higher grades than indicated sub-grades, the Inspection Committee may decide to stop excavation work at these levels, but request should be done by writing.
- (8) Where walls or footings are to be poured without forms, trench sides shall be sharp and true.

11-02-2 Backfilling

- (1) Use all suitable materials removed from excavation, including materials from suppliers, insofar as practicable, in the formation of backfills.
- (2) Deposit no excavated material at any time in manner that may endanger a partly finished structure by direct pressure, by overloading bands contiguous to the operations, or in any other way detrimental to the completed work.
- (3) After forms have been removed from footings, piers, foundation walls, etc., and when concrete work is hard enough to resist pressure resulting from fill, the materials from excavations shall be used for backfilling around them in horizontal layers not exceeding 15 cm with each layer being thoroughly compacted and rammed by wetting.

11-02-3 Filling and Grading

- (1) Use filling material suitable for structural earthfilling work as mentioned in the preceding Part 5.
- (2) Provide granular fill beneath all concrete building slabs on grade. Granular fill shall be clean crushed stone or gravel placed to a depth of 10 cm.

11-02-4 Disposal of Waste Materials

All excess waste and other unused excavated materials shall be used for site grading or leveling if required by the Inspection Committee, and shall not be removed from the Site without approval of the Inspection Committee. Surplus materials except used for above mentioned shall be disposed to the spoil bank as directed by the Inspection Committee.

11-03 REINFORCED CONCRETE WORK

11-03-1 General

All reinforced concrete work shall be completed as shown on the Drawings and as specified herein.

11-03-2 Concrete

- (1) Concrete shall consist of Portland Cement, fine aggregates, coarse aggregate, water, and where specified admixtures; proportioned, mixed, placed, cured and finished as specified in the preceding Part 6 "Concrete Work".
- (2) Miscellaneous:
 - 1) Shop drawings or form work, where required by the Inspection committee, shall be submitted for approval before fabrication and erection of such formwork.
 - 2) Provide temporary openings where necessary to facilitate cleaning and inspection immediately before depositing concrete.
 - 3) Side forms of footing may be omitted and concrete placed against the neat excavation only when approved by the Inspection Committee and when an appropriate credit is allowed.
 - 4) All exposed corners shall be square. Exercise due care while stripping forms and protect corners subsequently against chipping or other damage by approved means.
 - 5) Always provide continuous vertical supports for formwork directly below any pour line.

- 6) On completion of the work under this divisions, the Contractor shall clean down all exposed concrete work and remove from the premises form-lumber, cement sacks, and other debris caused by this work.

11-04 SCOPE OF WORK

11-04-1 General

- (1) All work described herein shall be governed by Thailand codes besides standards mentioned in other Part.
- (2) Submit to the Inspection Committee for approval, all shop drawings prior to fabrication. Any material fabricated before final approval of the shop drawings will be done at the risk of the Contractor.
- (3) The Contractor shall be responsible for the correct fitting of all structural members and for the elevation and alignment of the finished structure.
- (4) Substitutions of sections or modifications of details shall be made only when approved by the Inspection Committee, and at no additional cost to the JICA.

11-04-2 Materials

- (1) Structural Steel, welding electrodes, bolt and nut, etc. shall be governed by Thailand codes.
- (2) paint: Prime coat shall be iron oxide or red lead paint
- (3) Grout: Portland Cement and sand mixed in the proportion of 1:2 by volume

11-04-3 Fabrication

- (1) Material shall be properly match-marked where field assembly is required.
- (2) Connections and details not shown but necessary to develop member or joint are subject to the Inspection Committee's approval.

- (3) Welding shall be done by the shielded arc method in accordance with the applicable standard and code.

Sequence of welding in assembling built-up sections shall be such that warping of the finished product is prevented or jigs shall be achieved the same purpose. Welded connections of equal value may be substituted for reverted or bolted connections if not shown on the Drawings, subject to the Inspection Committee's approval.

- (4) Unfinished bolts shall be used for field connections. Lock washers shall be used under all nuts.
- (5) All structural steel members shall be thoroughly cleaned, with all rust and mill scale removed and shall receive one prime coat of paint before delivery. Unpainted areas left to preserve shop marks will not be permitted. After erection, all abrasions, rivets and bolt heads, and surfaces left unpainted for welding shall be painted with one prime coat of paint.

11-04-4 Inspection

- (1) Provide access to places where materials are being fabricated or produced for the purpose of inspection.
- (2) The Inspection Committee reserves the right to reject any materials at any time before final acceptance which does not conform to all the requirements of the approved drawings and specifications.
- (3) The Contractor shall engage the services of an approved testing laboratory at his expense to perform any required tests and shall submit 3 copies of all reports to the Inspection Committee. Correct measures, including additional and more complete testing which may result from these tests shall be the responsibility of the Contractor.
- (4) All welds shall be visually inspected prior to painting. Unless otherwise noted, individual members of the structure shall be leveled and plumbed to an accuracy of 1 to 500. Drift pins shall not be used to enlarge unfair holes in main material. Holes that must be enlarged to admit bolts shall be reamed.
- (5) Burning and drifting may be used to align unfair holes in secondary bracing members only upon approval of the Inspection Committee.

- (6) Upon completion of erection and before final acceptance, the Contractor shall remove all falsework, rubbish and water material.

11-04-5 Erection

- (1) The Contractor shall completely outline a proposed method and sequence of erection to the Inspection Committee for approval before delivery of any material to the work site. The outline shall be prepared to avoid delay of and damage to the work of other trades.
- (2) Temporary bracing and guy lines shall be provided to adequately protect all persons and property to insure proper alignment.
- (3) The Contractor shall be responsible for the accurate setting and leveling of all bearing plates or setting plates. Bearing plates or setting plates shall be leveled on steel wedges or shims or as otherwise detailed and then grouted in place before erection of structural members.

11-05 CEMENT AND MASONRY WORKS (Architectural Works)

11-05-1 General

- (1) The works include concrete masonry unit work, completed with cement plaster finish.
- (2) The following are specifically included under this section:
 - 1) All concrete hollow block curtain walls including mortar filling.
 - 2) Setting and incorporating into masonry bolts, anchors, metal attachments, pipe sleeves, inserts, frames for openings in masonry, and other divisions, and the location of which are shown in the Drawings and included in said other divisions.
 - 3) Chiseling, grouting, joint fillers.
 - 4) All cement plaster finishes for floors, walls, and ceiling indicated on the approved Drawings.

- 5) Protective measures for the prevention of damage of completed masonry and other work.
- 6) Removed of dirt, station, etc., from finished masonry surfaces.

11-05-2 Materials

- (1) All materials necessary for the work such as portland cement, sand, gravel and water, shall conform to the specifications under Part 6.

11-05-3 Mortar

- (1) All cement mortar shall be one (1) part Portland cement and two (2) parts sand by volume.
- (2) Positive measuring methods shall be agreed upon for all cementing materials and aggregates. The aggregates shall be introduced and mixed uniformly throughout the mass after which gradually mixed further until a mortar of the plasticity necessary for the intended purpose is obtained. Mortar shall be used so that it will be in place before the initial setting of the cement has taken place.
- (3) No mortar containing portland cement shall be re-mixed or retempered after one (1) hour, except as specified for repainting.
- (4) The material and compound for waterproofing and damproofing plaster and the location where to be applied shall be approved by the Inspection Committee.

11-05-4 Concrete Hollow Blocks and Brick

- (1) The load bearing concrete hollow blocks (CHB) shall have a minimum compressive strength of 70 kg/sq.cm for the individual unit respectively; all based on gross area. All bricks shall be the first class unless otherwise directed by the Inspection Committee.
- (2) All units shall be sound and free from cracks or other defects that would interfere with the proper placing of the unit or impair the strength or performance of the construction.

(3) Sampling:

- 1) Specimens shall be representative of the whole of units from which they are selected. If test specimens are selected at the site of work, units for moisture content tests shall be taken within 48 hours after delivery.
- 2) In sampling the blocks for the strength, absorption and moisture determination, ten (10) individual units shall be selected. Provided, however, that in the case of the non-load bearing type of CHB or brick, three (3) samples for tests shall be required.

(4) Testing:

The units shall be selected in accordance with Thailand or other applicable standard. No blocks shall be used unless results of tests are known and duly approved by the Inspection Committee.

(5) Rejection:

In case the shipment of units fails to conform to the requirements, the manufacturer may sort it and new specimens shall be selected again at random from the retained lot and tested at the expense of the Contractor. In case the second set of specimens fails to conform to the test requirements, the entire lot shall be rejected.

11-05-5 Laying of Blocks and Brick

- (1) Wet CHB thoroughly before using. The first row of blocks must be thoroughly anchored to the concrete walls, columns or slabs. Courses shall be laid straight and uniform with regular running bond and with vertical faces truly vertical, plumb, true to line with level, and accurately spaced.
- (2) All horizontal and vertical reinforcing bars shall be anchored 20 diameters into the concrete walls, column and slabs. Dowel bars properly spaced shall be placed into the walls, columns or slabs during pouring and hooked to the vertical bars, leaving another 20 diameters exposed to splice with the reinforcing bars of the CHB walls during construction.
- (3) Unless otherwise specified or detailed on the plans, horizontal and vertical joints shall be 3/8" (0.94 cm) thick. Joints shall be solidly filled from the face of the

blocks to the depth of the face pointing where necessary to completely and compactly fill the joints. Reinforcement will consist of 3/8" (0.94 cm) ϕ at 0.60 m vertical bars (or at every other block) and 3/8" (0.94 cm) ϕ horizontal bars every third course for both, 4" (10 cm) and 6" (15 cm) walls. Block cells with reinforcement shall be solidly filled with cement mortar grout.

- (4) The Contractor shall leave the work clean and in perfect condition removing all incidental rubbish. Keep floor dry as possible during laying of CHB and mortar plastering operations and protection from plaster dropping.
- (5) The brick work shall be carried out in the same manner and workmanship specified hereabove or as directed by the Inspection Committee.

11-06 CARPENTRY AND JOINERY

11-06-1 Scope of Work

The work includes carpentry and joinery work.

11-06-2 General Requirements

(1) Quality of Lumber

Lumber shall be of the best grade available, well-seasoned, thoroughly dry and free from loose or unsound knots, cup shakes or other imperfections that will impair strength, durability or appearance. Exposed surfaces shall be smooth unless otherwise indicated or specified.

(2) Protection and Storage

Protect lumber from dampness during and after delivery at the site. Lumber shall be delivered to the site at least 30 days before use, immediately piled in stack in such a manner as to provide air circulation around surfaces of each piece to ensure thorough air seasoning. Stacks shall be covered with well ventilated sheds and enough protection from driving rain.

11-06-3 Rough Carpentry

- (1) Work shall be well fitted, accurately set, and rigidly secured in place. Anchors and bolts (with nuts and washers), straps and tie rods shall be provided as required.
- (2) Framing and structural lumber shall be well-seasoned, straight, square-edge stocks and free from defects that will impair its strength.
- (3) Plates for walls and partitions shall be of the same width as the studs.
- (4) Lumber surfaces in contact with concrete or masonry shall be given two (2) brush coats of bituminous paint.

11-06-4 Joinery Work

- (1) Lumber used for joinery work shall be of the kinds specified and shall be of contours, patterns, and profile as indicated.
- (2) Joints shall be made as per approved drawing, installed tight and securely fastened. Exterior joints shall be mitered and interior angles coped. Panels shall be fitted to allow for shrinkages, avoid swelling and insure that the work shall remain in place without warping, splitting and opening of joints.
- (3) Interior trims shall be of approved standard stuck-moulding except where special patterns or profiles are indicated in the approved drawings.
- (4) Joints for cabinet work shall be glued aside from nails or other fastening device required. Nailing shall be concealed where practicable.
- (5) Exposed surfaces shall be machined or hand sanded to an even smooth surface, ready for finish. No hammer marks or other unsightly marks shall be allowed on wood panel or veneer.

11-06-5 Materials

Locally available lumber, plywood, glue, etc. can be acceptable after getting approval of the Inspection Committee.

11-07 OTHERS

11-07-1 Plumbing and Sewerage Works

The Work includes all necessary plumbing and sewerage works including septic tank in accordance with the working drawings submitted to and approved by the Inspection Committee.

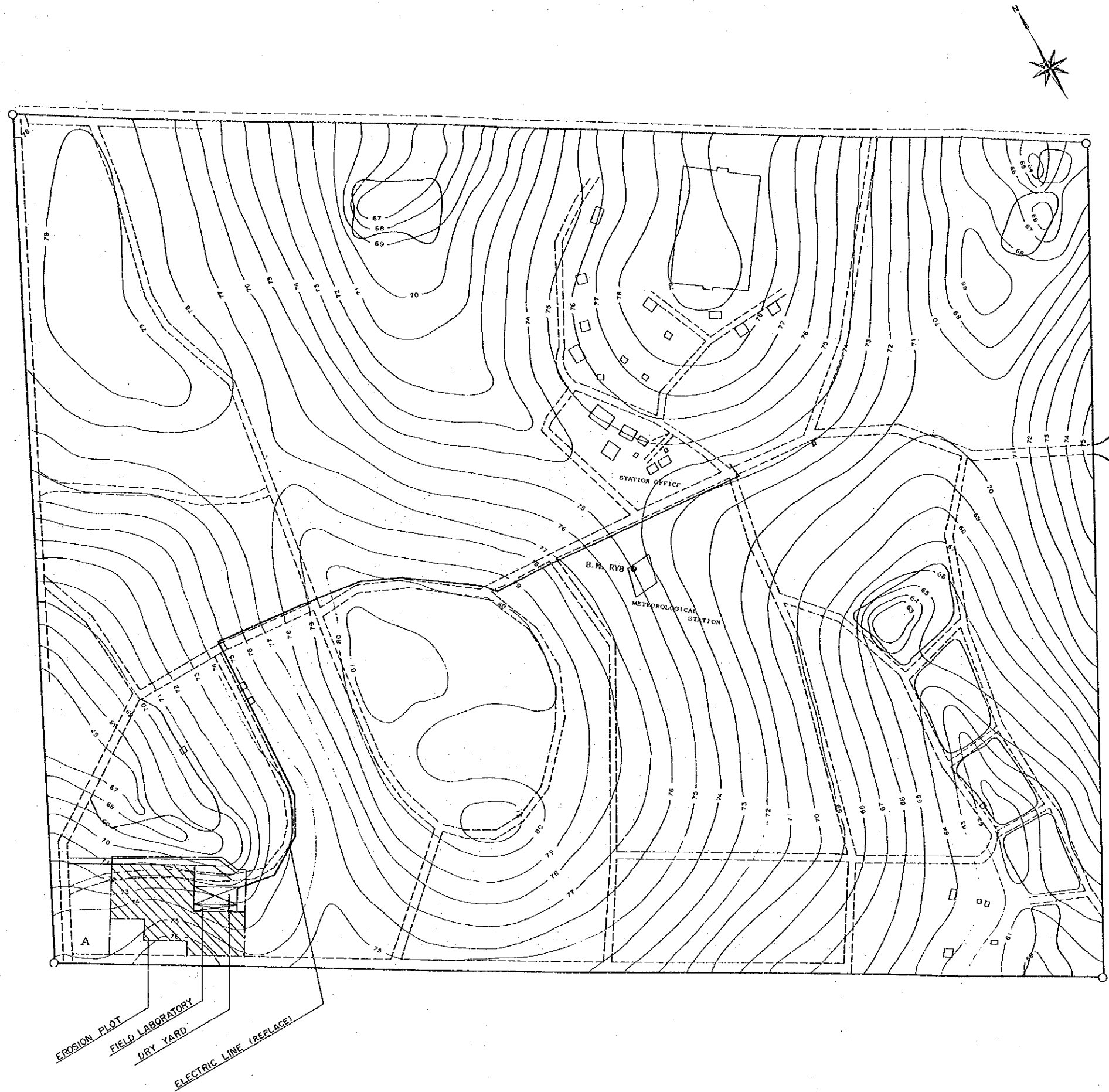
11-07-2 Duct and Other Works

The Work includes duct for electric cable and drain, additional floor concrete to bury thereof and all other relevant works on the floor of the pump house, etc. in accordance with the working drawings submitted to and approved by the Inspection Committee.

8.3 Design Drawings

L I S T O F D R A W I N G S

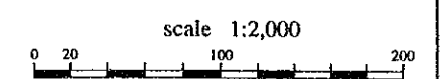
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2.	GENERAL PLAN
3.	LONGITUDINAL SECTIONS OF EXPERIMENTAL FIELD (1/2)
4.	LONGITUDINAL SECTIONS OF EXPERIMENTAL FIELD (2/2)
5.	CROSS SECTIONS OF EXPERIMENTAL FIELD (1/2)
6.	CROSS SECTIONS OF EXPERIMENTAL FIELD (2/2)
7.	GENERAL PLAN OF EXPERIMENTAL PLOTS (1/3)
8.	GENERAL PLAN OF EXPERIMENTAL PLOTS (2/3)
9.	GENERAL PLAN OF EXPERIMENTAL PLOTS (3/3)
10.	DETAILED PARTIAL VIEWS OF EXPERIMENTAL PLOTS (1/2)
11.	DETAILED PARTIAL VIEWS OF EXPERIMENTAL PLOTS (2/2)
12.	LONGITUDINAL SECTION OF FARM ROAD AND DRAINAGE CANAL
13.	LONGITUDINAL SECTION OF FARM ROAD AND DRAINAGE CANAL
14.	GENERAL PLAN OF FIELD LABORATORY
15.	STORAGE TANK



LEGEND

- STATION BOUNDARY
- LOOSE OR LIGHT SURFACE
- CONTOUR INTERVAL 1.0 METER

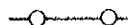
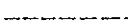
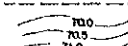


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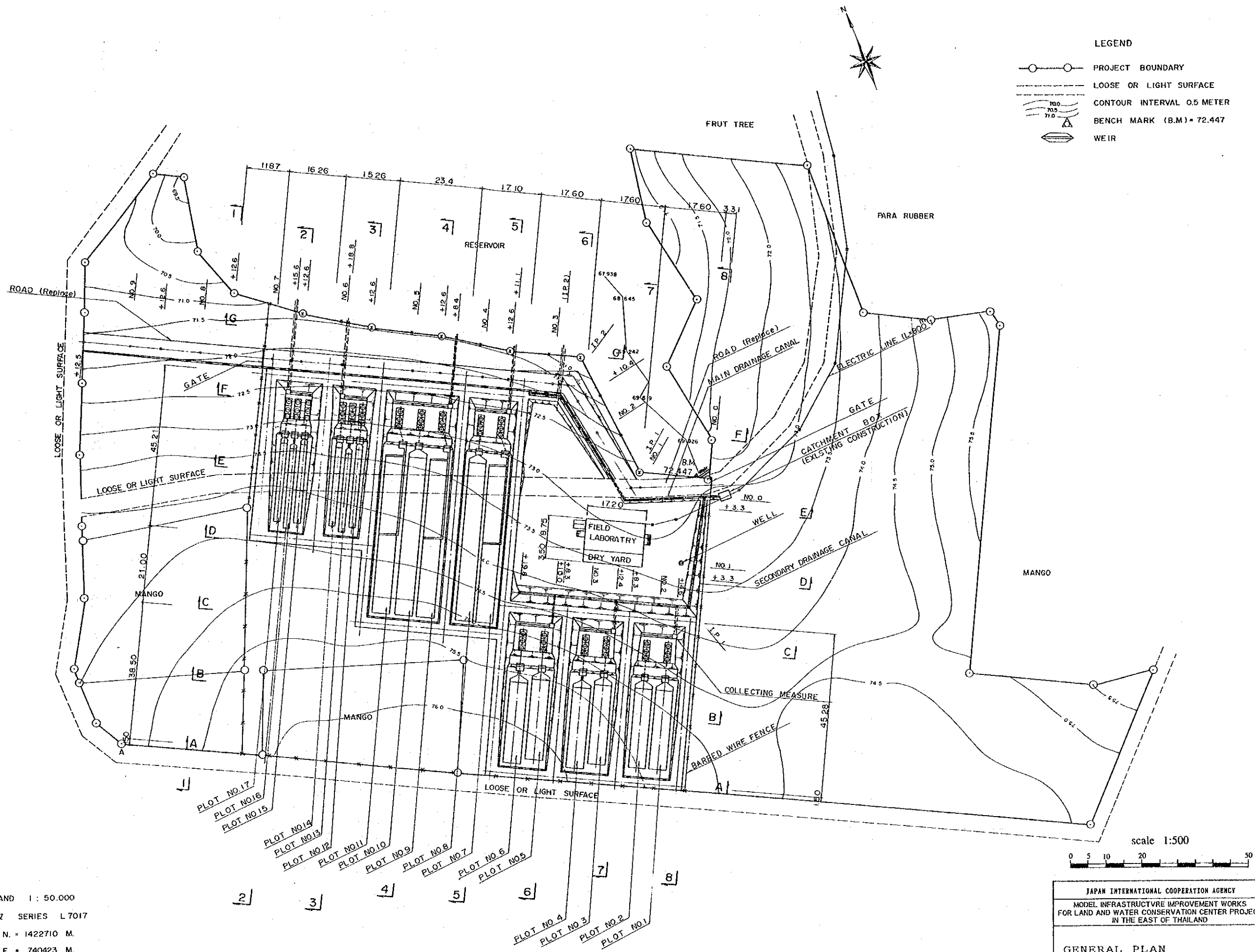


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 SHEET 5234 IV SERIES L7017
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 E. = 741520 M.
 BENCH MARK (B.M.) DOPLER RY8 = 75.020 M.

JAPAN INTERNATIONAL COOPERATION AGENCY	
MODEL INFRASTRUCTURE IMPROVEMENT WORKS FOR LAND AND WATER CONSERVATION CENTER PROJECT IN THE EAST OF THAILAND	
LOCATION MAP	
PREPARED BY	DRAWING NO.
CHECKED BY	1


LEGEND

-  PROJECT BOUNDARY
-  LOOSE OR LIGHT SURFACE
-  CONTOUR INTERVAL 0.5 METER
-  BENCH MARK (B.M.) = 72.447
-  WEIR

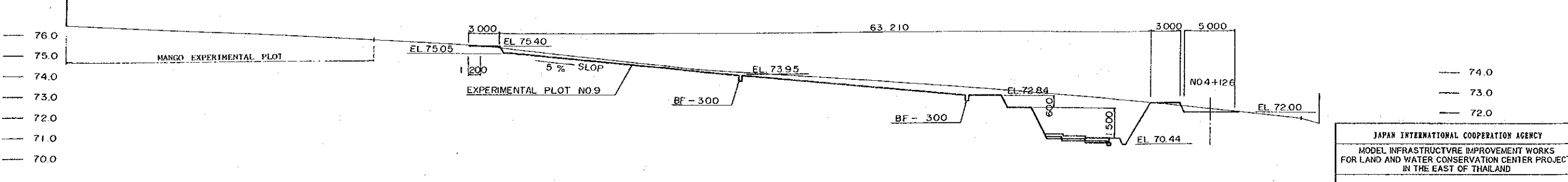
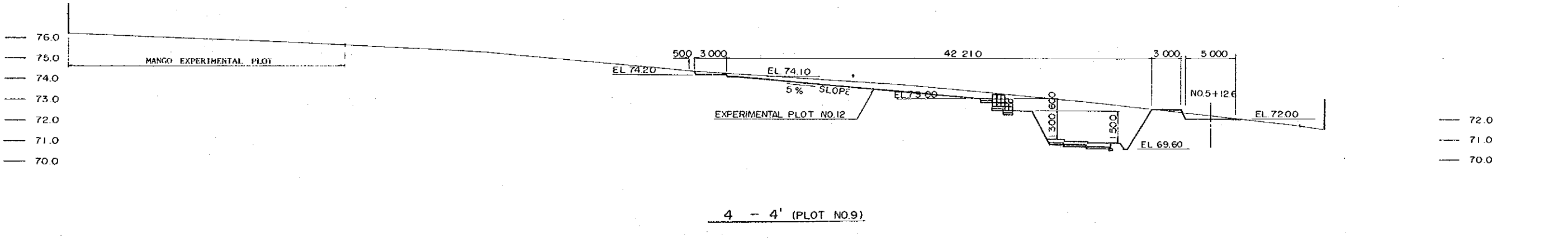
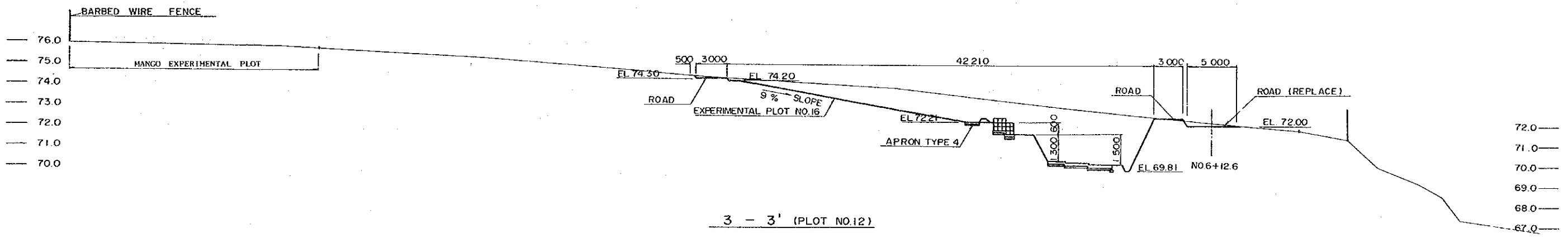
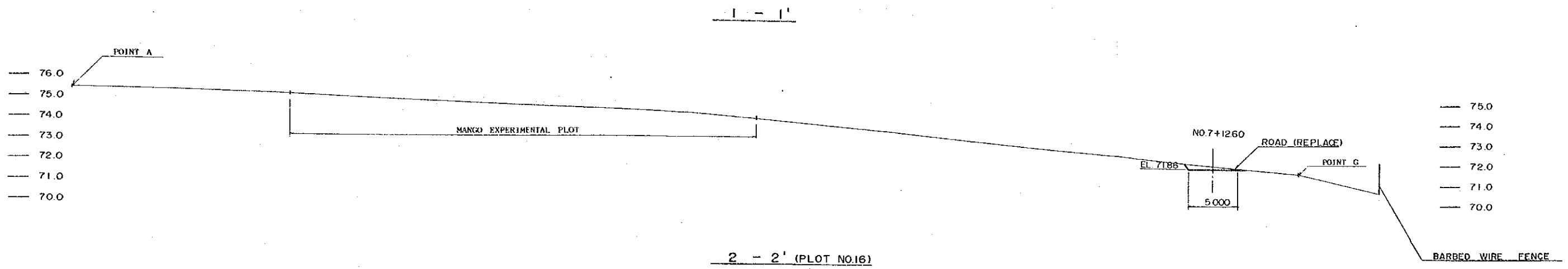


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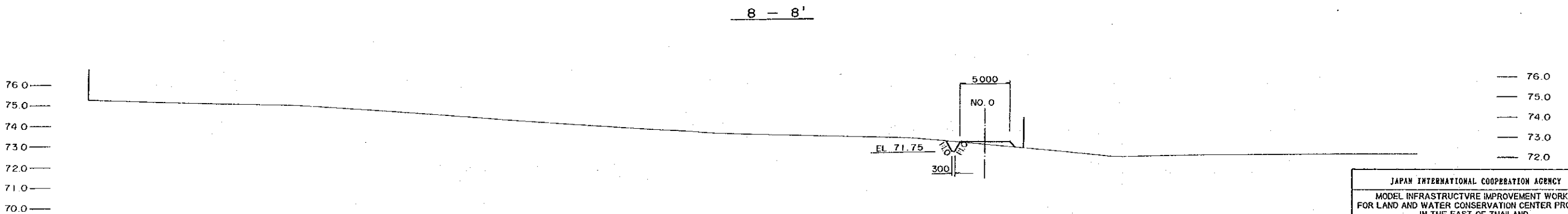
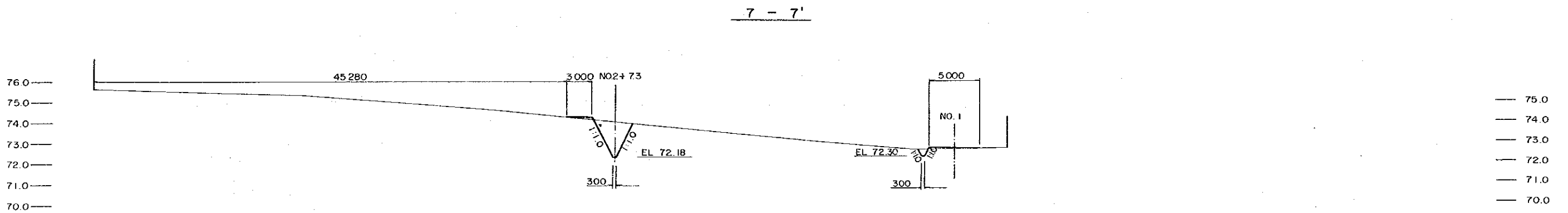
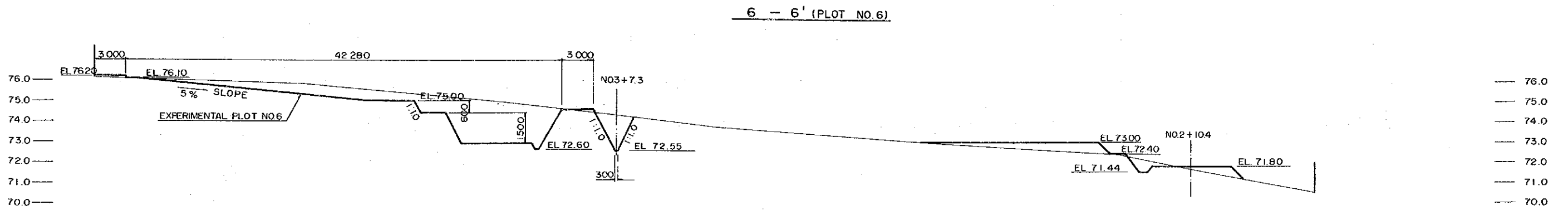
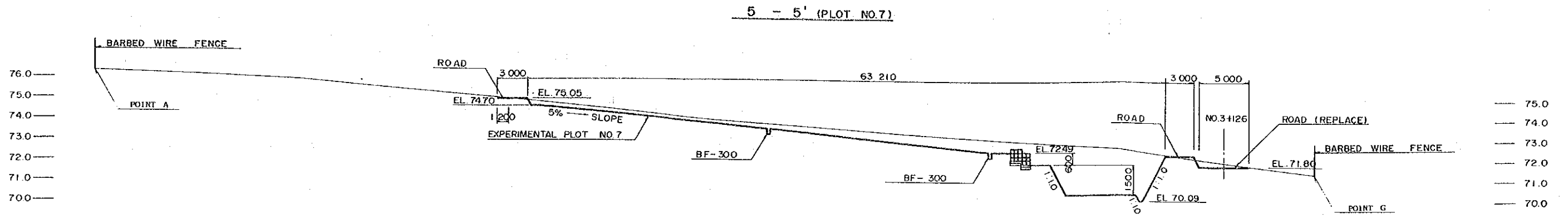
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 DATED NOVEMBER 1993

JAPAN INTERNATIONAL COOPERATION AGENCY	
MODEL INFRASTRUCTURE IMPROVEMENT WORKS FOR LAND AND WATER CONSERVATION CENTER PROJECT IN THE EAST OF THAILAND	
GENERAL PLAN	
PREPARED BY	DRAWING NO.
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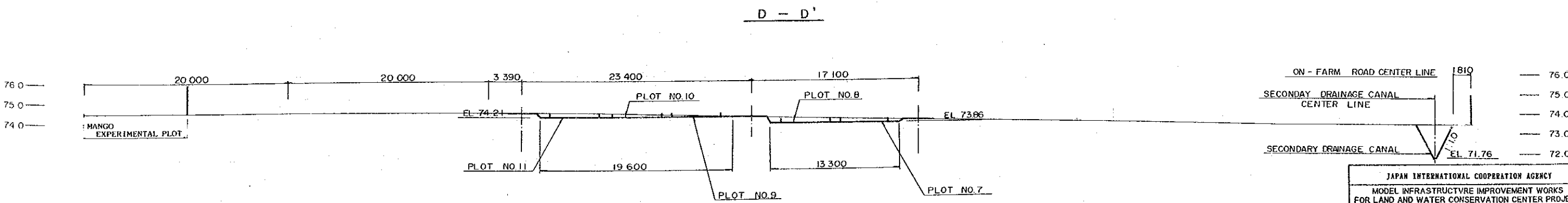
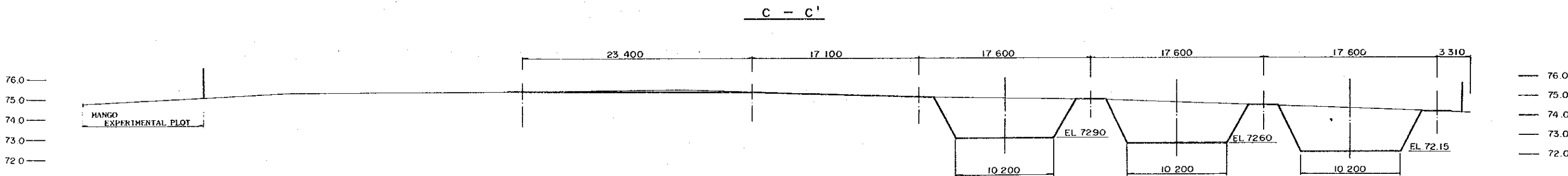
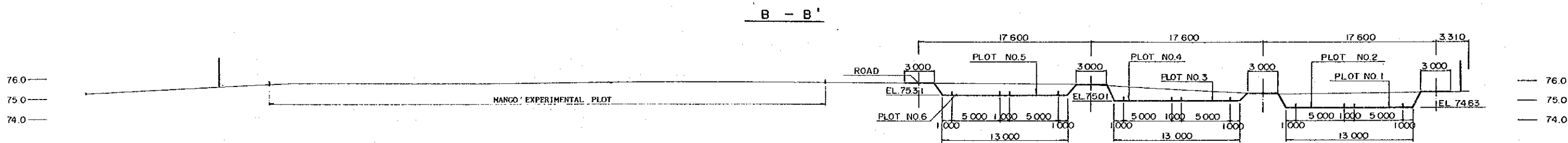
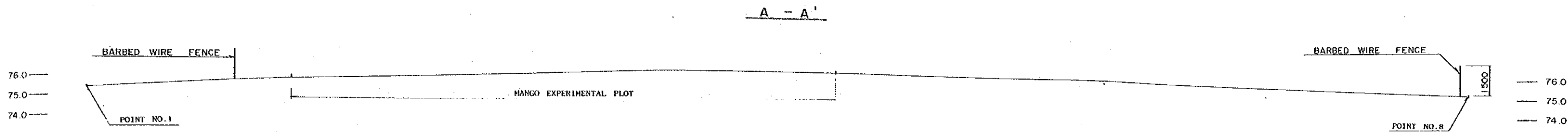
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JAPAN INTERNATIONAL COOPERATION AGENCY	
MODEL INFRASTRUCTURE IMPROVEMENT WORKS FOR LAND AND WATER CONSERVATION CENTER PROJECT IN THE EAST OF THAILAND	
LONGITUDINAL SECTION OF EXPERIMENTAL FIELD (1/2)	
PREPARED BY	DRAWING NO.
CHECKED BY	3



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JAPAN INTERNATIONAL COOPERATION AGENCY	
MODEL INFRASTRUCTURE IMPROVEMENT WORKS FOR LAND AND WATER CONSERVATION CENTER PROJECT IN THE EAST OF THAILAND	
LONGITUDINAL SECTION OF EXPERIMENTAL FIELD (2/2)	
PREPARED BY	DRAWING NO.
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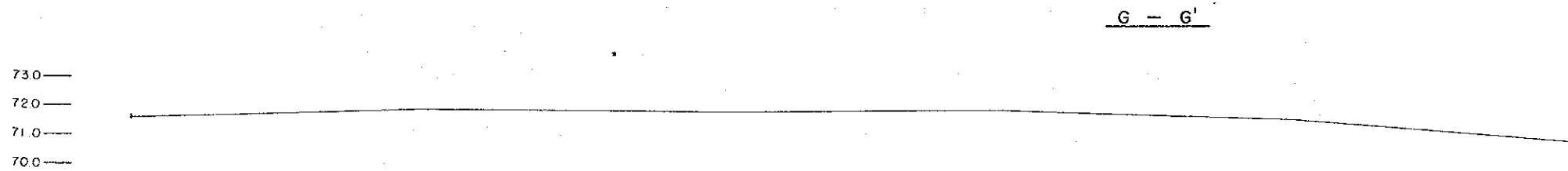
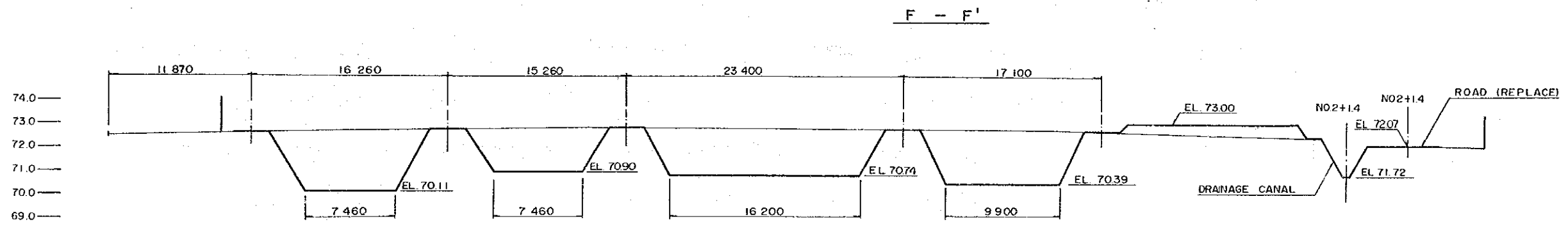
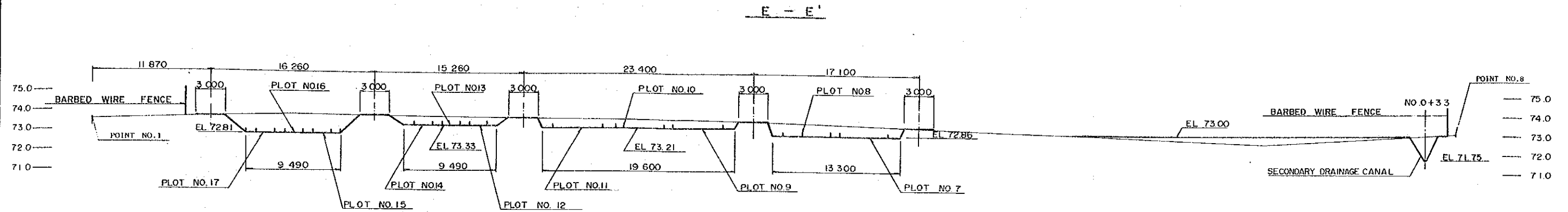


JAPAN INTERNATIONAL COOPERATION AGENCY
MODEL INFRASTRUCTURE IMPROVEMENT WORKS
FOR LAND AND WATER CONSERVATION CENTER PROJECT
IN THE EAST OF THAILAND

**CROSS SECTIONS OF
EXPERIMENTAL FIELD (1/2)**

PREPARED BY	DRAWING NO.
CHECKED BY	5

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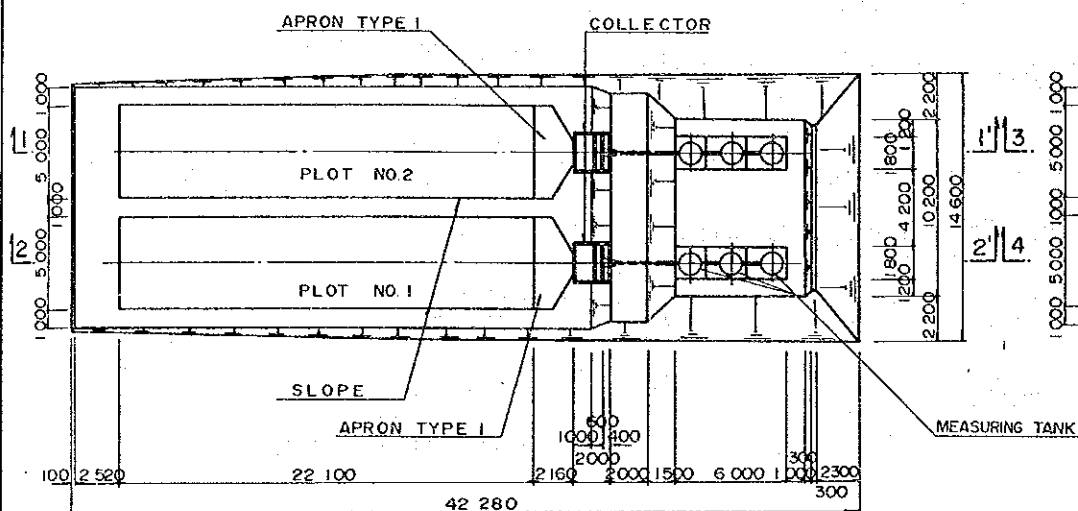
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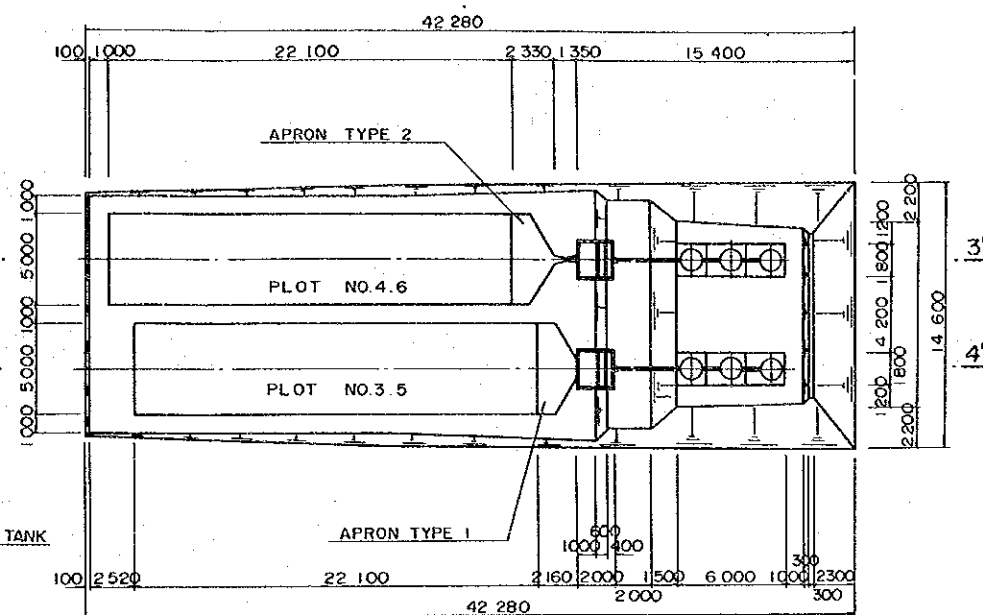
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PLOT NO. 1, 2

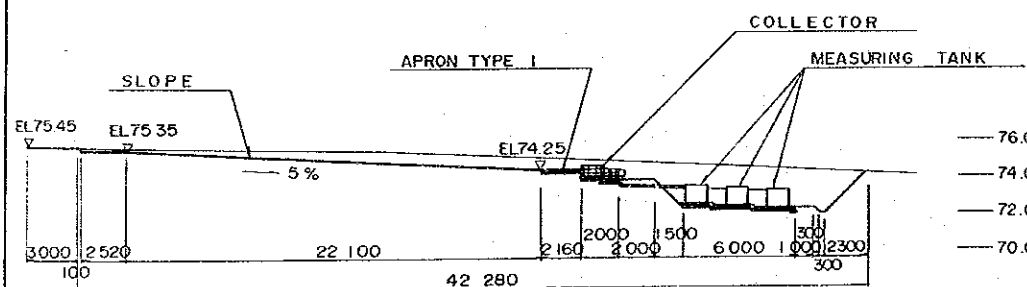
PLOT NO. 3, 4, 5, 6



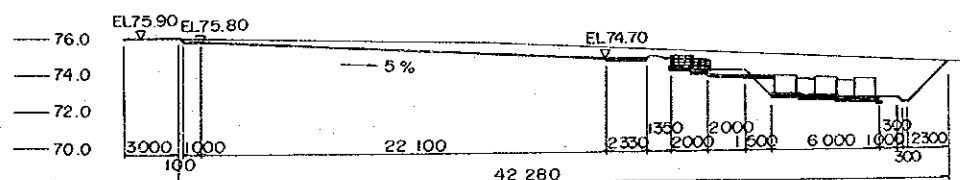
PLAN



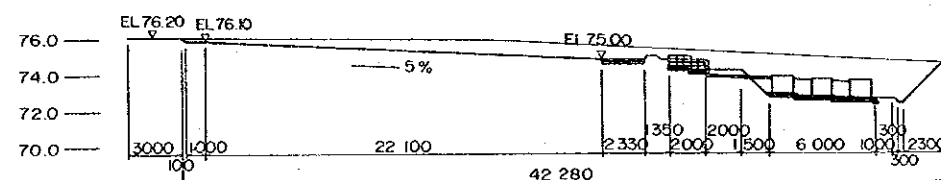
PLAN



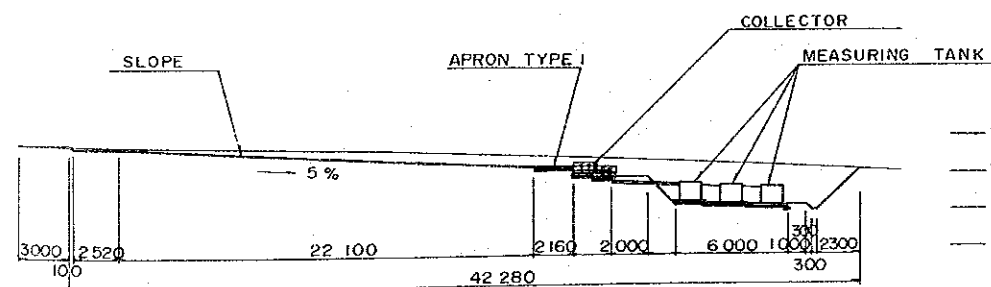
1 - 1' SECTION PLOT NO. 2



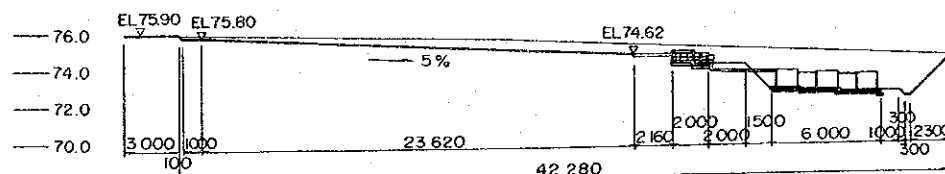
3 - 3' SECTION PLOT NO. 4



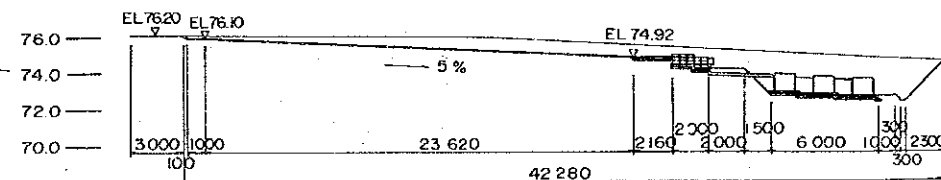
3 - 3' SECTION PLOT NO. 6



2 - 2' SECTION PLOT NO. 1



4 - 4' SECTION PLOT NO. 3



4 - 4' SECTION PLOT NO. 5

JAPAN INTERNATIONAL COOPERATION AGENCY
MODEL INFRASTRUCTURE IMPROVEMENT WORKS
FOR LAND AND WATER CONSERVATION CENTER PROJECT
IN THE EAST OF THAILAND

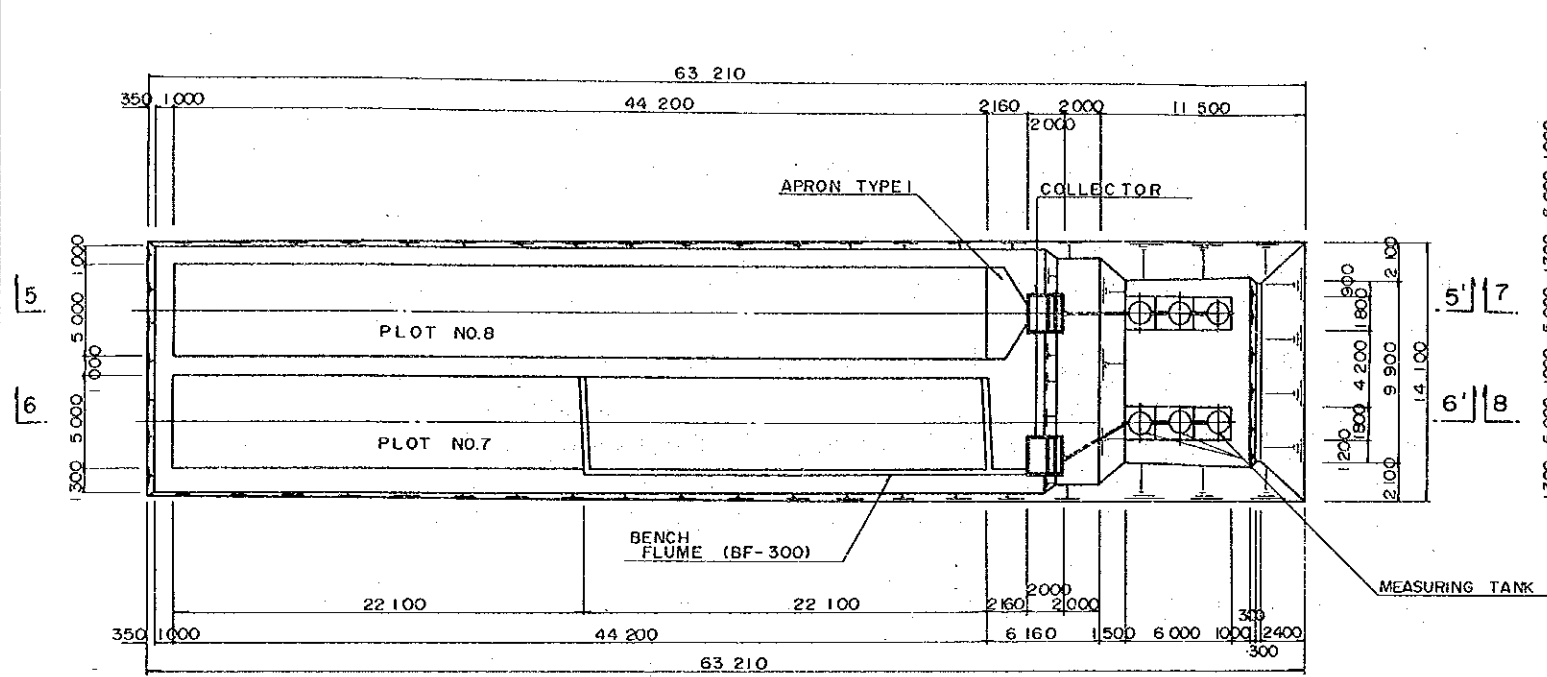
GENERAL PLAN OF
EXPERIMENTAL PLOTS (1/3)

PREPARED BY	DRAWING NO.
CHECKED BY	7

scale 1:200

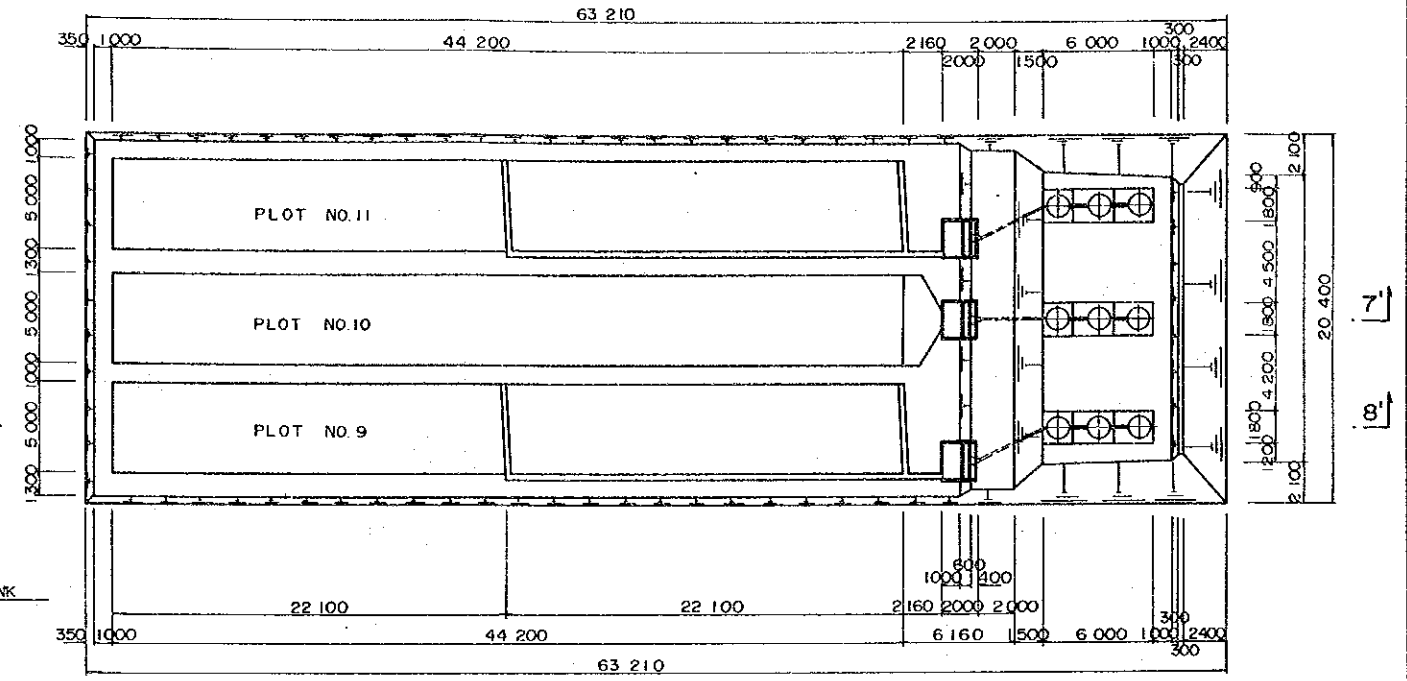
EROSION PLOTS (2/3)

PLOT NO.7,8

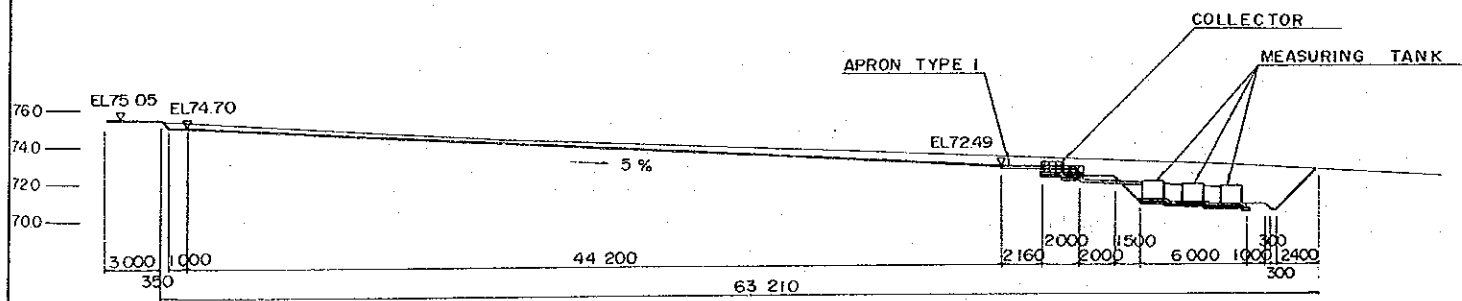


PLAN

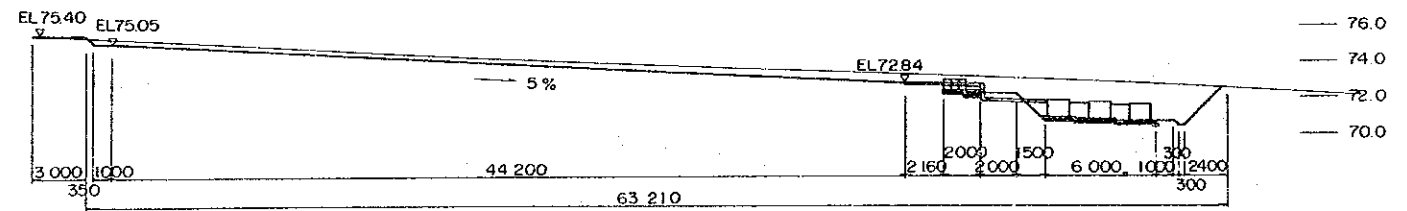
PLOT NO.9,10,11



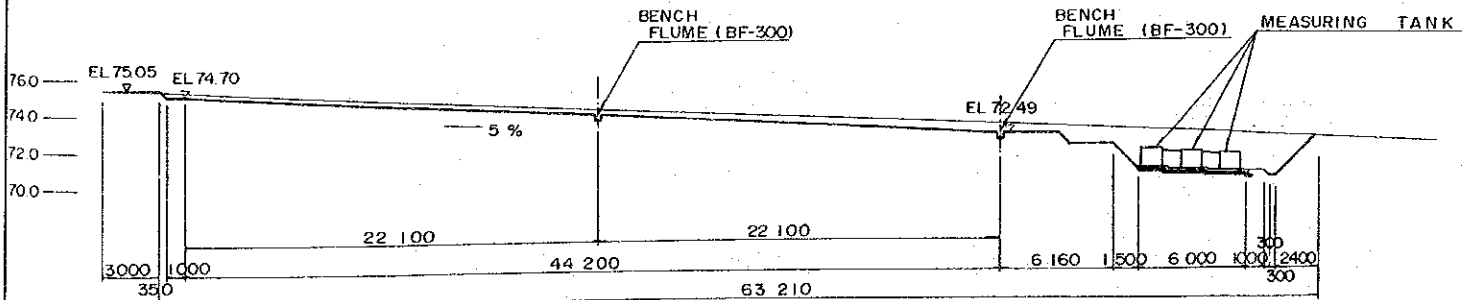
PLAN



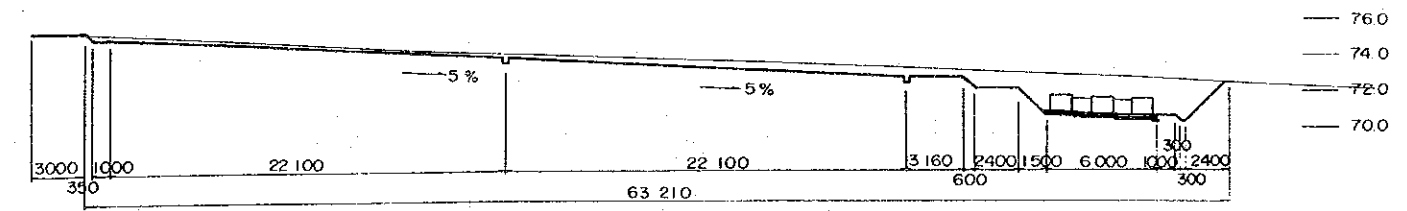
5 - 5' SECTION PLOT NO.7



7 - 7' SECTION PLOT NO.10



6 - 6' SECTION PLOT NO.8



8 - 8' SECTION PLOT NO.9,11

JAPAN INTERNATIONAL COOPERATION AGENCY
 MODEL INFRASTRUCTURE IMPROVEMENT WORKS
 FOR LAND AND WATER CONSERVATION CENTER PROJECT
 IN THE EAST OF THAILAND

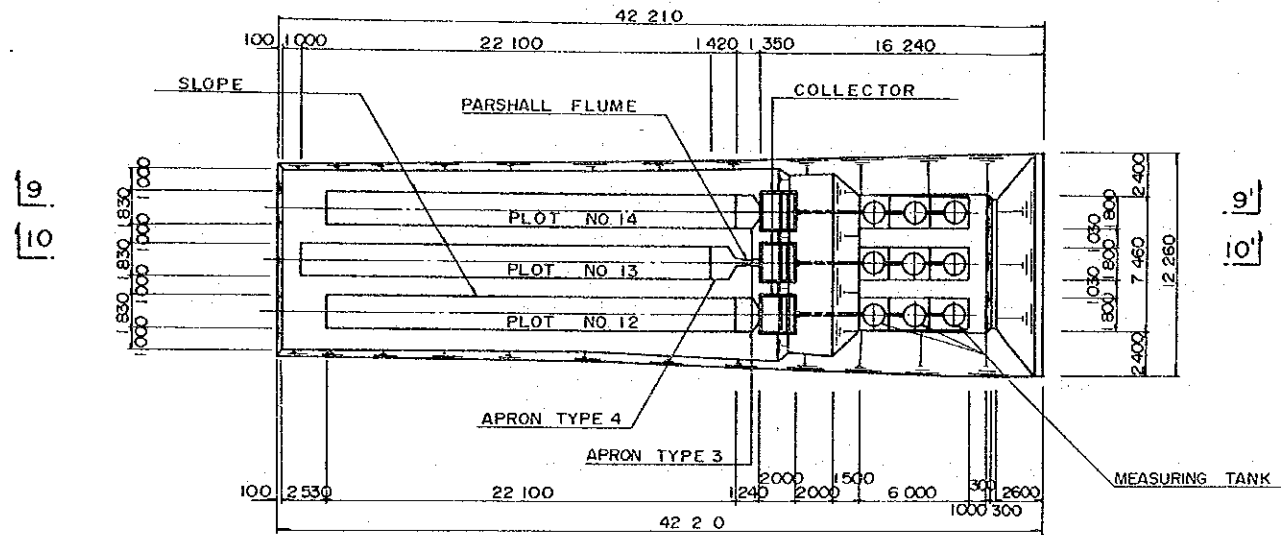
GENERAL PLAN OF
 EXPERIMENTAL PLOTS (2/3)

PREPARED BY	DRAWING NO.
CHECKED BY	8

scale 1:200

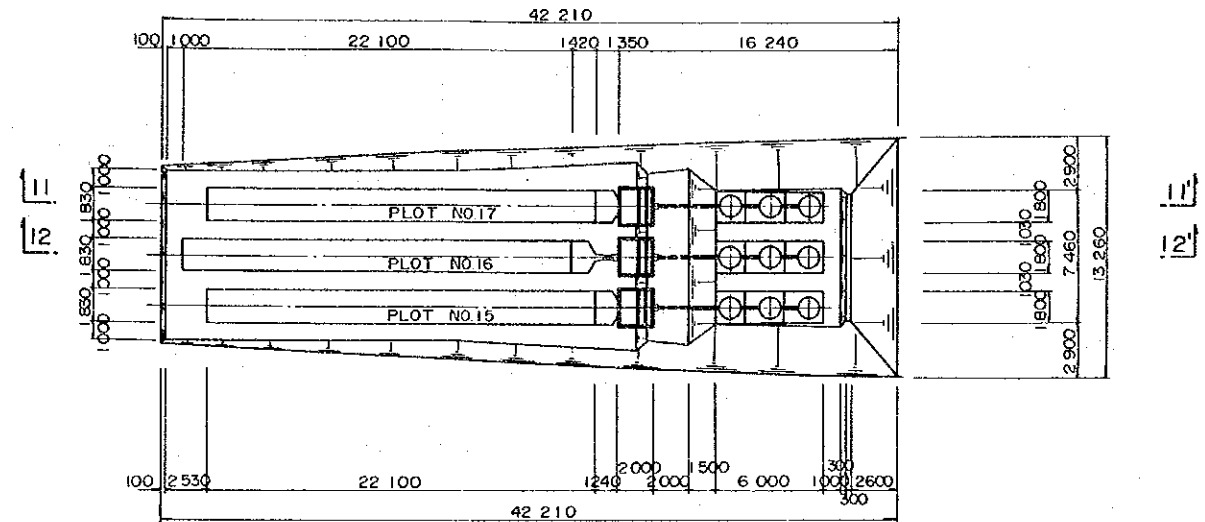
EROSION PLOTS (3/3)

PLOT NO.12,13,14

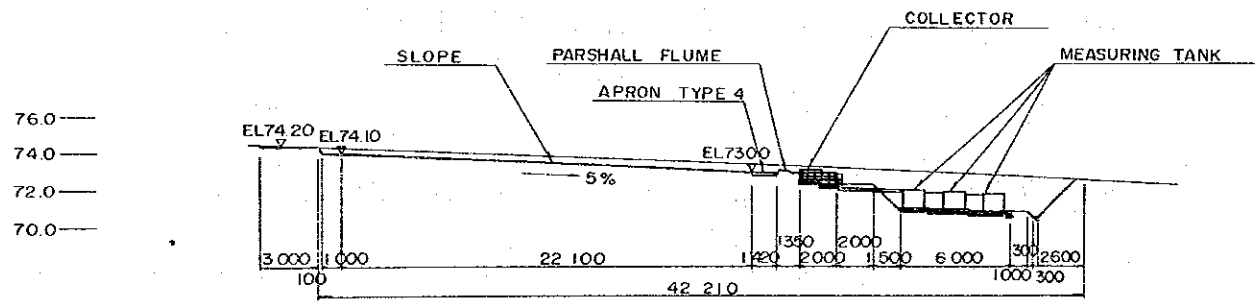


PLAN

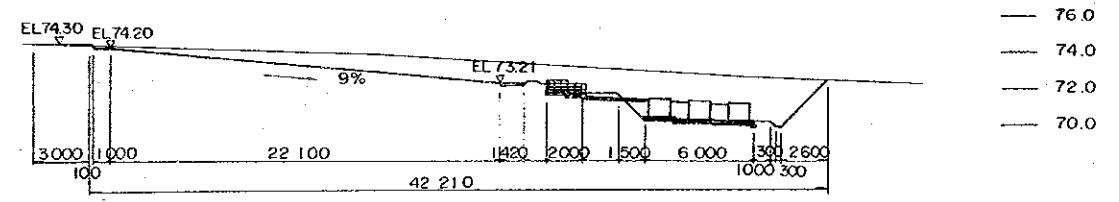
PLOT NO.15,16,17



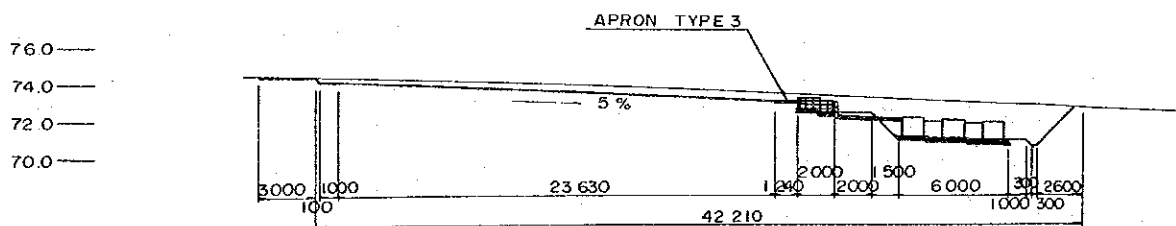
PLAN



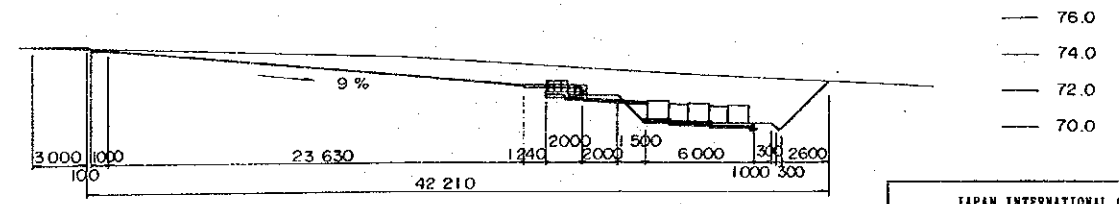
9 - 9' SECTION PLOT NO.13



11 - 11' SECTION PLOT NO.16



10 - 10' SECTION PLOT NO.12,14



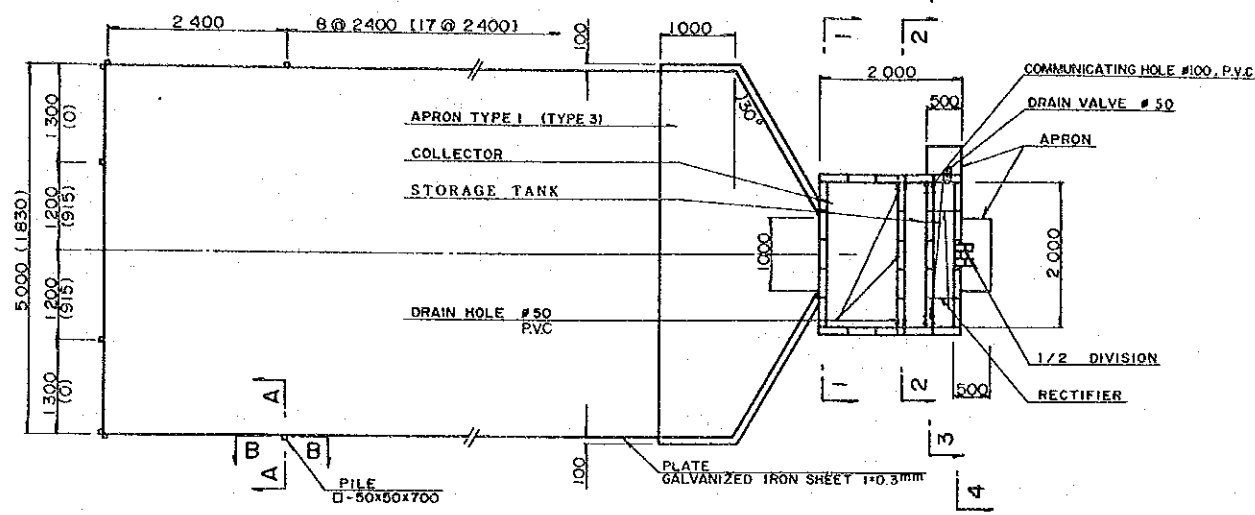
12 - 12' SECTION PLOT NO.15,17

JAPAN INTERNATIONAL COOPERATION AGENCY	
MODEL INFRASTRUCTURE IMPROVEMENT WORKS FOR LAND AND WATER CONSERVATION CENTER PROJECT IN THE EAST OF THAILAND	
GENERAL PLAN OF EXPERIMENTAL PLOTS (3/3)	
PREPARED BY	DRAWING NO.
CHECKED BY	9

scale 1:200

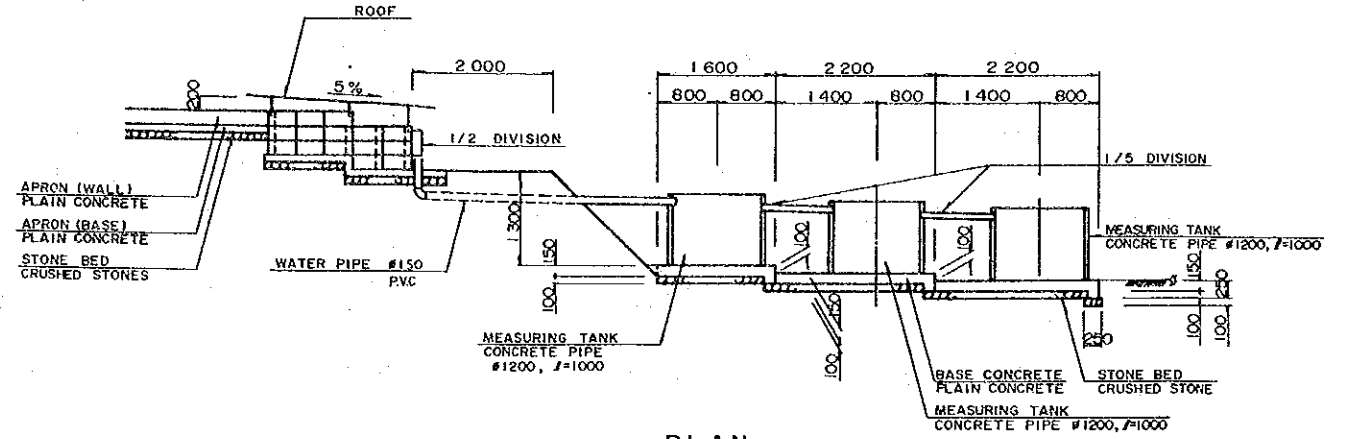
STANDARD PLAN WITHOUT PARSHALL FLUME (TYPE 1) S=1/50

PLOT NO. 1, 2, 3, 5, 8, 10, 12, 14, 15, 17
 () PLOT NO. 8, 10
 () PLOT NO. 12, 14, 15, 17

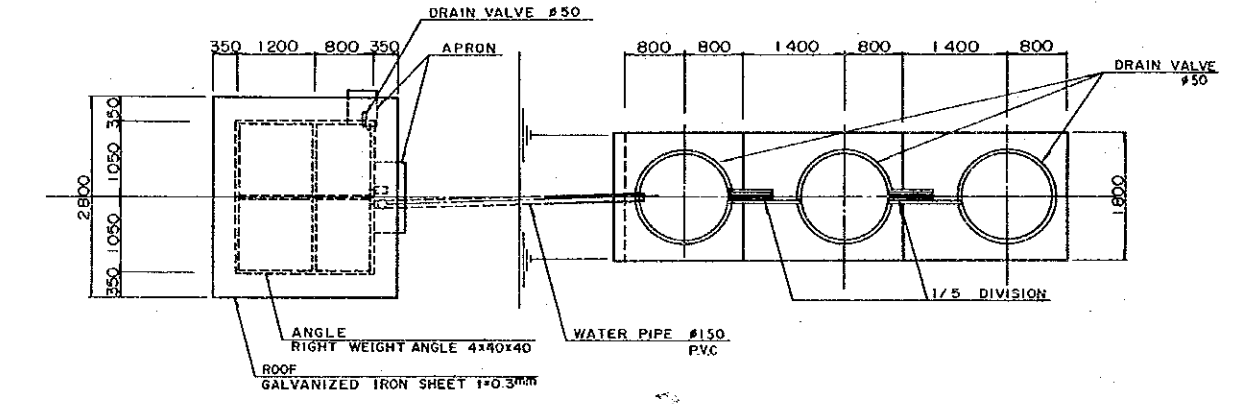


STANDARD PROFILE OF COLLECTING AND MEASURING FACILITIES S=1/50

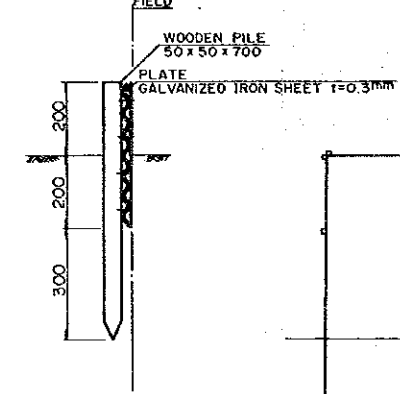
SECTION



PLAN

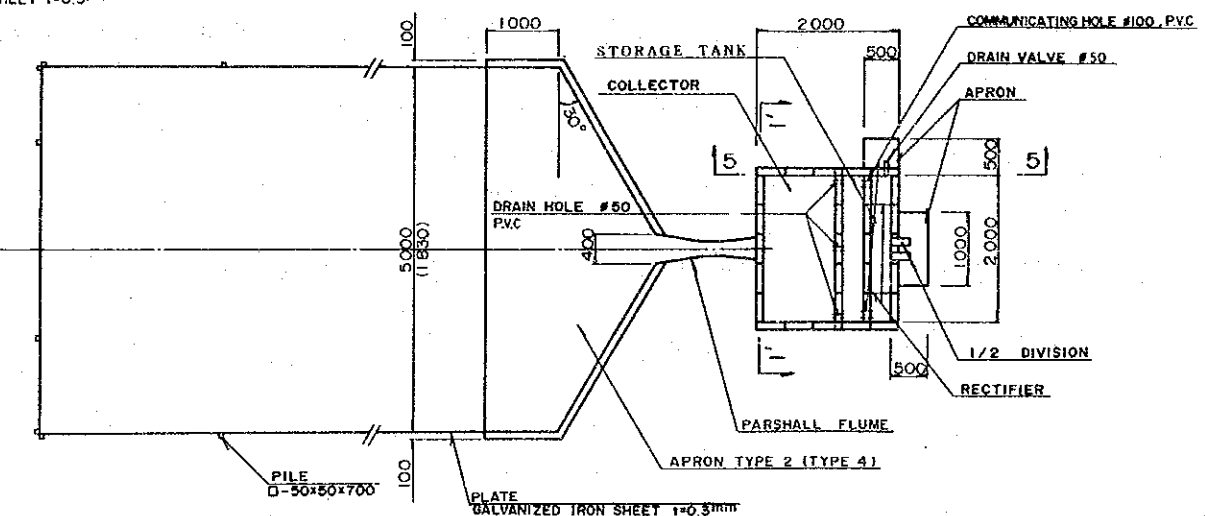


A-A S=1/10

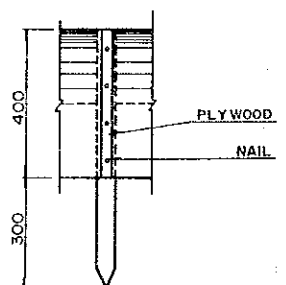


STANDARD PLAN WITH PARSHALL FLUME (TYPE 2) S=1/50

PLOT NO. 4, 6, 13, 16
 () PLOT NO. 13, 16

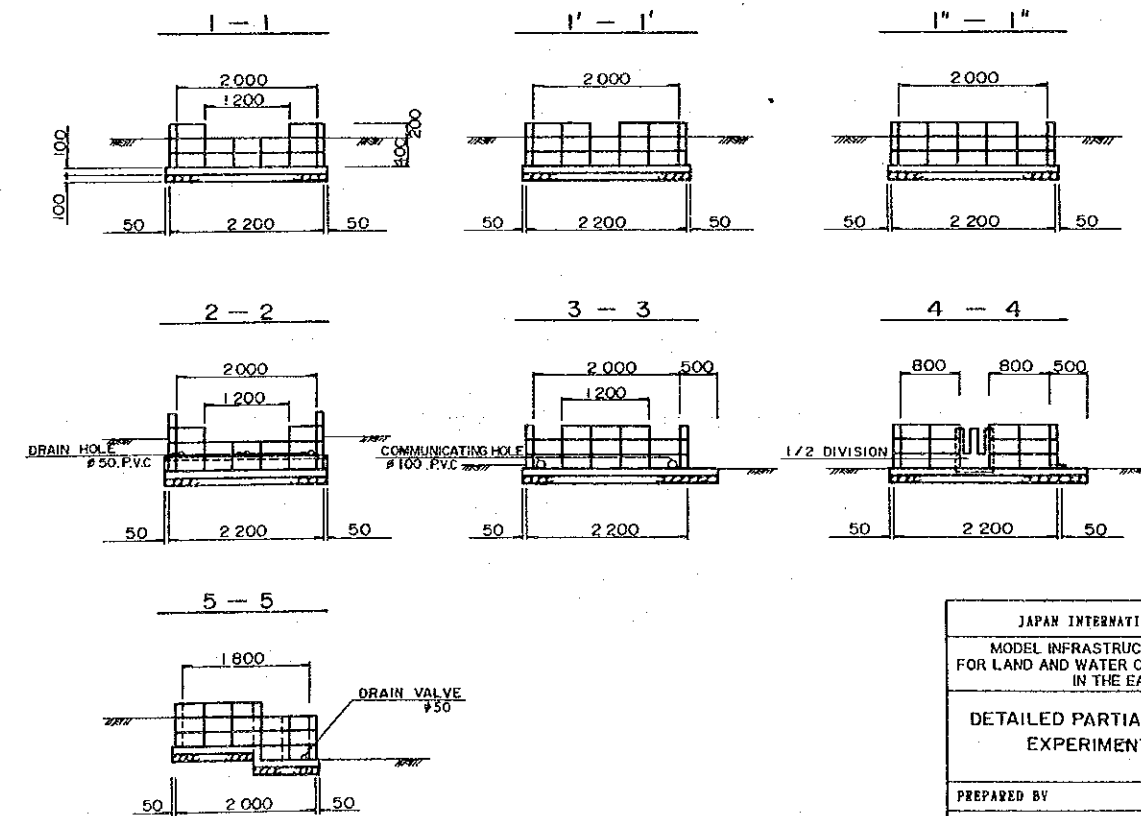
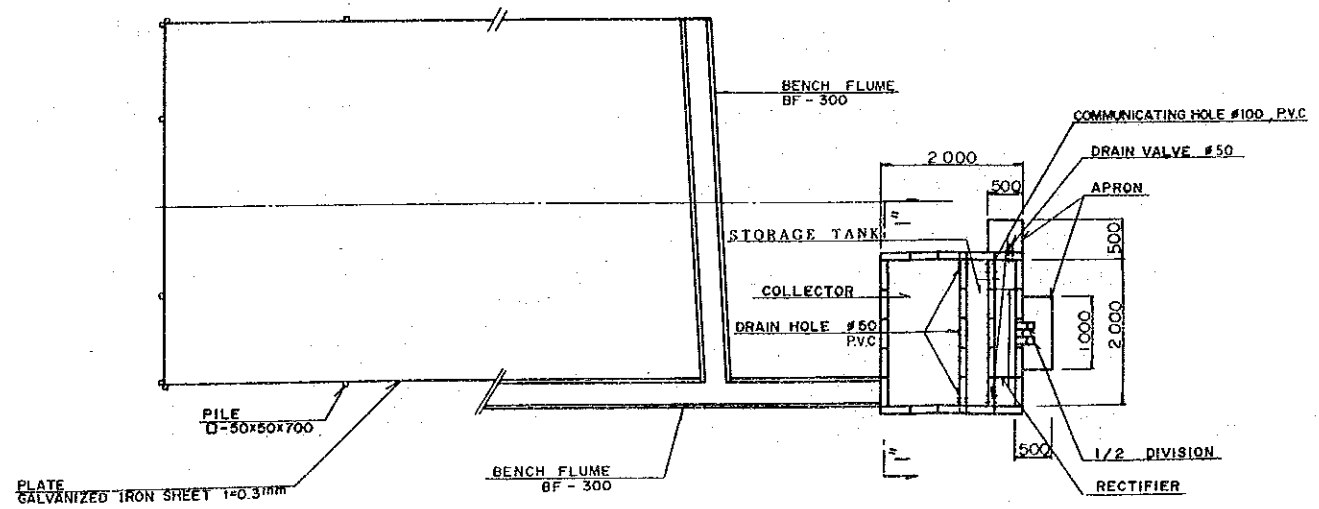


B-B S=1/10



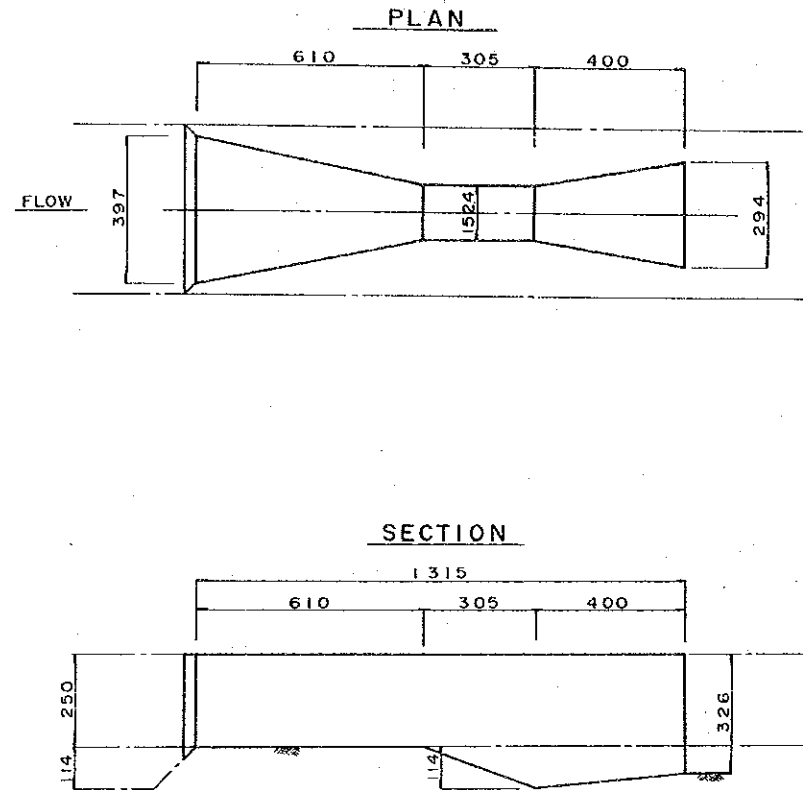
STANDARD PLAN WITH BENCH FLUME (TYPE 3) S=1/50

PLOT NO. 9, 11, 13

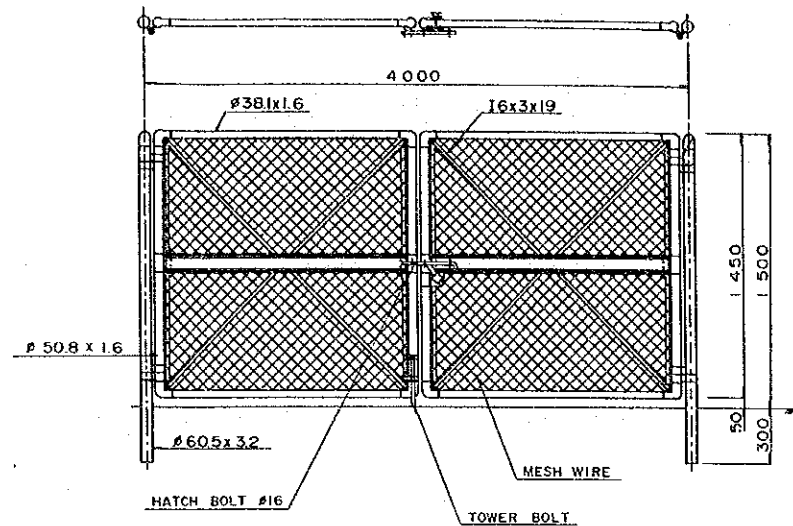


JAPAN INTERNATIONAL COOPERATION AGENCY	
MODEL INFRASTRUCTURE IMPROVEMENT WORKS	
FOR LAND AND WATER CONSERVATION CENTER PROJECT	
IN THE EAST OF THAILAND	
DETAILED PARTIAL VIEWS OF	
EXPERIMENTAL PLOTS (1/2)	
S=1/50	
PREPARED BY	DRAWING NO.
CHECKED BY	10

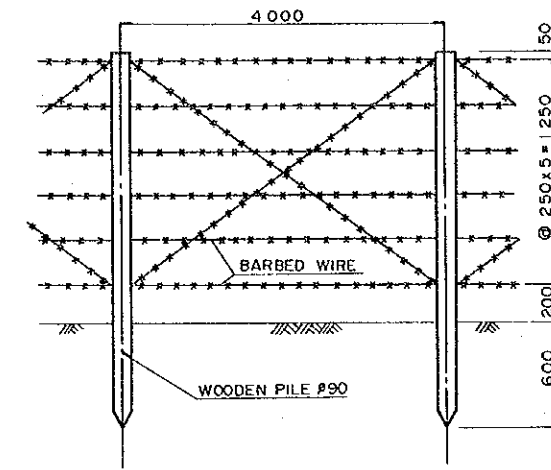
PARSHALL FLUME S=1/10



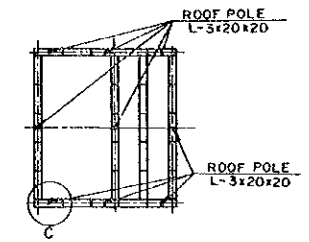
FENCE DOOR NO SCALE



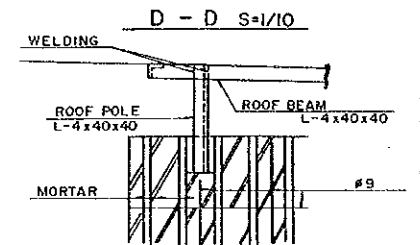
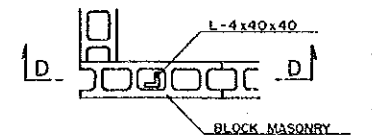
BARBED WIRE FENCE NO SCALE



PLACING OF ROOF POLE S=1/50

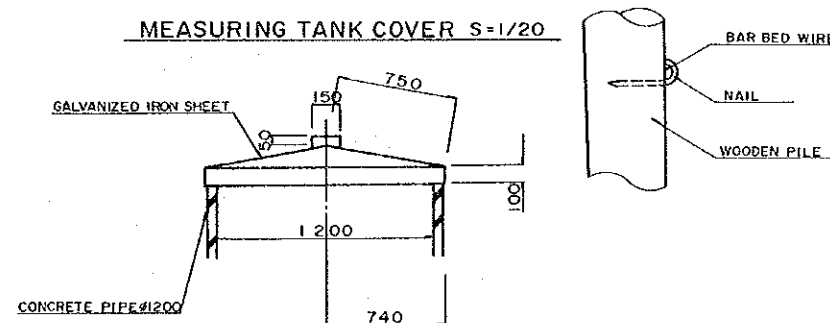


C DETAIL S=1/10

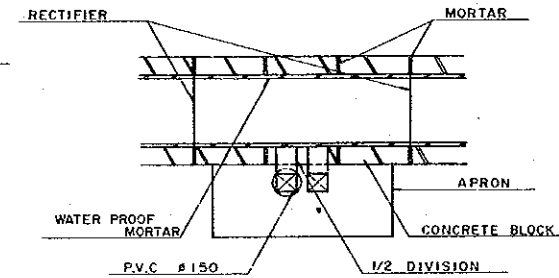


STOPPER DETAIL

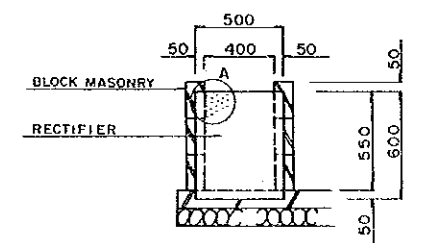
MEASURING TANK COVER S=1/20



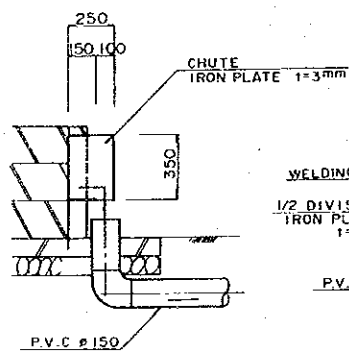
SETTING OF RECTIFIER S=1/20



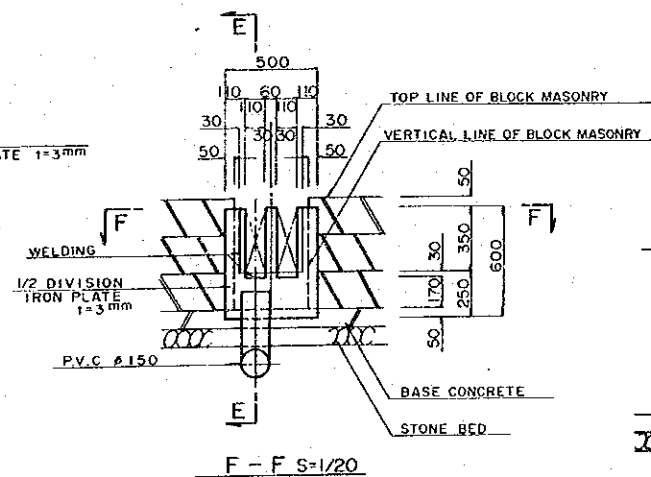
RECTIFIER S=1/20



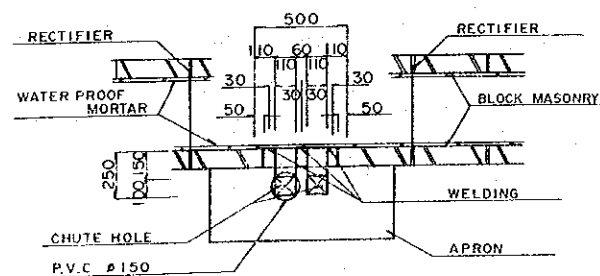
E - E S=1/20



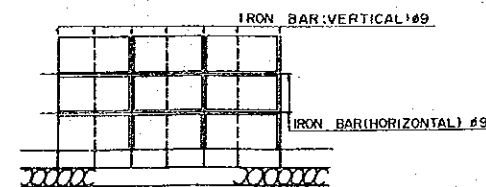
1/2 DIVISION S=1/20



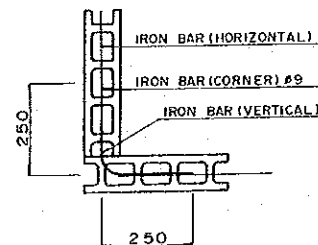
F - F S=1/20



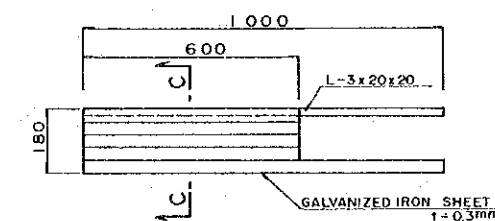
PLACING OF IRON BAR S=1/20



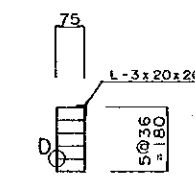
PLACING OF IRON BAR S=1/20



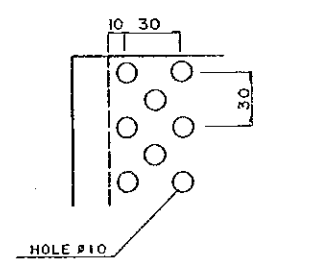
1/5 DIVISION S=1/10



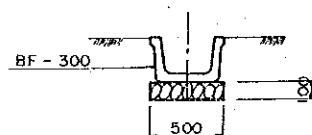
C - C S=1/10



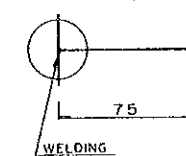
DETAIL A S=1/2



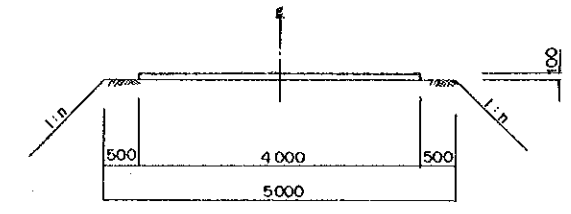
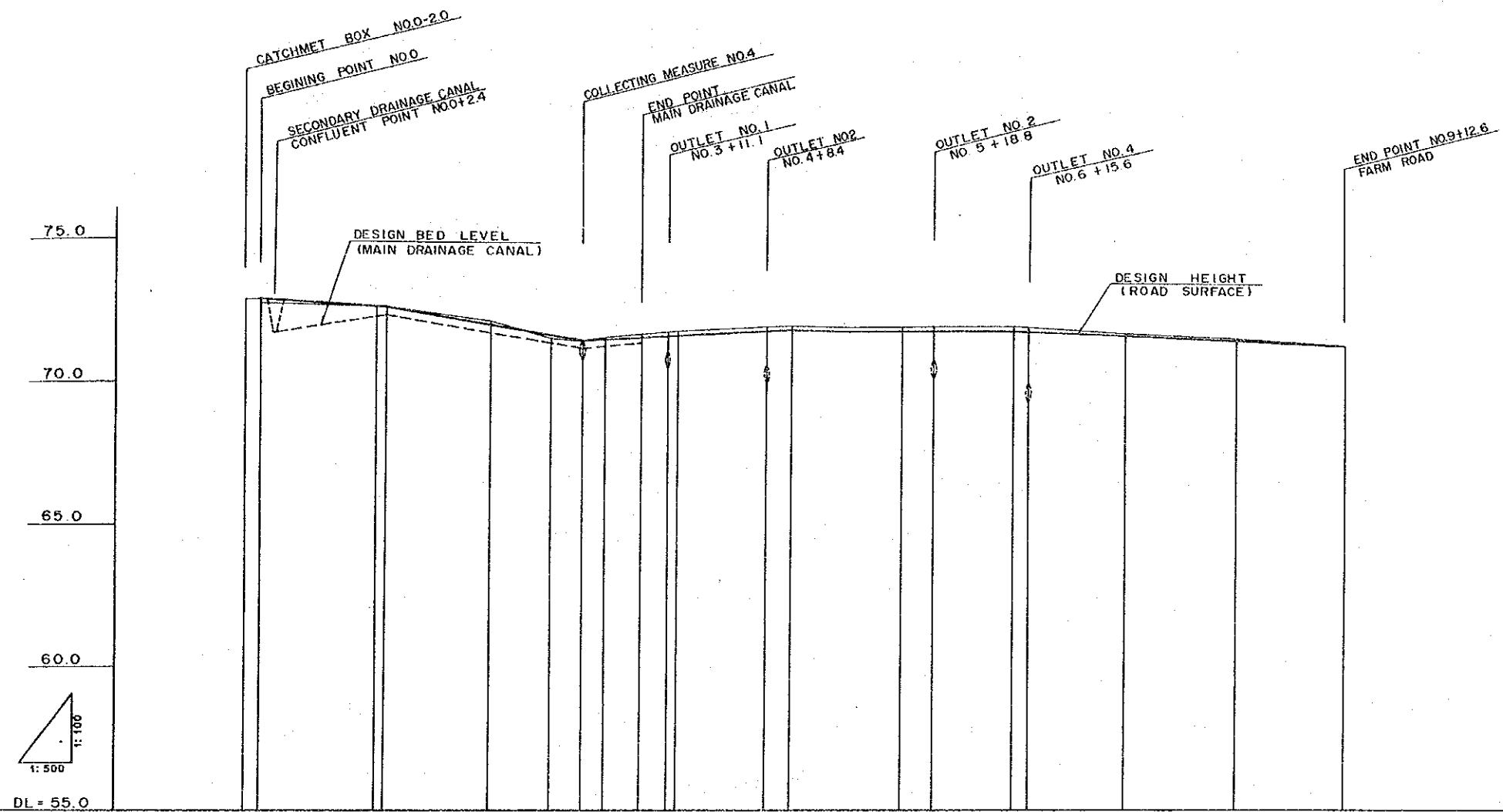
BENCH FLUME S=1/20



D DETAIL S=1/2

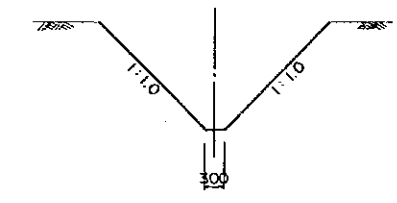


JAPAN INTERNATIONAL COOPERATION AGENCY	
MODEL INFRASTRUCTURE IMPROVEMENT WORKS FOR LAND AND WATER CONSERVATION CENTER PROJECT IN THE EAST OF THAILAND	
DETAILED PARTIAL VIEWS OF EXPERIMENTAL PLOTS (2/2)	
PREPARED BY	DRAWING NO.
CHECKED BY	11



X REMARK
 n=1.0 : CUTTING
 n=1.5 : BANKING

TYPICAL CROSS SECTION FOR FARM ROAD S=1/50



TYPICAL CROSS SECTION FOR DRAINAGE CANAL S=1/50

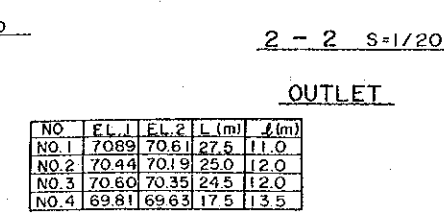
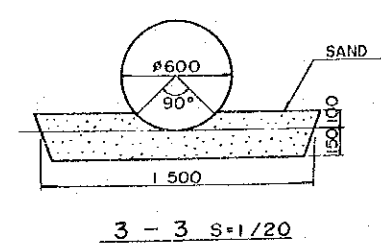
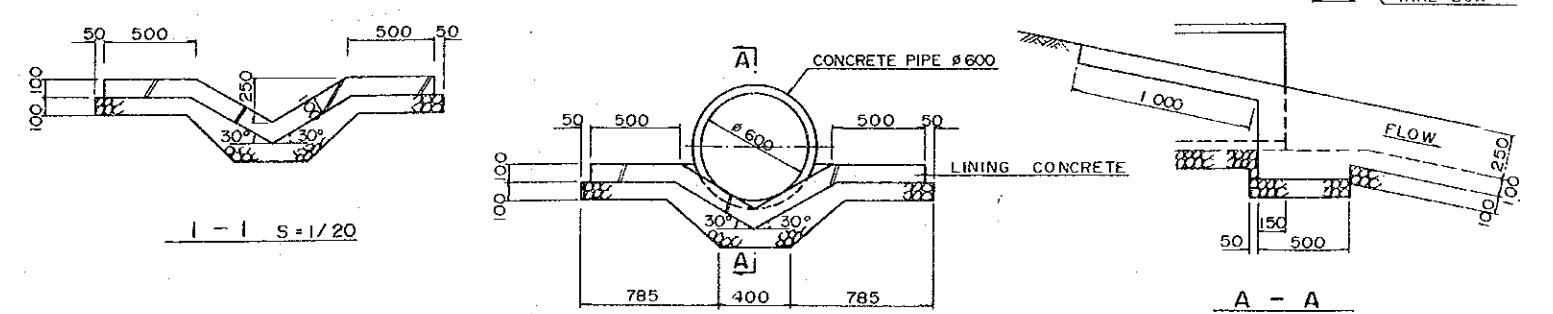
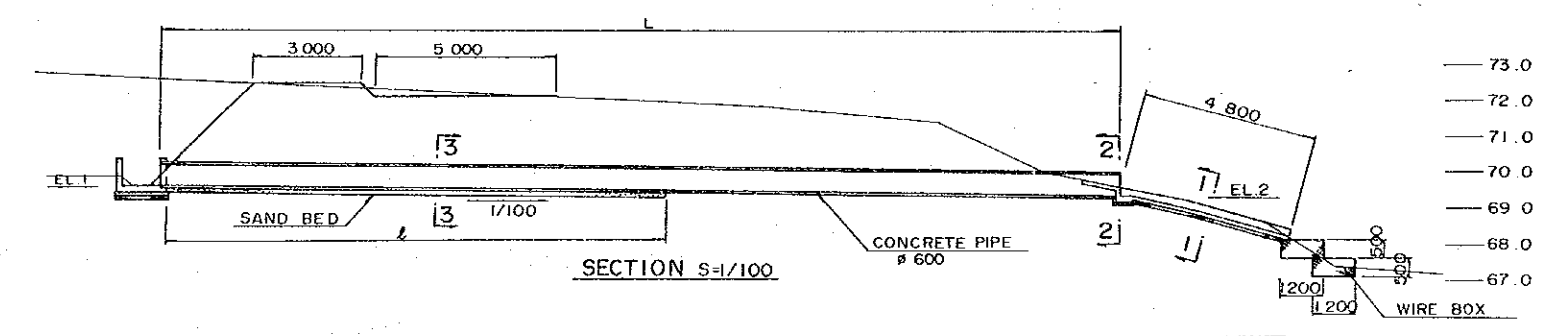
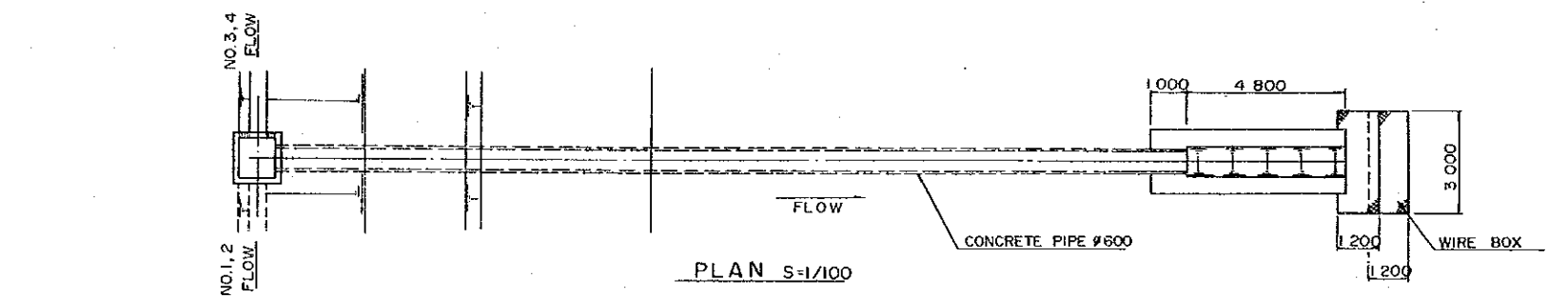
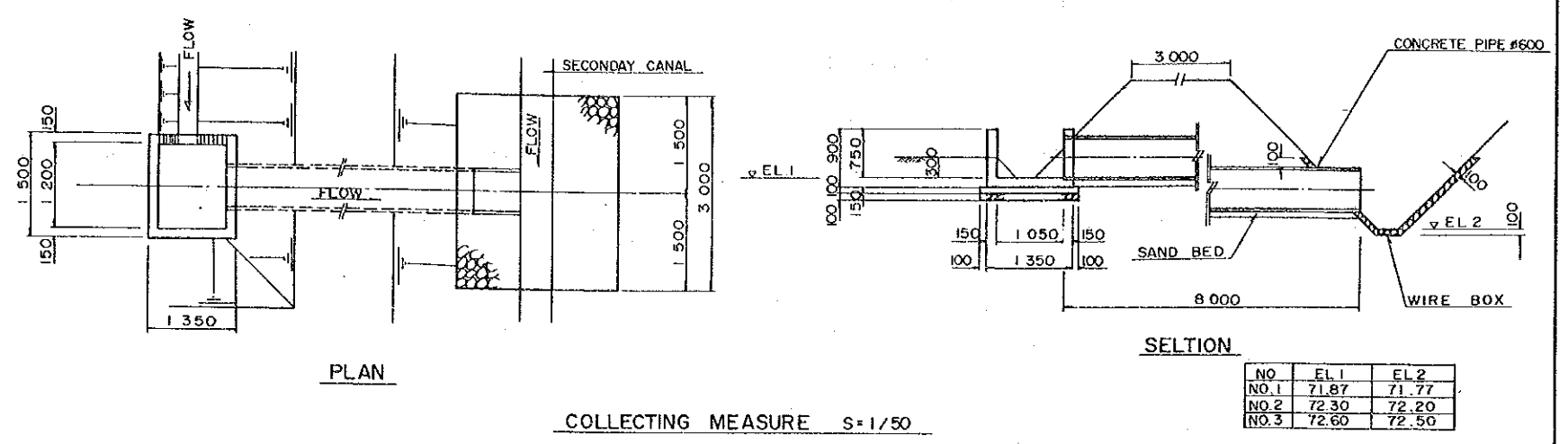
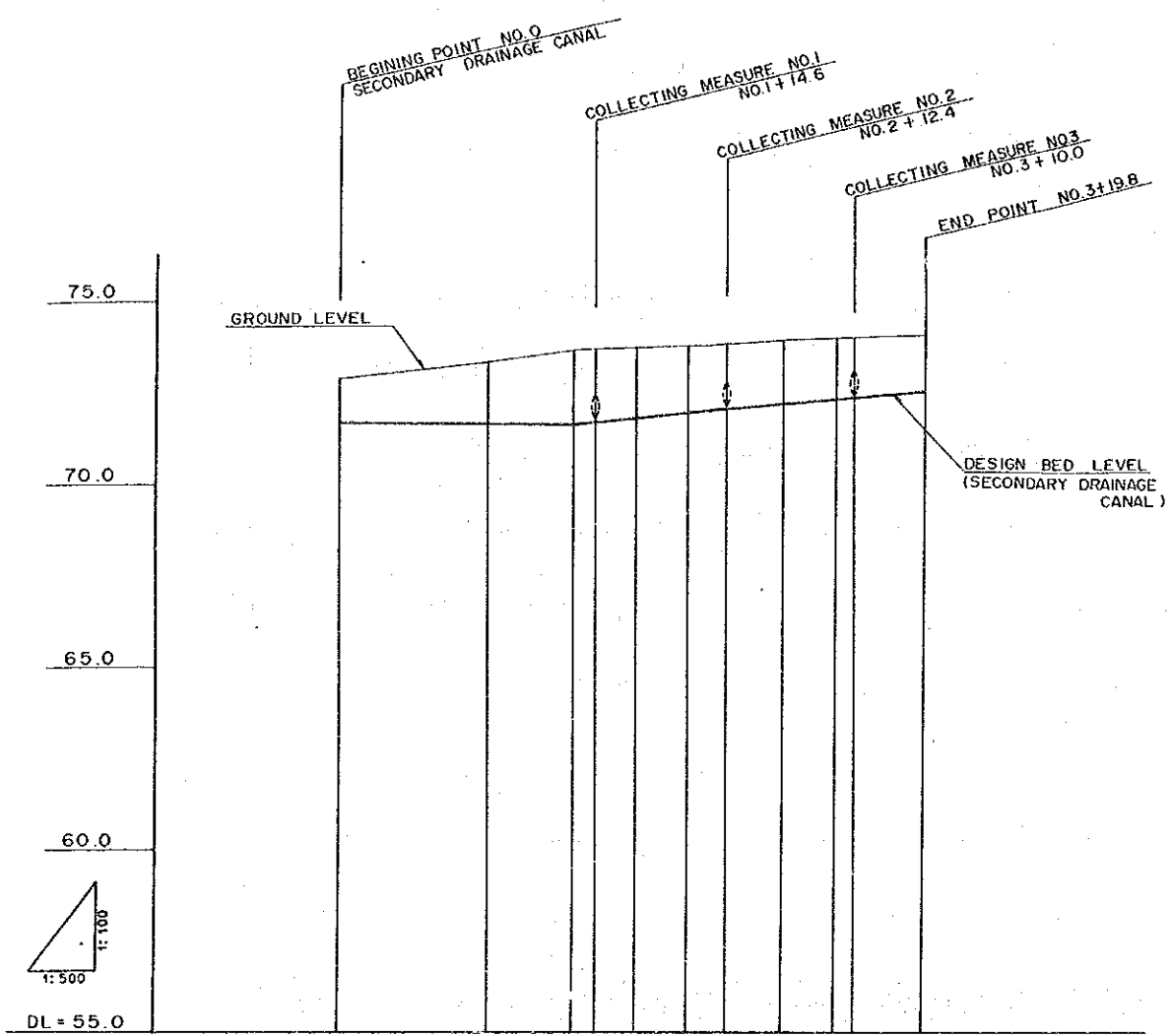
CANAL SLOPE		LEVEL		L=22.3m, h=0.63m, i=0.02825, θ=1°37'08"		L=34.6m, h=1.05m, i=0.03017, θ=1°43'41"		L=92m, n=0.2, i=0.02174, θ=1°41'43"		L=36.8m, h=0.37m, i=0.01005, θ=0°34'34"		L=40.0m, LEVEL		L=60.0m, h=0.42m, i=0.00700, θ=0°24'04"		
DESIGN BED LEVEL (CANAL)	71.75	72.38	71.72	71.45	71.33	71.39	71.53	72.00	72.00	71.58	72.00	72.00	71.58	72.00	71.58	
SLOPE	0.00	0.00	0.08	0.09	0.14	0.15	0.19	0.12	0.13	0.14	0.17	0.17	0.17	0.16	0.10	
BANKING	0.14	0.00	0.00	0.15	0.09	0.03	0.14	0.12	0.13	0.14	0.17	0.17	0.16	0.10	0.08	
CUTTING	0.00	0.00	0.08	0.09	0.14	0.15	0.19	0.12	0.13	0.14	0.17	0.17	0.16	0.10	0.08	
DESIGN HEIGHT (ROAD SURFACE)	72.90	72.70	72.02	71.80	71.63	71.67	71.78	72.00	72.00	71.87	72.00	72.00	71.95	71.72	71.67	
GROUND LEVEL	72.70	72.68	72.24	71.65	71.54	71.70	71.92	72.08	72.13	72.14	72.17	72.14	71.96	71.82	71.67	
TOTAL DISTANCE	0.0	20.0	40.0	50.4	55.5	60.0	71.1	88.4	92.6	100.0	112.6	120.0	132.6	140.0	152.6	
DISTANCE	0.0	17.6	19.4	10.0	5.1	4.2	11.1	8.4	6.2	7.4	12.6	7.4	4.7	4.4	12.6	
STATION	NO.0 +0.0	NO.1 +1.2	NO.2 +1.3	NO.4 +1.4	IP.2 +1.2	NO.3 +1.3	+6.4 +1.1	NO.4 +1.2	+8.4 +1.2	+26 +1.6	NO.5 +1.7	+12.6 +1.8	NO.6 +1.9	+15.6 +2.0	NO.7 +2.1	+12.6 +2.2
CURVE	IP.1 θ=59°40'		IP.2 θ=52°30'													

X REMARK
 () : DRAINAGE CANAL

JAPAN INTERNATIONAL COOPERATION AGENCY
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 FOR LAND AND WATER CONSERVATION CENTER PROJECT
 IN THE EAST OF THAILAND

LONGITUDINAL SECTION OF
 FARM ROAD AND
 DRAINAGE CANAL (1/2)

PREPARED BY _____ DRAWING NO. _____
 CHECKED BY _____ 12



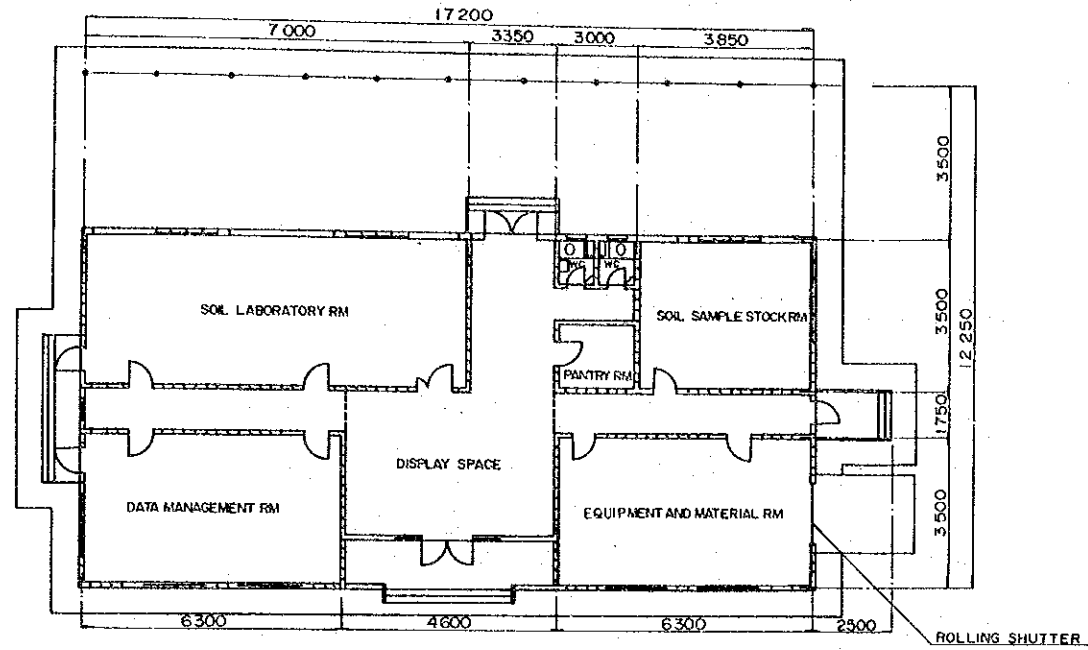
NO	EL.1	EL.2	L (m)	d (m)
NO.1	70.89	70.61	27.5	11.0
NO.2	70.44	70.19	25.0	12.0
NO.3	70.60	70.35	24.5	12.0
NO.4	69.81	69.63	17.5	13.5

BANKING																	
CUTTING		1.13	1.21		1.21	1.73		1.98	2.01	1.93	1.84	1.80					
CANAL SLOPE		71.75		L=346m, h=0.02 i=0.00058 θ=0°01'59"	71.76		71.77		L=179m, h=0.02 i=0.00210 θ=0°23'52"	71.77		72.20		L=274m, h=0.052 i=0.01898 θ=1°05'14"	72.20		72.72
DESIGN BED LEVEL (CANAL)		71.75	71.75		71.76	71.76		71.77	71.77	71.90	72.08	72.20	72.34	72.50	72.53	72.72	
GROUND LEVEL		72.88	72.96		73.38	73.45		73.75	73.78	73.83	73.92	74.00	74.13	74.21	74.23	74.31	
ACCUMULATED DISTANCE	0	3.3		20.0	23.3		31.3	34.6	40.0	47.3	52.4	60.0	67.3	70.0	79.8		
DISTANCE	0	3.3		16.7	3.3		8.0	3.3	5.4	7.3	5.1	7.6	7.3	2.7	9.8		
STATION	NO.0 +3.3		NO.1 +3.3	IP.1 14.6		NO.2 12.4	+7.3	12.4	NO.3 10.0	+7.3	10.0	+19.8					
CURVE	IPI θ=90°00'																

JAPAN INTERNATIONAL COOPERATION AGENCY
 MODEL INFRASTRUCTURE IMPROVEMENT WORKS
 FOR LAND AND WATER CONSERVATION CENTER PROJECT
 IN THE EAST OF THAILAND

LONGITUDINAL SECTION OF
 FARM ROAD AND
 DRAINAGE CANAL (2/2)

PREPARED BY _____ DRAFTING NO. _____
 CHECKED BY _____ 13



GENERAL SPECIFICATION

EXTERIOR FINISHING

- ROOF : METAL ROOF SHEET 0.5mm Thk
- WALL : EXPOSED CONCRETE BLOCK W/PAINT
- DOOR : WOODEN FLUSH DOOR
- WINDOW : WOODEN WINDOW W/GLASS PANEL

INTERIOR FINISHING

SOIL LABORATORY ROOM : DATA MANAGENT ROOM & DISPLAY SPACE

- FLOOR : CONCRETE STEEL TROWEL
- WALL : MORTAR W/VP
- CEILING : GYPSUM BOARD 9mm Thk W/INSULATION 50mm Thk

SOIL SAMPLE STOCK ROOM & EQUIPMENT AND MATERIAL ROOM

- FLOOR : CONCRETE STEEL TROWEL
- WALL : EXPOSED CONCRETE BLOCK W/VP
- CEILING : GYPSUM BOARD 9mm Thk W/INSULATION 50mm Thk

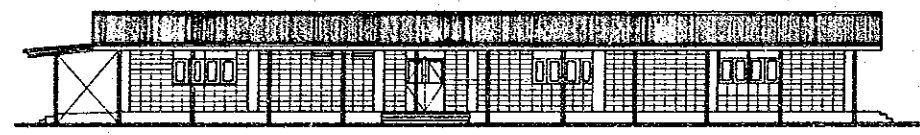
PANTRY WC. ROOM

- FLOOR : CONCRETE STEEL TROWEL
- WALL : EXPOSED CONCRETE BLOCK W/VP
- CEILING : MOISTURE RESISTANT GYPSUM BOARD 9mm Thk W/INSULATION 50mm Thk

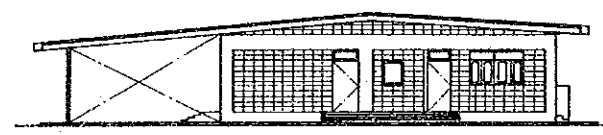
*** NOTE**

DO NOT SCALE THIS DRAWING USE ONLY FIGURED DIMENSIONS

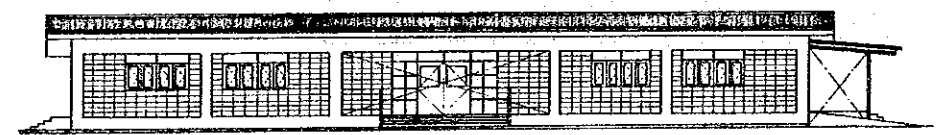
FLOOR PLAN



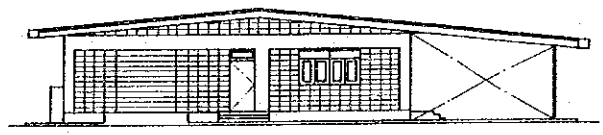
ELEVATION C



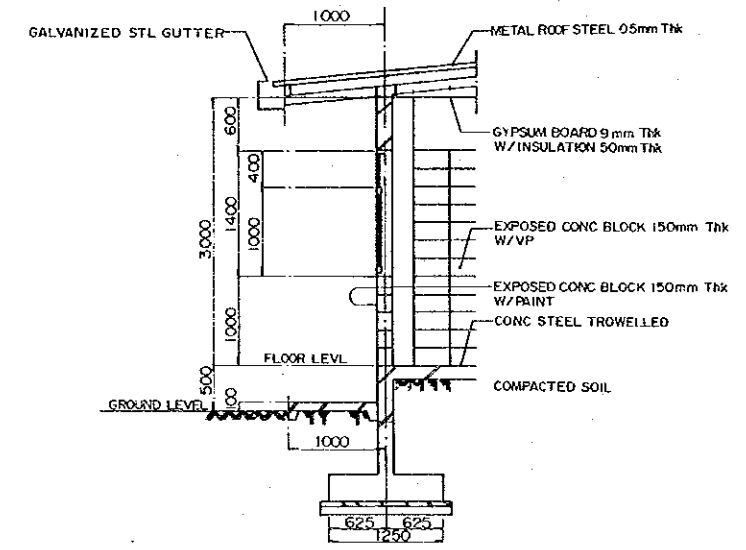
ELEVATION D



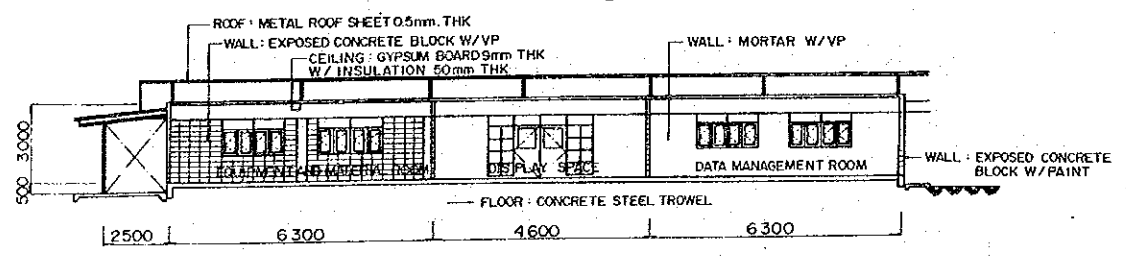
ELEVATION A



ELEVATION B



WALL SECTION DETAIL
1:40

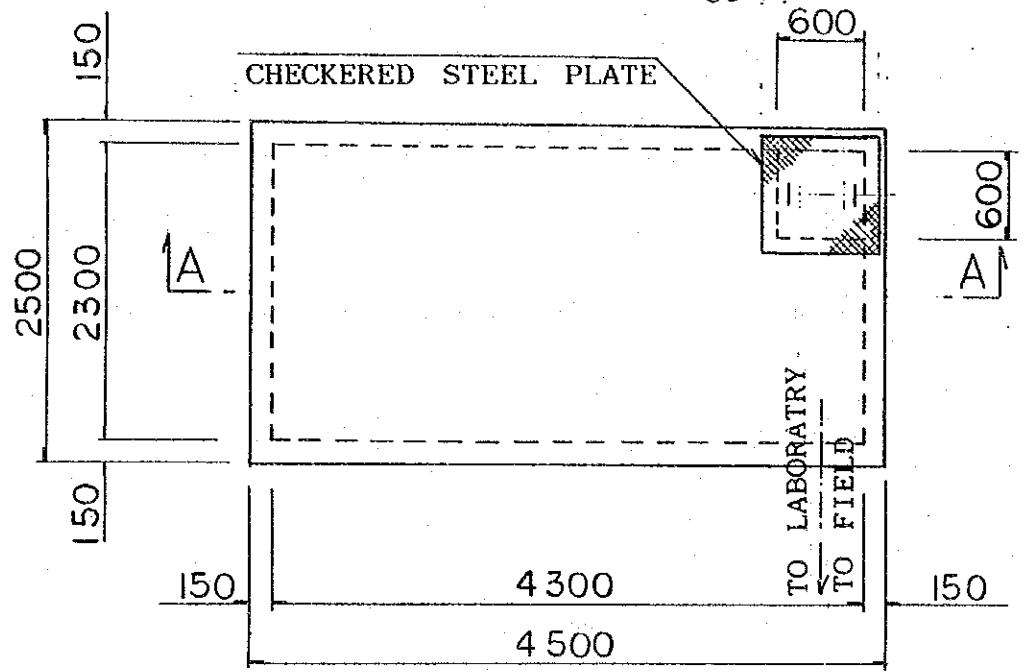


LONGITUDINAL SECTION

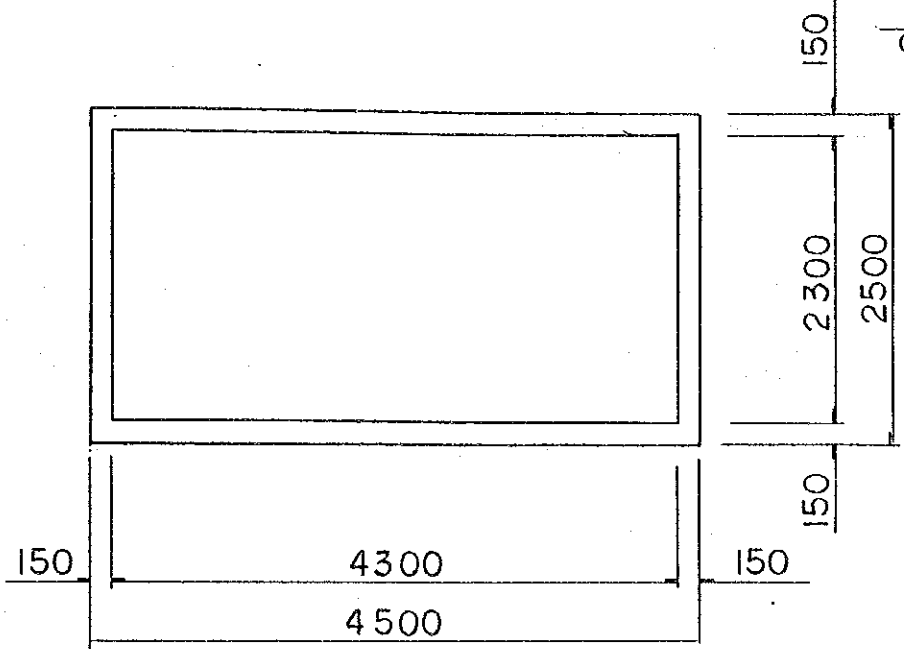
JAPAN INTERNATIONAL COOPERATION AGENCY	
MODEL INFRASTRUCTURE IMPROVEMENT WORKS FOR LAND AND WATER CONSERVATION CENTER PROJECT IN THE EAST OF THAILAND	
FIELD LABORATORY	
PREPARED BY	DRAWING NO. 14
CHECKED BY	

STORAGE TANK

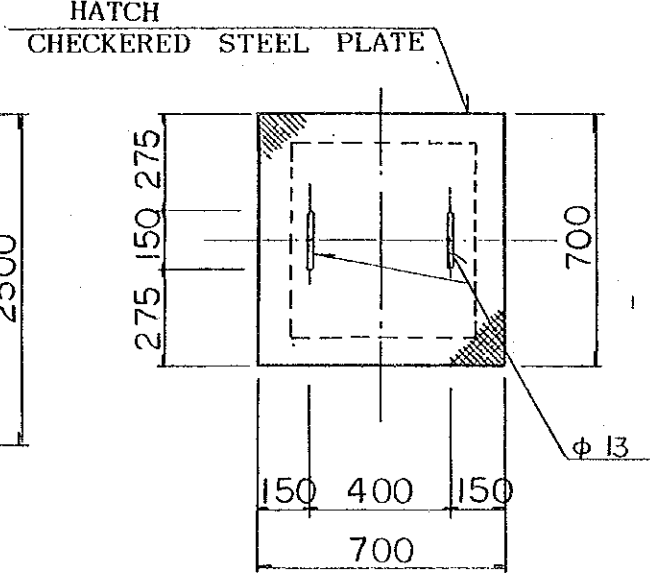
PLAN
S=1/50



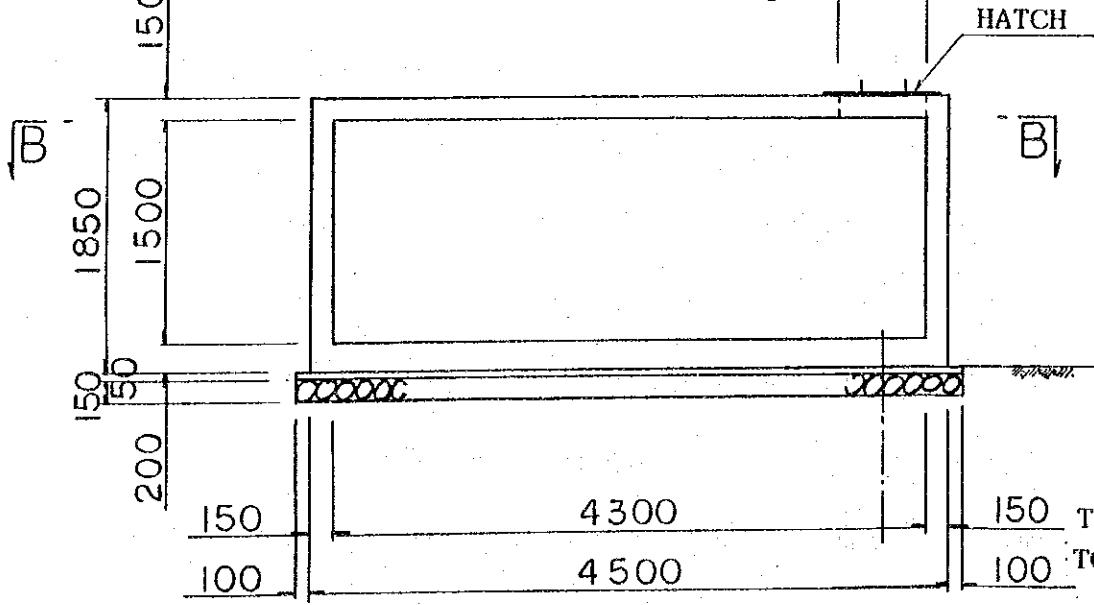
B - B
S=1/50



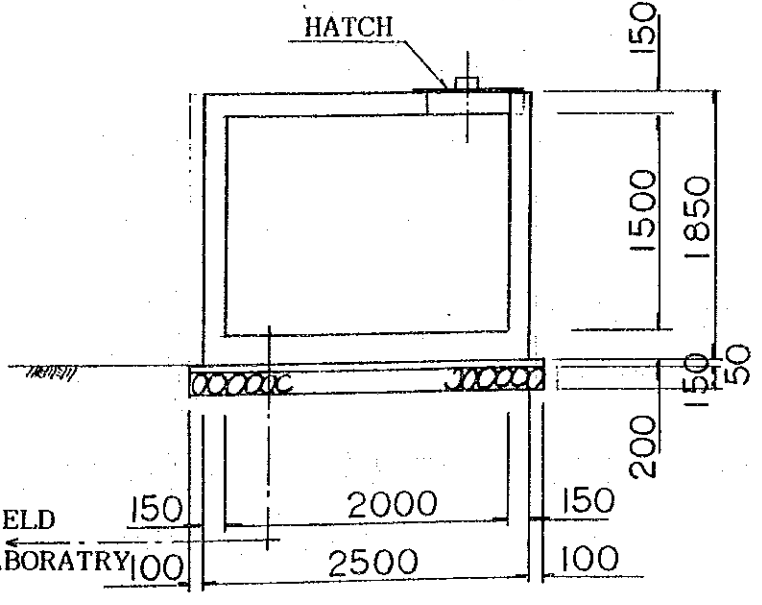
HATCH
S=1/20



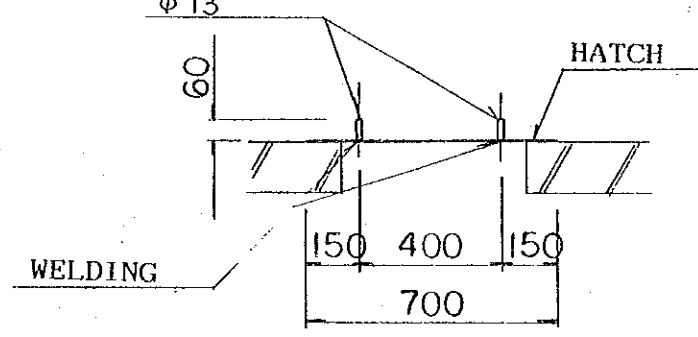
A - A
S=1/50



C - C
S=1/50



SECTION
S=1/20



JAPAN INTERNATIONAL COOPERATION AGENCY MODEL INFRASTRUCTURE IMPROVEMENT WORKS FOR LAND AND WATER CONSERVATION CENTER PROJECT IN THE EAST OF THAILAND	
STORAGE TANK	
PREPARED BY	DRAWING NO.
CHECKED BY	15

APPENDIX

1. Letter of Team Leader ----- A- 1
2. Field Report----- A- 8
3. Technical Data ----- A-22
 - (1) Soil Data ----- A-22
 - (2) Meteorological data----- A-27
 - (3) Necessity of the 17 test plots----- A-33

1. Letter of Team Leader

JAPAN INTERNATIONAL COOPERATION AGENCY

(J I C A)

DETAILED DESIGN SURVEY TEAM

FOR

THE LAND AND WATER CONSERVATION CENTER PROJECT

IN THE EAST OF THAILAND

November 23, 1993

Dr. Sitilarp Vasuvat
Director General
Department of Land Development
Ministry of Agriculture and Cooperatives

Dear Sir,

Re ; The Model Infrastructure Improvement Works for the Land and Water
Conservation Center Project in the East of Thailand

The Detailed Design Survey Team has been organized by the Japan International Cooperation Agency (JICA) for the purpose of formulating detailed plan on the Model Infrastructure Improvement Works for the captioned Project.

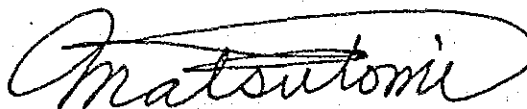
The Team has, so far, made a series of site reconnaissances and discussions with your staff concerned in order to determine the location and scale of the experimental farm and its facilities. As a result, We would like to submit to you the tentative idea for design of the experimental farm as per the attached.

Two team members, Mr.Sakanashi and Mr. Shimizu, will proceed with your staff to conduct further field surveys and investigations at the site and to make the detailed design on the basis of the result of those surveys. After the completion of the detailed design and assessment of its cost estimated by JICA, you will be informed of its result through the JICA Thailand office.

Further, for the timely commencement of the construction, we would like to request you to take the necessary formalities in due consultation with the JICA Thailand office.

Lastly, we would like to appreciate for kind cooperation of your staff during our stay.

Sincerely yours,



Tsuneo Matsutomi

Team Leader

Detailed Design Survey Team

(Japan International Cooperation Agency)

- cc ;
1. Chief of Japan Sub-Division,
Department of Technical and Economic Cooperation
 2. Project Manager,
The Land and Water Conservation Center Project
in the East of Thailand
 3. Embassy of Japan
 4. JICA Thailand Office
 5. Team Leader, JICA Experts, LWCC Project

ATTACHEMENT

1. Objective

This survey is to carry out the detailed design on the experimental farm to be constructed by the Japanese government.

The purposes of the construction of the experimental farm are as follows ;

- (1) To formulate the equation for water erosion prediction from various sites of farm land in the eastern Thailand.
- (2) To analyze factors relating to water erosion of farm land in the eastern Thailand.
- (3) To evaluate mechanical and vegetative control from bare land and managed land.

In light of the above, the Team had preliminary discussions on the framework of the experimental farm.

2. Location and Scale

The site of the experimental farm is located within the premises of DLD Rayong Station, Regional office II .

Bird's - eye map is shown in figure- 1.

3. Component of the experimental farm

The experimental farm consists of the following components;

(1) Erosion plot

Erosion plots with two different slopes (5% and 9%) will be planned to measure the soil loss, run-off and moisture content.

(2) Installation of observation equipments

The equipments for measuring run-off, soil moisture and so on will be installed at the right places in the erosion plots and so on.

(3) Field Laboratory

It will be planned for sample treatment, data collection and analysis and so on.

(4) Other necessary facilities

They will be planned if judged necessary.

4. Outline of the tentative schedule

The tentative schedule and procedure for the construction works of the experimental farm is shown in Table-1.

5. Others

(1) The Government of the Kingdom of Thailand is requested to take full responsibility on the following items for the execution of the Model Infrastructure Improvement Works.

- ① To resolve any problems which will arise during and after the construction works.
- ② To assign counterparts during the construction period.
- ③ To strengthen the organization for the experimental farm management.
- ④ To maintain the experimental farm properly with advice of JICA experts after the completion of the construction works.

(2) The team will convey to the Government of Japan the strong request of DLD that the experimentation works should be commenced from the beginning of the next rainy season for smooth and effective implementation of The Land and Water Conservation Center Project in The East of Thailand.

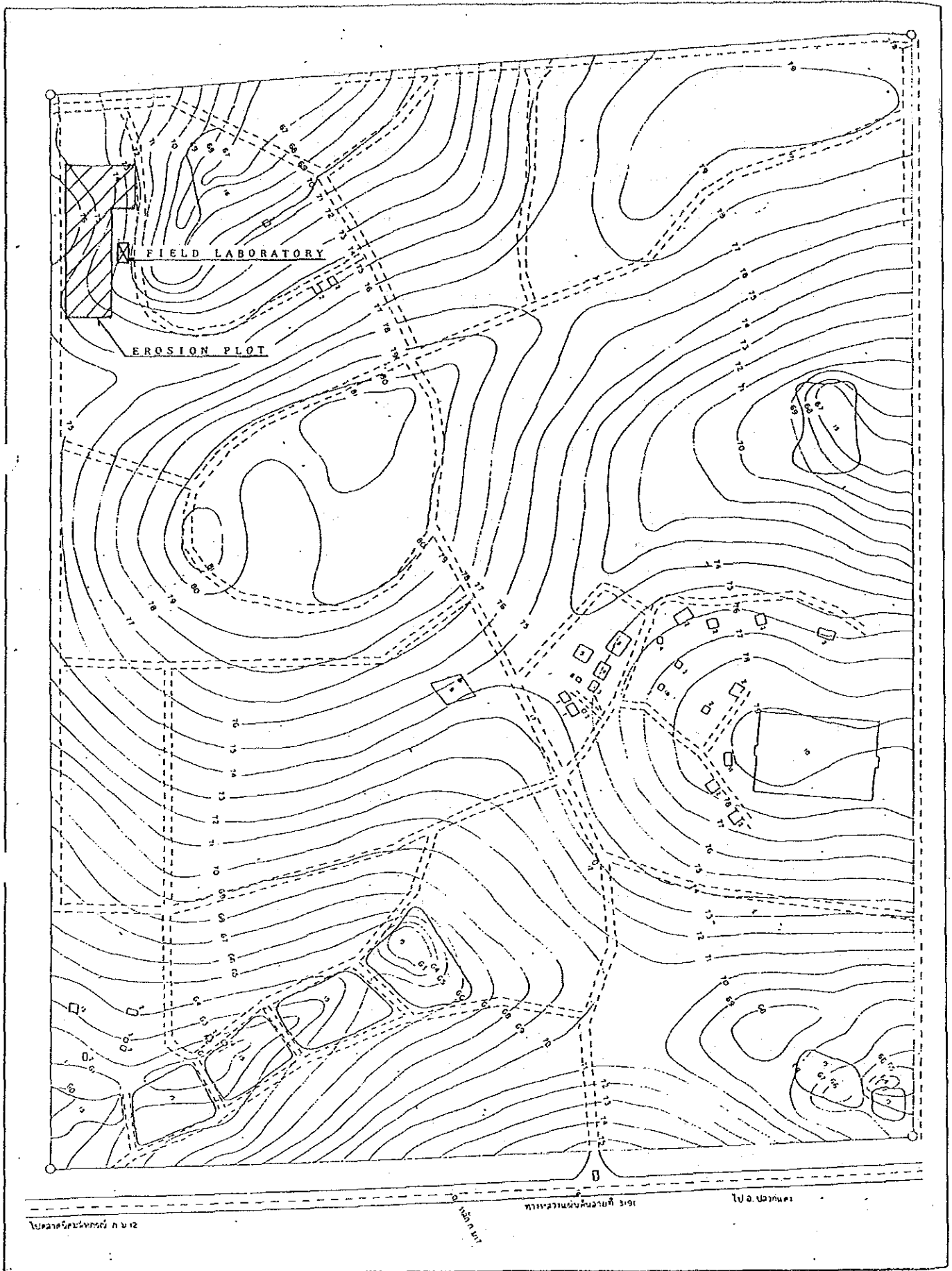


FIGURE-1. BIRD'S-EYE MAP

<OUTLINE OF THE TENTATIVE SCHEDULE ON MODEL INFRASTRUCTURE IMPROVEMENT WORKS
FOR THE LAND AND WATER CONSERVATION CENTRE PROJECT IN THE EAST OF THAILAND>

	NOVEMBER/1993	DECEMBER	JANUARY/1994	FEBRUARY	MARCH ~
<p><JAPANESE SIDE></p> <p>① Detailed Design Survey (Basic Plan of construction work) Report of the Survey Team (Outline of construction work)</p> <p>② Detailed Design in Japan</p> <p>*④ Exchange of supplementary Note to the R/D</p> <p>⑤ Submission of Final Report</p> <p>⑥ Consultation with Ministry of Foreign Affairs</p> <p>⑦ Dispatch of supervising expert</p> <p>*⑧ Exchange of Note Verbal</p> <p>⑨ Contract for construction</p> <p>⑩ Start of construction work</p>	<p>15</p> <p>①</p> <p>14</p> <p>②</p> <p>24</p> <p>③</p>	<p>④</p>	<p>⑤</p> <p>10</p> <p>⑥</p>		
<p><THAI SIDE></p> <p>① Preparation of Land</p> <p>② Preparation of Form A-1 for JICA expert on construction supervision</p> <p>③ Preparation of Form A-4 for Equipments</p> <p>*④ Exchange of supplementary Note to the R/D</p> <p>⑤ Receipt of Final Report</p> <p>⑥ Request of construction work (through JICA Thailand Office)</p> <p>*⑦ Exchange of Note Verbal</p>	<p>①</p> <p>②</p> <p>③</p>			<p>④</p>	<p>⑤</p> <p>⑥</p> <p>⑦</p>

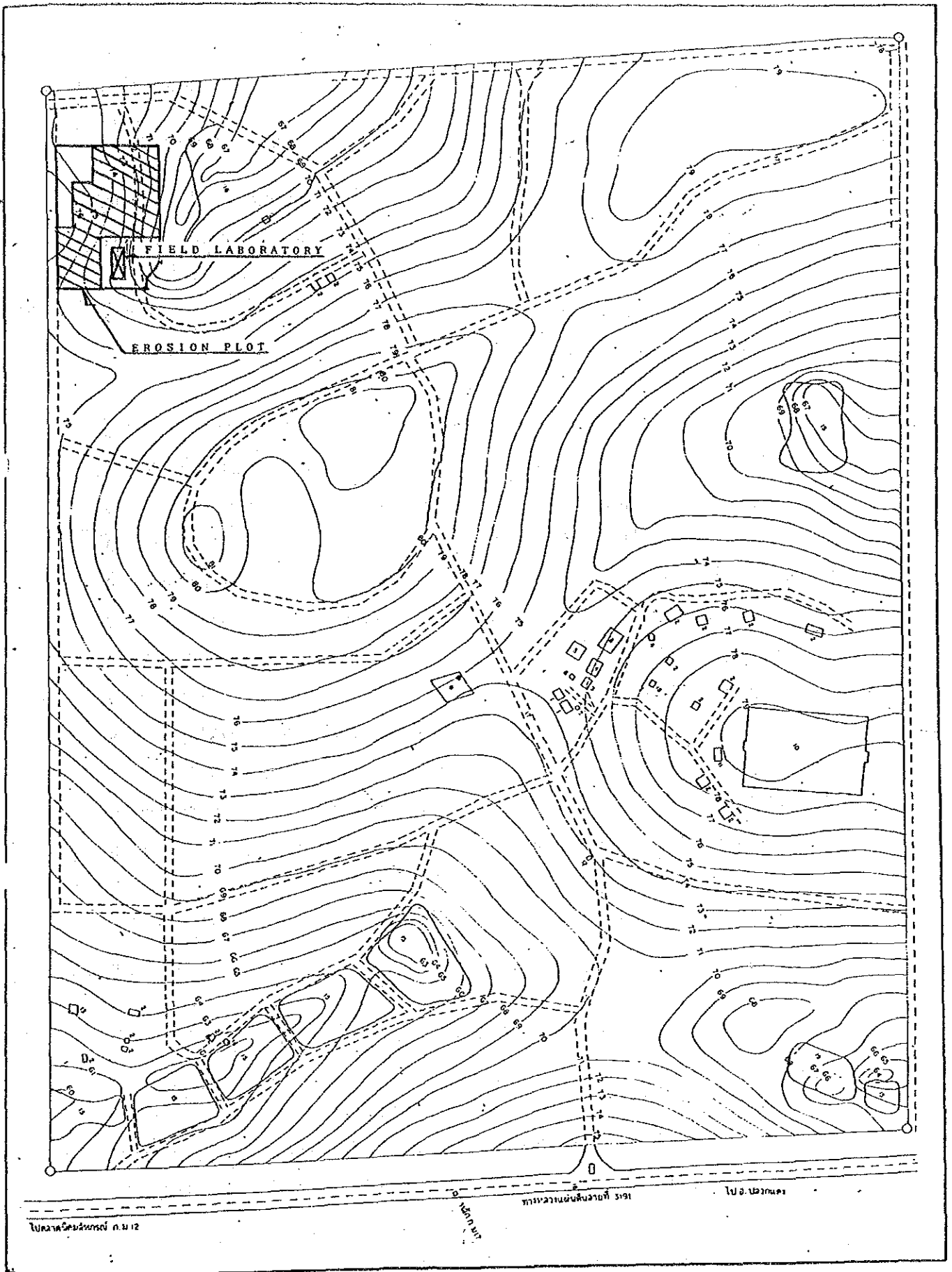
2. Field Report

THE KINGDOM OF THAILAND
DETAILED DESIGN SURVEY
F O R
THE LAND AND CONSERVATION CENTER PROJECT
IN THE EAST OF THAILAND

FIELD REPORT

December 1993

JAPAN INTERNATIONAL COOPERATION AGENCY



LOCATION MAP

LOCATION MAP

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ANNEX-2 Collected Data List	
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ANNEX-4 Layout of The Experimental Plots and Field Laboratory (Drawing)	

1. General

1.1 Objective

The objective of this survey is the detailed design of the experimental farm for the arrangement of the design criteria which apply to the Land and Water Conservation Center Project (LWCC) in the East of Thailand in the near future.

The purposes of the construction of the experimental farm are as follows:

- (1) To formulate the equation for water erosion prediction from various sites of farm land in the eastern Thailand.
- (2) To analyze factors relating to water erosion of farm land in the eastern Thailand.
- (3) To evaluate mechanical and vegetative control from bare land and managed land.

1.2 Member of the Survey

<u>Name</u>	<u>Speciality</u>	<u>Organization</u>
Mr. Tsuneo MATSUTOMI	Team Leader	Deputy Director, Overseas Land Improvement Cooperation Office, Design Division, Agricultural Structure Improvement Bureau, MAFF
Mr. Hirofumi HAYASHI	Coordinator	Staff, Planning Division, Agricultural Development Cooperation Department, JICA
Mr. Ryosuke SAKANASHI	Field Design	Taiyo Consultants Co., Ltd.
Mr. Noriyasu SHIMIZU	Irrigation Facilities Design	Taiyo Consultants Co., Ltd.

1.3 Work Schedule in Thailand

The Survey in Thailand was conducted for 30 days from November 15, 1993 to December 14, 1993.

No.	Date	Day	Member	City	Work Schedule
1.	Nov. 15	Mon.	4	Bangkok	Arrive in Bangkok from Japan
2.	16	Tue.	4	"	Courtesy call at DLD, JICA
3.	17	Wed.	4	"	Meeting with project members concerned
4.	18	Thu.	4	Sriracha/Rayong	Field reconnaissance and discussion
5.	19	Fri.	4	Chachoengsao	"
6.	20	Sat.	4	Bangkok	Preparation for letter of team leader
7.	21	Sun.	4	"	"
8.	22	Mon.	3	"	Meeting with project members concerned
			1	Sriracha/Rayong	Preparation for topo-survey
9.	23	Tue.	4	Bangkok	Submission of letter, reporting to JICA
10.	24	Wed.	2	"	Data collection
			2		Leave Bangkok for Japan
11.	25	Thu.	2	Sriracha/Rayong	Investigation of present condition
12.	26	Fri.	2	"	"
13.	27	Sat.	2	"	"
14.	28	Sun.	2	"	Data Arrangement
15.	29	Mon.	2	Bangkok	Data collection
16.	30	Tue.	2	Sriracha/Rayong	Investigation of present condition
17.	Dec. 1	Wed.	2	"	"
18.	2	Thu.	2	"	"
19.	3	Fri.	2	"	"
20.	4	Sat.	2	"	Data Arrangement
21.	5	Sun.	2	Sriracha	"
22.	6	Mon.	2	Sriracha/Rayong	Investigation of present condition
23.	7	Tue.	2	"	Reporting to LDRO2
x 24.	8	Wed.	2	"	Site meeting with electric surveyors
x 25.	9	Thu.	2	Bangkok	Report/Discuss with project members
26.	10	Fri.	2	"	Data Arrangement
27.	11	Sat.	2	"	Preparation of field report

No.	Date	Day	Member	City	Work Schedule
28.	12	Sun.	2	"	Preparation of field report
29.	13	Mon.	2	"	Reporting to DLD, JICA, EOJ
30.	14	Tue.	2		Leave Bangkok for Japan

2. Survey Site

The survey site is the premises of Rayong Land Development Station belong to the Regional office II in Amphoe Bandkhai, Rayong Province.

The scale of the experimental plots area is about 1.5ha including the field laboratory area.

3. Major Works Performed in the Survey Period

3.1 Topographic Survey

Topographic survey at the proposed site was performed on the following items under the surveyor's cooperation of LDR02.

- (1) traverse surveying along the boundary of the proposed site about 4ha.
- (2) contour line check surveying with meshed survey
- (3) profile and cross sectional leveling, and
- (4) drainage canal route surveying, etc.

3.2 Soil Survey

Soil survey was carried out by excavating six test pits (SP.1 ~ SP.6) and supplementary auger boring test of three places. Soil profile and soil analysis were executed using these pits and holes.

3.3 Ground Water Level and Water Quality Survey

Well and water quality were investigated on the following three items for the existing two well in the Rayong Station.

- (1) fluctuation of ground water level
- (2) electrical conductivity (EC),
- (3) pH

3.4 Data Collection

Data collection on meteorology, soil and others was carried out. Major collected data list is attached ANNEX-2

3.5 Construction Cost Survey

Data and information on the construction materials, equipments and labour, etc. were collected in the field survey period.

3.6 General Layout of the Experimental Plots and the Field Laboratory

General layout of the experimental plots and the field laboratory were designed during the field survey period. This layout has drawn up based on the consideration of locations, number, slope and sizes of each plots.

On the detailed layout are as follows.

(1) Experimental Plots Plan

The layout of experimental plots were done in this proposed area of the gentle slope with gradient of 3° to 5°. The plots field consist of two kinds of plot slope (5% and 9%) and three kinds of plot size (5m×22.1 m, 1.83m× 22.1m, 5m×44.2m).

The specification of each plots are shown in ANNEX-3.

(2) Installation of observation equipments

Observation equipments for measuring run-off, soil moisture, rainfall and so on will be installed at suitable places in the experimental plots area.

(3) Field Laboratory Plan

The field laboratory house consist of four main rooms. These rooms are soil laboratory room, data management room, equipment and materials room, sample storage room and one display space.

(4) Other necessary facilities

For the laboratory, new extensional electric line and water supply system use of deep well will be planned.

4. Home Office Work

Home office work in Japan will be undertaken by the detailed design survey team for about one month in succession for the field survey. The contents of the home office work are described in this chapter.

4.1 Detailed Design and Drawings

Major items of detailed design and drawing will be as follows.

- (1) General layout of the experimental plots and the field laboratory.
- (2) Layout of land consolidation
- (3) Runoff plots for measuring soil loss and runoff water designing
- (4) Field laboratory house designing
- (5) Dry yard designing
- (6) Drainage canal designing
- (7) Extensional electric line designing
- (8) Water supply system use of well designing

4.2 Construction Plan and Cost Estimation

Appropriate construction plan will be formulated in accordance with the site conditions based on the survey. Construction cost estimation will be carried out based on the unit cost of labour, materials and machinery applicable to the site, being clarified through the survey.

Final construction cost will be decided by the JICA.

4.3 Tentative Contract Documents

Following tentative contract documents will be prepared in English as a basis of placing the order:

- (1) Form of Contract
- (2) Terms and Conditions of Contract
- (3) Technical Specifications
- (4) Bill of Quantities

4.4 Report

The draft final report will be explained to the JICA at the end of the home office work, the early in February.

The final report will be submitted within one month after the explanation of the draft final report, the early in March.

A N N E X

ANNEX-1 Letter of Team Leader

ANNEX-2 Collected Data List

ANNEX-3 Table of the Plot Layout and Arrangement (17 Plots)

ANNEX-4 Layout of The Experimental Plots and Field Laboratory (Drawing)

ANNEX-2 COLLECTED DATA LIST

1. Meteorology data

- Monthly mean temperature, rainfall, humidity, sunshine duration
: Field Crop Research Station of DOA at Rayong Province (1983 ~1992)
- Monthly mean temperature, rainfall, humidity, wind direction and wind velocity : Rayong station of Meteorological Department (1969~1988)

2. Soil data

- "Soil data report at DLD Rayong station" (Report) : LDR02
- "Erosion Induced Loss in Soil Productivity" (Report) : DLD Bangkok
- Soil profile data at the proposed area for the experimental plots : LDR02

3. Map

- Map of Rayong Province (S = 1/165,000)
- Map of DLD Rayong station (S = 1/2,000) : LDR02
- Contour Map of DLD Rayong station (S = 1/500) : LDR02

4. Cost estimation data

- Rate cost of concrete works and stones : Eng. Div. DLD
- Standard building accountancy budget 1994
- Account of standard price of heavy material : Annual budget 1994
- Tendering form (B/Q, Quotation)
- Construction cost of materials, labour, machines and others : Eng. Div.

ANNEX-3 Table of the Plot Layout and Arrangement (17 Plots)

Plot Layout and Arrangement

Symbol ○ : the item of investigation

Plot No.	Purpose of Plots	Introduced Crop		Cultivation Method	Remarks		soil loss	har-vest	USLE factor			
		(Main)	(Sub)		rainy season	dry season			K	L	C	P
1	Traditional farming	cassava	-	up and down ploughing	5m × 22.1m	5%	○	○			○	
2		cassava	-		-ditto-	-ditto-		○	○			○
3	Intercrop farming test	cassava	peanut	Contour ploughing	-ditto-		○	○			○	
4		cassava	mungbean		-ditto-	-ditto-		○	○			○
5		cassava	cowpea		-ditto-	-ditto-		○	○			○
6		cassava	blackgram		-ditto-	-ditto-		○	○			○
7	Soil erosion test (trial)	(bare land)		up and down ploughing	5m × 22.1m	× 2.5%	○			○		
8		-ditto-		-ditto-	5m × 44.2m	× 1.5%	○			○		
9		-ditto-		contour ploughing with deep tillage	5m × 22.1m	× 2.5%	○				○	
10	Soil erosion test	-ditto-		-ditto-	5m × 44.2m	× 1.5%	○				○	
11		-ditto-		vertical drain method	5m × 22.1m	× 2.5%	○				○	
12		(bare land)		up and down ploughing	1.83m × 22.1m	5%	○				○	
13	Soil erosion test	-ditto-		-ditto-	-ditto-		○			○		
14		-ditto-		-ditto-	-ditto-		○			○		
15	Soil erosion test (Standard)	(bare land)		up and down ploughing	1.83m × 22.1m	9%	○				○	
16		-ditto-		-ditto-	-ditto-		○			○		
17		-ditto-		-ditto-	-ditto-	-ditto-		○			○	

3. Technical Data

(1) Soil Data

Line 1 (No.1,2,3)

Mb-gr-slB

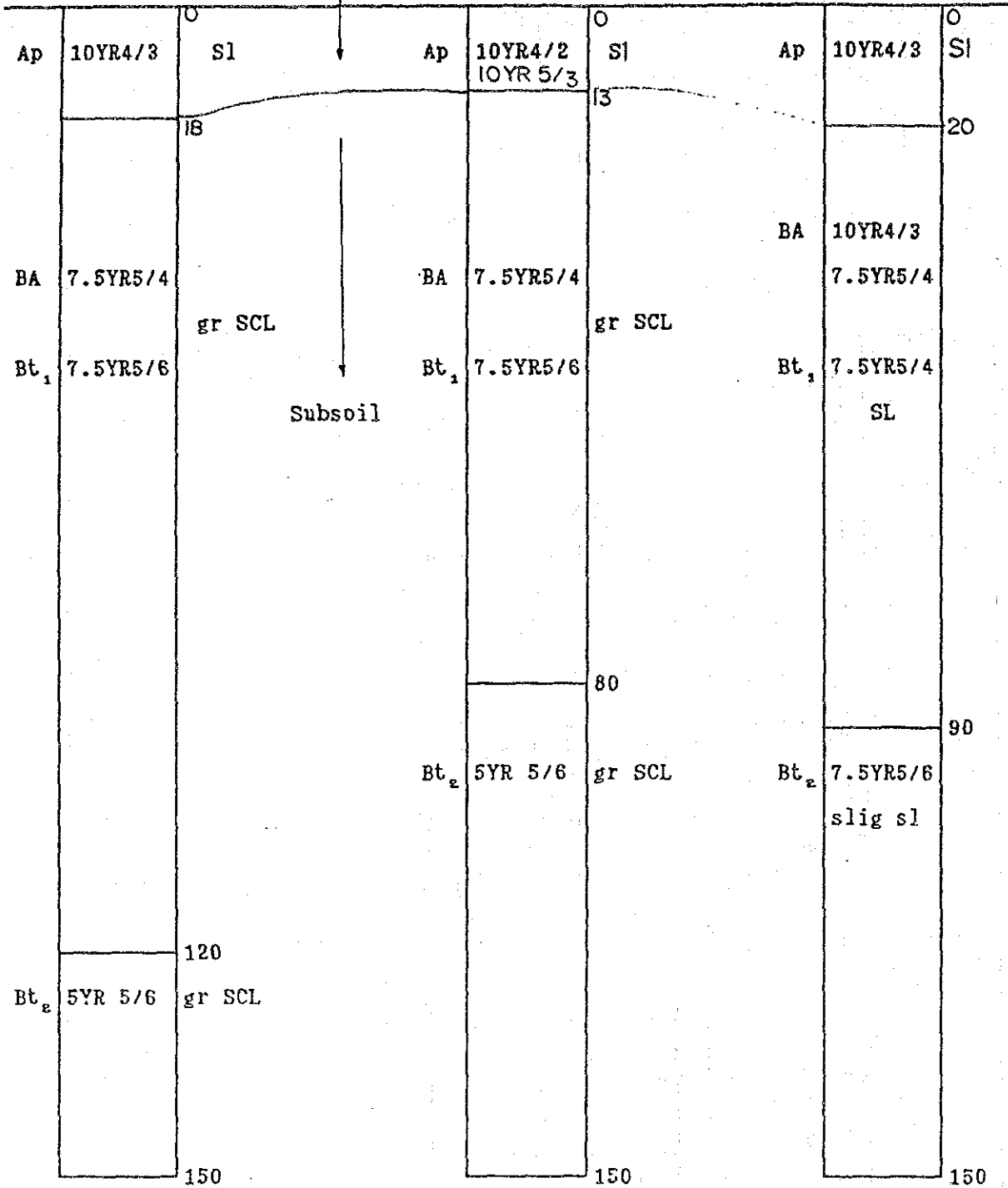
Mb-col-s1A

No.3

No.2

No.1

Surface soil



Line 2 (4,5,6)

Mb-hb-gr-s1B

Mb-gr-s1B

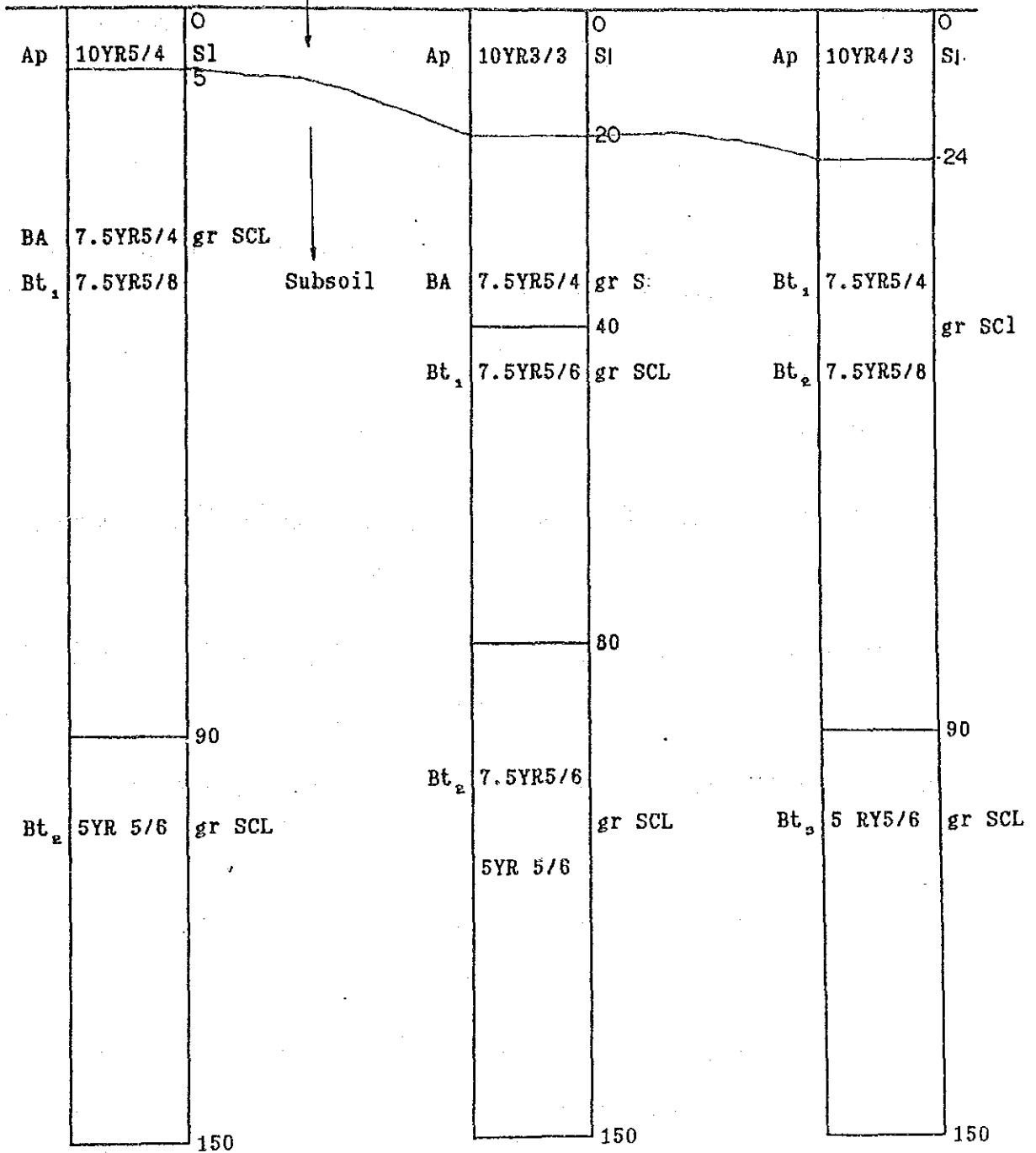
Mb-gr-s1B

No.6

No.5

No.4

Surface soil



1. Mb-col-s1A (Map Bon coarse loamy variant)

Ap 0-20(cm) : Dark brown(10YR4/3), sandy loam, slightly acid (pH 6.5)

BA 20-40(cm) : Mixed dark brown (10YR4/3) and brown (7.5YR5/6)
sandy loam; medium acid (pH 6.0)

Bt₁ 40-90(cm) : Brown (7.5YR 5/4), sandy loam; medium acid (pH 6.0)

Bt₂ 90-150(cm) : strong brown (7.5YR5/6) slightly gravelly sandy loam;
medium acid (pH 6.0)

2. Mb-gr-slB (Map Bon gravelly subsoil variant)

Ap 0-13(cm) : Mixed dark grayish brown (10YR4/2) and brown (10YR5/3)
sandy loam, medium acid (pH 6.0)

BA 13-45(cm) : Brown (7.5YR5/4), slightly gravelly sandy clay loam;
slightly acid (pH 6.5)

Bt₁ 45-80(cm) : Strong brown (7.5YR 5/6) gravelly sandy clay loam;
slightly acid (pH 6.5)

Bt₂ 80-150(cm) : Yellowish red (5YR5/6) gravelly sandy clay loam;
strongly acid (pH 5.5)

3. Mb-gr-slB (Map Bon gravelly subsoil variant)

Ap 0-18(cm) : Dark brown (10YR4/3) sandy loam; strongly acid (pH 5.5)

BA 18-35(cm) : Brown (7.5YR5/4) slightly gravelly sandy clay loam;
strongly acid (pH 5.5)

Bt₁ 35-80(cm) : Strong brown (7.5YR5/6) gravelly sandy clay loam;
slightly acid (pH 6.5)

Bt₂ 80-120(cm) : strong brown to yellowish red (7.5YR5/6-5YR5/6) gravelly
sandy clay loam; slightly acid (pH 6.5)

Bt₃ 120-150(cm): Yellowish red (5YR5/6) gravelly sandy clay loam;
medium acid (pH 6.0)

4. Mb-gr-s1B (Map Bon gravelly subsoil variant)

Ap 0-24(cm) : Dark brown (10YR4/3) sandy loam; slightly acid (pH 5.5)

BA 24-40(cm) : Brown (7.5YR5/4) gravelly sandy clay loam; medium acid
(pH 6.0)

Bt₁ 40-90(cm) : Strong brown (7.5YR5/8) gravelly sandy clay loam; medium
acid (pH 6.0)

Bt₂ 90-150(cm) : Yellowish red (5YR5/6) gravelly sandy clay loam;
medium acid (pH 6.0)

5. Mb-gr-s1B (Map Bon gravelly subsoil variant)

Ap 0-20(cm) : Dark brown (10YR3/3) sandy loam; medium acid (pH 6.0)

BA 20-40(cm) : Brown (7.5YR5/4) gravelly sandy loam; medium acid
(pH 6.0)

Bt₁ 40-80(cm) : Strong brown (7.5YR5/6) gravelly sandy clay loam;
slightly acid (pH 6.5)

Bt_e 80-150(cm) : Strong brown to yellowish re (7.5YR5/8-5YR5/6)
gravelly sandy clay loam; strongly acid (pH 5.5)

6. Mb-hb-gr-slb (Map Bon hibg base gravelly subsoil variant)

Ap 0-5(cm) : Dark brown (10YR4/3) sandy loam; medium acid (pH 6.0)

BA 5-35(cm) : Brown (7.5YR5/4) gravelly sandy clay loam; slightly
acid (pH 6.5)

Bt₁ 35-90(cm) : Strong brown (7.5YR5/8) gravelly sandy clay loam;
slightly acid (pH 6.5)

Bt_e 90-150(cm) : Yellowish red (5YR5/6) gravelly sandy clay loam;
slightly acid (pH 6.5)

Mr. Sutham S.
17

(2) Meteorological data

①. Rayong DLD station (1983~1987)

Rayong Province
Land Development Station
(1983)

(MM)

DATE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DATE
1								12.8	8.4		52.0		1
2								19.0					2
3					14.3			6.3					3
4								12.5	41.0	34.0			4
5					57.8						38.9		5
6						7.0	4.3				6.6		6
7			5.9				13.6	1.9	5.3				7
8						3.7		7.9	6.3		17.9		8
9					25.0					36.5	37.4		9
10							3.8		18.1	5.5	58.3		10
11			8.4						3.7	18.6			11
12										28.8	15.4		12
13						19.3				45.5			13
14							13.6		57.5		16.3		14
15							2.3	19.0		19.0	33.9		15
16							13.4						16
17										8.1			17
18							17.1		14.3	119.1			18
19							41.3	27.7		4.5			19
20									5.2	1.2			20
21													21
22										7.2			22
23							28.2		25.8	33.6			23
24							24.9		4.8	8.5			24
25					66.0	2.2	27.0	2.2	98.7				25
26					28.7				34.0	1.4			26
27			1.6		18.4	1.9	6.2	6.0	24.3				27
28					10.3	1.0	22.7		11.8	5.0			28
29					23.5	4.0	28.2		15.5				29
30			1.2		7.6	1.7	1.7	127.3					30
31					47.6			52.4					31
TOTAL	0.0	0.0	17.1	0.0	299.2	40.8	248.3	295.0	374.7	376.5	276.7	0.0	TOTAL
TOTAL FOR YEAR	1 MO.	2 MO.	3 MO.	4 MO.	5 MO.	6 MO.	7 MO.	8 MO.	9 MO.	10 MO.	11 MO.	YEAR	
	0.0	0.0	17.1	17.1	316.3	357.1	605.4	900.4	1275.1	1651.6	1928.3	1928.3	
DAYS	0	0	4	0	10	8	15	12	16	16	9	0	DAYS

Rayong Province
Land Development Station
(1984)

(MM)

DATE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DATE
1										3.0			1
2									4.2	1.0			2
3													3
4							4.3						4
5						63.2							5
6						27.5		16.7	9.8				6
7					22.8	37.7	1.1		30.3				7
8								7.0	8.5	21.9			8
9					24.0								9
10													10
11									8.3				11
12						17.0			26.4	10.0			12
13					8.3				10.6	32.2			13
14									16.0	1.7			14
15										7.8			15
16						1.8				1.6			16
17						17.8	5.0						17
18					37.8	21.8				12.6			18
19						9.0	7.8	1.3	25.5				19
20				47.6			7.0						20
21						49.2	5.1						21
22				13.8									22
23				9.0					2.2				23
24													24
25				10.4									25
26				12.4	1.2								26
27													27
28				16.6					55.7				28
29				1.4									29
30				2.6				2.2	39.3				30
31								4.1					31
TOTAL	0.0	0.0	0.0	113.8	94.1	245.0	30.3	31.3	236.8	91.8	0.0	0.0	TOTAL
TOTAL FOR YEAR	0.0	0.0	0.0	113.8	207.9	452.9	483.2	514.5	751.3	843.1	843.1	843.1	YEAR
DAYS	0	0	0	8	5	9	6	5	12	9	0	0	DAYS

Rayong Province
Land Development Station
(1985)

(MM)

DATE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DATE
1			38.2					5.7		8.3			1
2													2
3										10.0			3
4						6.8							4
5						9.9							5
6			1.3										6
7			1.9										7
8										8.0			8
9							3.2						9
10					4.5				20.0				10
11					3.7		10.2		4.5				11
12							16.2			35.0			12
13						17.9				28.3	3.3		13
14					1.2					16.2	10.0		14
15					10.0				3.7				15
16					38.1				17.6				16
17						9.5			29.3	10.4			17
18				6.8	21.8		24.8		11.1				18
19									16.6				19
20				11.7					57.5				20
21				64.9					20.0				21
22		1.2		19.6			6.3		14.8				22
23		2.2							16.5	10.0			23
24					20.0	5.5		3.0	9.9				24
25	6.6	39.1	2.6		74.4	6.5			14.7				25
26									15.2	10.0			26
27	8.7				12.8				28.4	9.1			27
28		3.3		57.2	26.2				6.5				28
29				13.6	3.9				3.4				29
30				2.6	9.4								30
31			8.4										31
TOTAL	15.3	45.8	52.4	176.4	226.0	44.1	72.7	5.7	268.1	169.9	13.3	0.0	TOTAL
TOTAL FOR YEAR	15.3	61.1	113.5	289.9	515.9	560.0	632.7	638.4	906.5	1076.4	1089.7	1089.7	
DAYS	2	4	5	7	12	4	7	1	16	12	2	0	DAYS

Rayong Province
Land Development Station
(1986)

(MM)

DATE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DATE
1										11.0			1
2							5.6	4.0		15.0			2
3							6.0			1.0		1.0	3
4								2.0		10.0			4
5						18.9		2.0		2.0	2.0		5
6							5.5	1.0		53.0			6
7					14.9				8.2	8.0			7
8					123.0				17.9	6.9			8
9					5.0				30.0	12.0			9
10				2.0				4.5	7.6				10
11				7.0			1.0		9.1	10.0			11
12				12.4	11.8				5.0	2.0		3.0	12
13				2.2		3.0	6.0	7.5	13.0	13.0	13.0		13
14				13.0		1.0		4.0			7.0		14
15								18.0		5.0			15
16						2.0		7.7		2.0	1.0		16
17							24.0	10.0		9.0			17
18							4.0			5.0			18
19						2.0	3.8	14.0	62.8	14.0			19
20						16.3	13.0	15.4	41.5	15.4			20
21						1.6	45.0						21
22					18.0	6.2	10.0		57.5				22
23							13.8			27.0			23
24						1.0	1.0		1.5	2.0			24
25							56.0	27.0	19.9	1.0			25
26							1.0	1.0		17.8			26
27				4.0		5.3	1.6						27
28				5.5									28
29				1.7		1.0		28.8		28.8			29
30				10.0						1.0			30
31													31
TOTAL	0.0	0.0	0.0	57.8	172.7	58.3	197.3	146.9	274.0	271.9	23.0	4.0	TOTAL
TOTAL FOR YEAR	0.0	0.0	0.0	57.8	230.5	288.8	486.1	633.0	907.0	1178.9	1201.9	1205.9	
DAYS	0	0	0	9	5	11	16	15	12	24	4	2	DAYS

Rayong Province
Land Development Station
(1987)

(MM)

DATE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DATE
1			1.4		1.3			2.0		2.0	1.0		1
2								11.0		32.0	3.0		2
3			6.7			2.4		2.0		27.0	17.0		3
4						5.2				1.0			4
5			5.3		69.3	29.0	13.0		1.00	2.0	14.0		5
6					16.3	8.3			16.00	1.0	8.0		6
7						9.4			13.00		5.0		7
8						16.0	9.0			2.0	5.0		8
9										14.0	7.0		9
10			2.0			12.3		2.0	2.00	19.0			10
11								2.0	4.00	1.0	2.0		11
12						33.9		5.0	1.00	15.0	2.0		12
13						16.5				4.0	7.0		13
14					79.3						2.0		14
15					14.5					7.0			15
16						3.0		15.0	30.00	53.0			16
17									15.00	3.0			17
18								9.0	33.00		2.0		18
19						8.4		3.0	29.00		1.0		19
20						2.5			4.00				20
21						32.3		12.0		9.0			21
22									30.00	19.0	5.0		22
23									9.00	11.0			23
24								13.0	4.00				24
25						1.9		10.0	12.00				25
26								2.0	17.45				26
27									22.08				27
28									20.70		1.0		28
29				5.5	33.1				24.91	9.0	4.0		29
30					7.2				17.79				30
31										1.0			31
TOTAL	0.0	0.0	15.4	5.5	221.0	181.1	22.0	88.0	305.93	232.0	86.0	0.0	TOTAL
TOTAL FOR YEAR	1 MO.	2 MO.	3 MO.	4 MO.	5 MO.	6 MO.	7 MO.	8 MO.	9 MO.	10 MO.	11 MO.	YEAR	
	0.0	0.0	15.4	20.9	241.9	423.0	445.0	533.0	838.93	1070.9	1156.9	1156.93	
DAYS	0	0	4	1	7	14	2	13	20	20	17	0	DAYS

② Agri. Meteo. Sta. (1983~1992)

(単位: mm)

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
JAN	0.3	0.0	21.5	0.0	0.0	0.0	140.5	33.8	0.9	31.1
FEB	0.0	10.9	56.5	11.5	38.1	105.5	138.2	2.0	40.8	5.5
MAR	72.6	22.8	52.7	0.7	12.7	9.4	64.0	61.6	21.4	0.0
APR	1.5	50.1	148.6	71.2	63.7	121.6	72.4	14.7	144.8	51.9
MAY	123.1	91.3	318.8	223.5	134.2	240.6	57.8	154.5	191.3	18.5
JUN	36.6	200.4	100.6	47.1	211.4	96.9	39.3	38.7	123.2	190.8
JUL	179.1	125.3	133.8	126.1	49.8	320.7	76.7	31.1	150.5	407.8
AUG	418.7	38.4	98.3	69.0	126.6	225.6	131.6	82.2	59.3	155.6
SEP	400.0	252.6	151.0	197.6	229.7	376.1	208.1	222.7	151.2	142.0
OCT	381.9	202.2	281.5	215.3	341.9	291.6	284.6	230.5	304.5	325.1
NOV	386.3	52.7	84.8	54.8	188.0	12.3	36.3	31.8	0.0	20.4
DEC	20.6	0.0	0.0	0.0	0.0	0.0	4.5	2.4	0.1	10.5
YEAR	2020.7	1046.7	1448.1	1016.8	1396.0	1800.3	1254.0	906.0	1188.0	1359.2

(3) Necessity of the 17 test plots

IN THE EXPERIMENTAL FARM ON THE MODEL INFRASTRUCTURE CONSTRUCTION PROJECT FOR THE EAST THAILAND AGRICULTURAL LAND CONSERVATION PLAN

1. PURPOSE BEHIND ESTABLISHMENT OF EROSION PLOTS

The East Thailand Agricultural Land Conservation Plan Project was introduced to determine quantitatively with the use of erosion plots the agricultural land conservation effects of predetermined agricultural and engineering techniques. Therefore, when planning agricultural land conservation projects individually developed by DLD, it is possible to confirm the techniques to examine concretely combinations of agricultural land conservation technologies.

When planning agricultural land conservation projects, Point (3) is applicable.

- (1) Determination of Soil Loss Conditions
- (2) Establishment of Design Soil Loss
- (3) Examination of Necessary Agricultural and Engineering Prevention Measures for Effective Design
- (4) Calculation of Project Cost Estimates
- (5) Calculation of Economic Effects

The purpose of this project is to use erosion plots for concrete techniques (experimental and analysis techniques etc.), and to transfer the technologies to DLD's counterparts by drawing up test manuals and conducting on-the-job training, so that DLD can determine quantitatively the effects of each agricultural land conservation project.

2. EXPERIMENTAL PURPOSE FOR EACH EROSION PLOT

In line with the above, experimental verification of the erosion plots to demonstrate numerically the effects of agricultural and engineering measures for practical agricultural land conservation projects in East Thailand, based on the USLE, will be conducted in this project.

The contents of this experimental verification are as follows.

(1) Confirmation of Soil Erodibility in the Test Area (Uncultivated)

- 1) Standard Test
- 2) Representative Slope

(2) Soil Erosion under Traditional Agricultural Techniques (Single Crop Cassava (Tapioca))

(3) Agricultural Measures (Cassava + Cover Crop): Intercropping

(4) Engineering Measures

- 1) Contour Terracing
- 2) Deep Plowing
- 3) Covered Underdrain

(1) Standard Test Plots (6 Plots)

Experiments conducted on uncultivated ground to confirm the soil erodibility on the test plots.

The Japanese Ministry of Agriculture, Forestry and Fisheries, with tests carried out to determine standard design criteria for agricultural land reclamation, has obtained soil erodibility data from a total of 9 test plots, 3 each at slopes of 3°, 7° and 10°. However the slope of the original test plots in the USLE experiments was 9°, and as the average slope in East Thailand is 5°, tests were conducted on 3 plots each at these two slopes, a total of 6 plots.

1) 9° Test Plots

To discuss soil erodibility numerically as one factor in the USLE, comparison is easy when using the same plot design with the same slope as in the original experiments. Furthermore, soil erodibility may be obtained numerically from the soil loss. The number of 9° slope test plots is less than in the Ministry of Agriculture, Forestry and Fisheries tests and therefore a 9° slope was employed.

2) 5° Test Plots

The slope of the fields in East Thailand are between 3° and 10°, with an average of about 5°, and therefore this slope was used as a representative ground slope for the

region to determine the basic soil loss. It should be compared with the 9° test plots. For the reasons above, all the other test plots will be at 5° slopes and it will be necessary to form standard test plots at 5° slopes.

These tests are a basis for determining the basic numerical values for all the tests, and therefore a minimum of three test plots should be established.

From the results of investigations, there is a wide distribution of soil characteristics in East Thailand, and the soil at the test site is said to be representative of that in actual projects.

(2) Traditional Agricultural Techniques (2 Plots)

For comparison with the other measures, soil loss tests will be carried out on a single crop of cassava, traditionally the most commonly seen cultivation method by the farmers. Other single crops were also examined, but with the purpose of the tests as stated above, they should be limited to the single crop of cassava, it being the most common problem.

Traditionally, cassava is planted either at the beginning or the end of the rainy season, and therefore 2 plots were selected.

For these plots, the quantity grown (percentage of cover), soil loss, surface discharge and soil water content will be measured, and the soil loss and soil water content retention will be determined for traditional agricultural techniques.

(3) Agricultural Measures (4 Plots)

Every kind of agricultural measure was considered, but on this project the following measures were recommended.

- (1) Fruit Trees
- (2) Contour Planting
- (3) Intercropping

As growing fruit trees would take a long time, they were excluded from these tests.

For the intercropping beans will be planted (it is necessary to have a cash crop for propagation), and there will be verification tests for the contour planting.

Based on this, the recommended crops were examined and four kinds of beans will be planted with the cassava. The quantity grown (percentage of cover), soil loss, surface discharge and soil water content will be measured, and the soil loss prevention and soil water content retention effects will be determined for the intercropping .

(4) Engineering Measures (5 Plots)

It is considered possible to implement the following engineering measures at a farm level.

(1) Contour Terracing

(2) Deep Plowing

(3) Covered Underdrain

Even combined they will be considered at a minimum level; five plots with a length of 44.2 m (22.1 m x 2), twice the length of the standard plots, will be established. The soil loss, surface discharge and soil water content will be measured, and the effects of each technique will be determined.

1) Plot 1 (5 m x 44.2 m, 5%: Uncultivated)

Together with Plot 2, the soil loss and the surface discharge will be measured, and the soil loss prevention effects of the contour terracing will be determined.

2) Plot 2 (5 m x 22.1 m x 2, 5%: Uncultivated)

The soil loss and the surface discharge will be measured, and the soil loss prevention effects of the contour terracing will be determined.

3) Plot 3 (5 m x 44.2 m, 5%: Deep Plowing)

The soil loss, surface discharge and soil water content will be measured, and the soil loss prevention and soil water content retention effects of the deep plowing will be determined.

4) Plot 4 (5 m x 22.1 m x 2, 5%: Deep Plowing)

The soil loss, surface discharge and soil water content will be measured, and the soil loss prevention and soil water content retention effects of deep plowing and contour terracing will be determined.

5) Plot 5 (5 m x 22.1 m x 2, 5%: Covered Underdrain)

The soil loss, surface discharge and soil water content will be measured, and the soil loss prevention and soil water content retention effects of covered underdrains and contour terracing will be determined.

Having established the 17 plots above, a comparison of the soil losses will be conducted and, as stated before, with the focus on verification for practical implementation of the measures, combination of the test conditions (plot numbers) should be minimized. In addition reiteration of the test plots will not be carried out except for the standard test where the basic test will be conducted.

JICA