

PART 6 FARMLAND PREPARATION

6-01 SCOPE

The farmland preparation involves such kinds of construction works as earth works and concrete works in connection with the construction of land shaping, land levelling, farm roads, irrigation and drainage canals and appurtenant structures. Earth works for the land preparation such as open excavation, foundation preparation, earth fill and backfill shall be performed by the Contractor in accordance with the Specifications indicated in PART 4 and PART 5 and concrete works for the farmland preparation such as pavement and placing of concrete shall be carried out by the Contractor based on the Specification described in PART 7. Accordingly, the Specifications contained in this part prescribe the rules and other matters, to which special attention shall be given by the Contractor in carrying out the Construction work for farmland preparation.

6-02 GENERAL

(a) Preparation for Construction

Prior to commencement of construction work for farmland preparation, attention shall be given to interception of excess rain water draining in from out-side of the experimental farm so that the construction works for farmland preparation can be executed under almost dry conditions.

(b) Procedure of Construction Work

Construction work for farmland preparation should commence with land levelling including land shaping firstly and continue in due course with the work of farm road, irrigation canal and drainage canal.

6-03 LAND SHAPING AND LAND LEVELLING

(a) Land Levelling

The construction of land levelling including land shaping shall be prosecuted by taking the following procedure, as a standard type of the construction for land levelling.

Cut and earth fill -- Land Levelling - Land Shaping.

(b) Exclusion of Water Accumulated

In the event of water accumulating in a depression or water standing in an existing drainage channel, the Contractor shall be responsible for dewatering the depression as well as the existing drainage channel so that the earth fill for both the depression and the existing drainage channel may be carried out under suitably dry conditions, by draining all water during the process of the construction until its completion.

(c) Cut and Fill

The earth materials necessary for filling of lower land to be elevated shall be provided from those excavated from higher land within the experimental farm. For formulating the land levelling,

the elevation of each plot in the experimental farm after a completion of the land levelling, has been decided such that the volume of earth materials necessary for filling will be well-balanced, as a whole, with those to be excavated.

(d) Prevention of Settlement

The special care shall be taken in filling works where settlement of the embankment may be anticipated in order to keep any such settlement as small as possible. The Contractor must pay special attention to filling works in depressions as well as where the depth of fill will be comparatively high.

(e) Tolerance

Unless otherwise specified, no point of the finished surface shall be more than +/-5.0 cm from the mean level in the plot of the experimental farm. The deviation of graded surfaces will be generally measured and determined by readings on 15 m to 30 m grids covering the whole land levelling unit.

(f) Final Arrangement of Land

The arrangement of land for each plot in the experimental farm shall be finished to the lines and grades shown in the drawings so as not to disturb the cultivation of the experimental field.

6-04 EMBANKMENT FOR IRRIGATION CANALS AND FARM ROADS

- (a) As far as practicable, as determined by the Engineer, filling materials shall be used from required excavation for canals and structures or excess materials from farmland. If these materials are not suitable for filling or where use of such materials is not practicable, as determined by the Engineer, the Contractor shall furnish laterite as filling materials from a borrow pit area approved by the Engineer. The materials for filling shall be free from any stumps, bushes, weeds, roots, clods and any matter that may decay. The embankment shall be constructed to the width and side slopes as shown on the Drawings. Unless otherwise specified, ten (10) percent of extra filling to embankment height shall be made.
- (b) Before the material for the first layer of the embankment is placed the foundation for the embankment shall be prepared as provided in Clause 4-05 hereof and shall be moistened or dried and compacted in the manner hereinafter specified for compacted embankment to be placed thereon. The material shall be deposited in horizontal layers, and the thickness of each horizontal layer after compaction shall not be more than 20 cm. The excavation and placing operation shall be such that the materials when compacted will be blended sufficiently to secure the highest practicable unit weight and best impermeability and stability. If the surface of any compacted layer of embankment is too dry or smooth to bond properly with the layer of material to be placed thereon, it shall be moistened and/or scarified in an approved manner to provide a satisfactory bonding surface before the next succeeding layer is placed.
- (c) Prior to and during compaction operations the material shall not have a moisture content of greater than 5% above or below optimum moisture content as determined by the Engineer, such moisture content being defined as "The moisture content which will result in the maximum dry

unit weight of the soil when subjected to the Protector Compaction Test" (JIS A-1210).

- (d) Insofar as practicable as determined by the Engineer, moistening of the material shall be performed at the site of stockpiles but such moistening shall be supplemented by sprinkling at the time of compaction, if necessary. If the moisture content is less than optimum for compaction by more than 5% or greater than optimum for compaction by more than 5%, the operation shall not proceed, except with the specific approval of the Engineer, until the material has been wetted or allowed to dry out, as may be required, to obtain optimum moisture content within the tolerance permitted above.
- (e) When the materials have been conditioned as above specified, they shall be compacted by soil compactors or by mechanical tampers which shall be subject to the approval of the Engineer. Where mechanical tampers are used to compact soils in confined areas, they shall be equipped with suitably shaped heads to obtain the required density. Prior to commencement of embankment work, compacting equipment to be used shall be approved by the Engineer.
- (f) The dry density of the soil in the compacted material shall not be less than 95% of the maximum dry density as determined by the Standard Protector Compaction Test (JIS A-1210) for the material being compacted.

6-05 EXCAVATION FOR IRRIGATION AND DRAINAGE CANALS

Excavation for irrigation and drainage canals shall generally be carried out in accordance with Clause 4-02 hereof, and excavation is to be executed in such a manner as to ensure that the side slopes, as shown on the Drawings, are not in any way endangered by undercutting. The Contractor may propose slight modifications to the side slopes of drainage canals shown on the Drawings provided that the sectional area of the canal is maintained and the proposed slope is stable.

6-06 CONCRETE LINING ON IRRIGATION CANALS

(a) Materials

For the portions and lengths shown on the Drawings, irrigation canals shall be lined with whichever plain concrete or precast concrete units including concrete bricks approved by the Engineer. The concrete used shall be specified in Part 7.

(b) Placing the Lining

The concrete shall be placed and spread directly on the subgrade, and shall be screeded to the specified thickness. Any groove exceeding 1.5 mm in depth shall be smoothed by an approved float or belting or burlap drag. The finished surface shall conform to the lines, grades and cross sections shown on the Drawings.

6-07 GRAVEL PAVEMENT FOR FARM ROAD

(a) Material

Materials for road pavement shall be graded gravel consisting of a natural mixture of hard, durable particles of coarse aggregate, sand and silt. The materials shall be relatively free from soft particles and excess clay, and shall be uniformly graded so that they can be

compacted into a hard and dense mass. Unless otherwise approved by the Engineer, no particles of greater than 25 millimeters in size shall be included in the materials, and fine materials passing 0.074 millimeters sieve shall not exceed 15% of the material in weight.

(b) Construction

The materials shall be spread longitudinally and compacted separately in uniform layers to produce the correct finished thickness. Care shall be taken to ensure that no segregation occurs. Compaction of the materials shall be made at the moisture content approved by and to the satisfaction of the Engineer. The surface of the metalling shall be formed so that the finished surface is true to line and the level without appreciable irregularity.

6-08 BIRD NET

Bird net shall be subject to the Engineer's approval. The Contractor shall submit to the Engineer, samples of the net prior to commencement of its work for his approval.

Bird net to prevent birds from picking at the rice shall be procured in Nigeria. The mesh size of bird net shall be within 2.0 cm and the thickness of net meshes shall be accordingly thin.

PART 7 CONCRETE WORKS

7-01 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 contraction joints and furnish and place waterstops, joint fillers, and dealing compound, if required; and,
- (d) Prepare, clean, cut, bend and place steel reinforcement.

7-02 CEMENT

(a) General

Cement for mortar and concrete work shall be ordinary Portland Cement which conforms to the requirements of the appropriate Standards for Portland Cement (BS, A.S.T.M. or JIS).

(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 of being damp shall not be used unless otherwise approved by the Engineer.

7-03 FINE AGGREGATE

(a) Composition

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

(b) 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:

1. Grading - Fine aggregate shall be well graded from fine to coarse and the gradation shall conform to the following requirements as delivered to the mixtures:

Nominal Sizes (mm)	Standard Percentage by Weight Passing Individual Sieve
10	100
5	90 - 100
2.5	80 - 100
1.2	50 - 90
0.6	35 - 60
0.3	10 - 30
0.15	0 - 10

In addition to the grading limits shown above, the best modulus shall be in the range from 2.4 to 3.1.

(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.

7-04 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:

Nominal Sizes (mm)	Standard Percentage by Weight Passing Individual Sieve
25	100
20	95 - 100
10	30 - 60
5	0 - 10

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 7-03 (c) for fine aggregates.

7-05 AGGREGATE SAMPLES

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

7-06 WATER

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

7-07 PROPORTIONING OF CONCRETE

- (a) The Contractor shall design the mix proportion for every class of concrete placing for the approval of the Engineer. The Contractor shall carry out the mix test in case being requested by the Engineer. The test is to be made at the expense of the Contractor.
- (b) The compressive strength of the age of 28 days shall be as follows for the desirable mix proportion indicated.

Mixture Type	Min. Compressive Strength at 28 days Age	Max. Size of Aggregates	Max. Water Cement Ratio	Approx. Cement Content
	kg/cm ²	mm	%	kg/m ³
A	210	20	55	320
B	180	20	60	300
C	130	20	80	200

Mixture Type	Application
A	Reinforced concrete for beam, girder, column, etc.
B	Reinforced and plain concrete
C	Levelling concrete

Other proportions for mixed design if necessary may be indicated by the Engineer at the site of work.

7-08 MIXING

- (a) Equipment

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

(b) Measurement

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

(c) Mixing Time and Method

The mixing time of concrete shall be more than two (2) minutes and less than five (5) 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 a reduction in the required mortar content of the mix.

7-09 CONVEYING

(a) General

Concrete shall be conveyed from mixer to 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.

7-10 PLACING

(a) Approval

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

(b) General

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

(c) Cooling of Aggregates

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

(d) Concrete on Earth Foundation

All concrete shall be placed upon clean, damp surfaces 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

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

(f) Consolidation of Concrete

Concrete shall be placed and consolidated with the aid of mechanical vibrating equipment or of hand-spading and tamping. In no case shall vibrators be used to transport concrete inside the forms. In placing concrete through reinforcement, care shall be taken that no segregation of the coarse aggregate occurs.

7-11 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.

(b) Cleaning and Oiling of Forms

At the time concrete is placed in the forms, the surfaces of the forms shall be free from incrustations 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 the 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.

7-12 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, water-saturated 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.

7-13 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.

7-14 STEEL REINFORCEMENT

(a) General

The Contractor shall furnish plain round and deformed steel bar in accordance with the drawings and 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 reasonably 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 of Reinforcement to Concrete Surfaces

The distance from the edge of the main reinforcement to the concrete surface shall be 5 cm except such portion as shown in the drawings. The concrete covering for 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.

7-15 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 such materials, shall be included in the Bill of Quantities.

(c) 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 detailed 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 8 MISCELLANEOUS

8-01 TIMBER WORK

Timber species both for temporary and permanent work shall be the most suitable for each particular purpose, and shall in all cases be thoroughly seasoned, sound, dry, straight and free from saps, shakes, dead knots, dogmarks or other defects. Timber shall be sawn into scantlings not less than one (1) month before use, so that the scantling will be of the specified dimensions after planning and preparing.

Timber for carpentry work shall except as otherwise specified be of the best quality available within the locality, sound, round or sawn square as shown on the Drawings, straight and well seasoned, free from rot, worm, beetle, decayed knot or other defects.

All timber shall be properly stacked and protected from the weather. Timber shall be wrought and prepared for painting unless otherwise specified.

8-02 STOPLOG

The stoplogs required for division box and drainage outlet shall be designed, manufactured and painted by the Contractor as shown on the Drawings or as directed by the Engineer.

Timber to be used for the stoplogs shall be of first class material and shall be as specified in Clause 8-01 hereof. Cutting, smoothing with plane and finishing of the timber work shall be performed by the Contractor as directed by the Engineer.

8-03 PAINTING ON METAL AND TIMBER WORKS

All paints and materials for painting shall be furnished by the Contractor and used in accordance with the manufacturer's recommendation for the particular location where the paints are to be applied. The quality of such paints and materials shall be subject to the Engineer's approval.

Undercoats shall be of distinctive tints and finishing colors are to be approved by the Engineer. Except as required for certain water thinned paints, paints shall be applied only to surface that are thoroughly clean and dry, and only under such combination of humidity and temperature of the atmosphere and of the surface to be painted as will cause evaporation of moisture rather than condensation.

Surfaces, which have been cleaned, pretreated and/or otherwise prepared for painting, shall be primed as soon as practicable after such preparation has been completed, but in any event prior to deterioration of the prepared surface.

Paint shall not be applied to any surface, which is excessively hot for the type of paint used, and freshly painted surface shall be shaded and protected from overheating, until sufficiently hardened, to prevent the occurrence of cracking or blistering.

Painted timber work and metal work shall be lightly rubbed down with glass paper between coats and dusted down. At least 24 hours shall elapse between the application of successive coats, unless otherwise specified by

the manufacturers. On completion of painting, the Contractor shall remove all paint spots and shall touch up or re-paint imperfect work. Painted exterior surfaces shall be protected from the weather, until the paint is thoroughly dry and hard.

Timber work to be painted shall be rubbed down with glass paper, knotted and primed. Any holes, cracks and joints shall then be neatly stopped with putty. Joinery shall be primed before assembly. After stopping, all timber works shall be given undercoat and finishing coat as directed by the Engineer.

Unless otherwise specified, steel and metal work shall receive the following painting treatment.

The surface of steel and metal work, other than steel reinforcement, which is to be encased in concrete or other work, shall have a coat of approved primer applied at the place of manufacture and shall be thoroughly wire brushed to remove any rust immediately before it is built into the work.

8-04 PVC PIPES

The Contractor shall furnish and install polyvinyl chloride pipes (PVC pipes) where shown or indicated on the Drawings or directed by the Engineer. PVC pipes shall be procured from the approved manufacturer and shall have the diameter indicated on the Drawings.

8-05 NET FENCE, GATE AND SIGN BOARD

The area of the facility yard to be prepared shall be enclosed by fencing as shown on the Drawings. Fence shall be constructed with wire net supported on the steel angles and shall have an entrance gate as shown on the Drawings or as directed by the Engineer. The gate shall be double swing type with an opening of 4 m. Sign boards shall be installed at the entrance and corner of each test field as shown on the Drawings or as directed by the Engineer. All the posts and bracing shall securely be set in the concrete foundations. The fence shall be constructed true to line, rigid and without deviations as shown on the Drawings. All steel except the wire net shall be finished with oil paint.

PART 9 ARCHITECTURAL WORKS

9-01 SCOPE

In accordance with the Specifications and as shown on the drawings or otherwise directed by the Engineer, the Contractor shall furnish labor, equipment and materials and perform all operations in connection with the construction of buildings, including earthworks, grading for the houses foundation, concrete works, construction of columns, walls, roof, windows, doors, finishings, electrical facilities, water supply and drainage facilities and other related works and facilities.

9-02 EARTHWORKS

(a) General

Except as otherwise herein provided, earthwork shall be performed in strict accordance with the requirements specified in PART 4 OPEN EXCAVATION AND FOUNDATION PREPARATION and PART 5 BACKFILL AND EARTHFILL.

(b) Site Preparation

The Employer will prepare site clearing prior to the commencement of the construction. The Engineer will determine the ground line for each of the structures at the Site.

(c) Site Clearing and Grading

The Contractor shall be responsible to prepare the facility yard by laterite embankment and shall grade the Site for each structure to an extent of 5 m from the perimeter of each building to the level as directed by the Engineer.

The ground surface where embankment is built shall be cleaned of any vegetation, organic matters, spoil, refuse, standing water and other deleterious matters. Soil to be used for embankment may, in principle, be laterite soil, which shall be obtained from a borrow pit as specified hereafter.

The soil shall be dried or watered as required to have the optimum moisture content to attain maximum consolidation after compaction. The soil shall be placed in continuous horizontal layers of not more than 20 cm and compacted thickness shall extend the full space of embankment.

Each layer of the soil placed shall be well compacted by means of roller or other means approved by the Engineer to achieve at least the same degree of consolidation as the undisturbed ground in the Site.

(d) Excavation

1. Open Excavation

Excavation which is to remain open permanently shall be carried out to the excavation lines shown on the Drawings or to such

other excavation lines as directed by the Engineer, depending on the nature of the ground exposed.

The excavated faces shall be trimmed so that no point of large stone protrudes within the excavation lines and cleaned of any loose pieces of stone. The voids made by removing loose or protruding pieces shall be filled up and compacted to the same quality as the surrounding ground at no extra cost to the Employer.

If the excavation is carried out beyond the lines and levels, the over-excavation shall be filled up in the same manner as prescribed above.

2. Structure Excavation

Excavation to form a foundation for structure, building or the like shall be carried out to the lines necessary to permit the proper construction of the said structures depending on the nature of the ground exposed. The depth of the excavation shall be as shown or to the levels where sound ground to carry the load exerted on the foundation is expected.

During the course of the excavation works, the Contractor shall show the Engineer the exposed ground and obtain his direction on where to set the excavation depth or the approval to proceed to the succeeding works.

The excavated trench or pit shall be kept well drained of storm water or subsoil water until and during backfilling operation. The over-excavation shall be dealt with as specified in "Open Excavation" hereinbefore.

(e) Backfill

Prior to commencement of backfillings, the places shall be cleaned of all temporary facilities, concrete forms, refuse, debris or any other deleterious matters and all embedded structure, pipes, cables and the like shall be inspected and approved by the Engineer.

Soil to be used for backfill may, in principle, be excavated or laterite soil so far as it does not contain any vegetation, organic matters, large fragments or rock, metallic or other harmful refuse.

The soil shall be placed in not more than 30 cm layers evenly spread and each layer shall be well compacted to attain at least the same degree of consolidation as undisturbed soil in the Site. The soil shall be dried or watered as required to have the optimum moisture content to attain the required consolidation. The surface of backfilling after compaction shall have a slightly cambered surface where required to facilitate drainage.

Care shall be exercised on the places adjacent to the structure not to cause damages to them. Compaction on such places shall be carried out by approved hand tools. Unless otherwise specified by the Engineer, backfilling material shall not be placed and compaction shall not be permitted adjacent to concrete for seven (7) days after placing thereof.

(f) Borrow Pits

The Contractor shall obtain good soil for facility yard embankment from borrow pits, in case of an insufficiency of soil suitable for use. The Contractor shall be responsible for selecting suitable borrow pits and for devising and effecting the methods of working them to the approval of the Engineer.

(g) Disposal of Surplus Soil and Refuse

The Contractor shall remove surplus soil from excavations from the Site and deposit these at dumping points approved by the Engineer. The Contractor shall at all times keep the dumped soil in a tidy and self-draining state. Surplus soil shall be disposed of within the Site as directed by the Engineer.

(h) Laying Hardcore

The Contractor shall place hardcore at the locations as shown in the Drawings or directed by the Engineer. Hardcore shall have a grade between 40 mm and 60 mm in size and shall be hard, solid, durable, uncoated rock fragments, free from dirt, mud and organic material.

9-03 CONCRETE, FORM AND REINFORCEMENT WORKS

(a) General

Except as otherwise herein provided, the Work under this Clause shall be performed in strict accordance with requirement specified in PART 7 CONCRETE WORKS.

(b) Levelling Concrete

Mix type for levelling concrete shall be Type C specified in Clause 7-07 thereof.

(c) Reinforced Concrete

Mix type for reinforced concrete shall be Type A specified in Clause 7-07 thereof.

(d) Exposed Surfaces

The finished faces of all concrete work shall be sound, solid and free from honeycombing, protuberance and blemishes. No plastering of imperfect concrete faces shall be allowed and any concrete that is defective in any way is to be cut out and replaced to such depth or be made good in such a manner as directed by the Engineer.

9-04 STRUCTURAL STEEL WORKS

(a) Shop Drawings

The Contractor shall, based upon the Drawings, prepare all necessary shop drawings in large scale showing all necessary details, and submit these to the Engineer for approval. The information and symbols on the drawing may be in accordance with the standards prevailing in Japan, all dimensions and weight shall be in metric system.

(b) Materials

All materials furnished by the Contractor shall be new and shall have the best quality of their respective kinds and shall conform to the standard such as British Standard (BS) or Japan Industrial Standard (JIS). The JIS examples are set out below.

Structural steel	JIS G-3101 (SS41)
Structural steel for welding	JIS G-3106 (Class 1)
Shaped steel	JIS G-3192
Steel deck	JIS G-3352
Steel tube and pipe	JIS G-3444 (Class 2)
Steel square pipe	JIS G-3466 (Class 1)
Light gauge steel	JIS G-3350 (SSC 41)
Steel bolt, nut and washer	JIS G-3101, B-1180, B-1181, G-1256
High tensile bolt, nut and washer	JIS G-1186 (F 10T)
Welding rod	JIS Z-3211, Z-3212

All materials shall be obtained and fabricated at an approved manufacturer.

(c) Workmanship

1. General

Workmanship and finish shall be of first class and equal to the latest practice in modern fabrication and machine shops. Before laying out, cutting or fabricating the Work in any way, the material shall be thoroughly straightened by methods that will not result in injury. Finished members shall be free from kinks, bands or winds.

Shearing shall be accurately done, and all portions of the Work neatly finished. Corners shall be square and true unless otherwise shown on the Drawings. Bends, except for minor details, shall be made by bending rollers. When heating is required, precautions shall be taken to avoid overheating the metal and it shall be allowed to cool in such a manner as not to destroy the original properties of the metal. Steel with welds will not be accepted unless welding is definitely specified on the Drawings or approved by the Engineer. All bolts, nuts and screws shall be tight.

Unless otherwise specifically authorized, deviations of the major dimensions of any structure fabricated of structural steel shall be within 3 mm of the dimensions shown on the Drawings.

2. Welding

Unless otherwise authorized or specified, welding shall be by the electric arc-welding process. Highly important joints and connections which will be heavily stressed in service and all field splices shall be made with special precautions to insure

that such joints are sound and without flaws. The Contractor shall assign to such work, the best welder qualified by pertinent JIS or equivalent standard, or approved by the Engineer. Welding shall be subject to inspection by the Engineer.

3. Unfinished Bolt Connection

Connection by unfinished bolts shall not be used for the structural members which are subject to heavy stresses in service.

4. High Tensile Bolt Connection

Unless otherwise specified or approved by the Engineer, field connection shall be with friction type high tensile bolts. Holes for the bolts shall be not more than 1.5 mm larger than the nominal diameter of the bolt. Deviation of the bolt holes from the alignment shall be adjusted by a mechanical reamer. Adjusting by driving drift pins shall not be permitted.

Friction surface of the members shall be cleaned as specified hereafter and shall be straight, free from warps, bends, dents, etc. The bolt shall be tightened either by torque wrench or impact wrench suitable for the service to the designated torque in JIS. Pneumatic or hydraulic pressure for the tightening equipment shall be kept constant and adjusted whenever required.

Tightening work shall be performed in a suitable sequence and in two steps; temporary tightening and final tightening. The final tightening shall be performed after all alignment of the members has been achieved. After the final tightening work, it shall be tested by the Contractor by a calibrated torque wrench as directed and in the presence of the Engineer. At least 10% of the whole number of bolts shall be tested unless otherwise directed by the Engineer.

(d) Shop Assembly

Full size drawings of the steel members at the shop shall be subject to inspection by the Engineer wherever practicable. Any error, omission, deformity, defect, or the like in the shop assembly work shall be thoroughly corrected and remedied before despatching the steels from the shop. The Contractor shall execute temporary shop erection work wherever reasonably required to satisfy himself with the Work.

The steel members shall be properly protected and bundled or put in crates for transportation against expected shocks and loads during transportation, loading and unloading.

The steel members shall be assembled in the shop to as large components as possible before despatching as the transportation conditions allow to minimize field connection work. All steel members and assembled components shall be match-marked at the shop to facilitate smooth erection in the field.

(e) Field Assembly and Erection

Any serious damage in the steel members in the opinion of the Engineer found in those delivered to the Site shall be replaced with the new ones immediately without causing delay in field assembly and erection works. Minor damage may be remedied in the field by proper method approved by the Engineer.

The Contractor shall obtain the approval of the Engineer as to the erection method. The Contractor shall, before commencing erection, install all anchor bolts and anchor connections to an accurate alignment and elevation in accordance with details and instructions as shown on the Drawings. The Contractor shall notify the Engineer of the position of alignment, elevation and plumb of all columns and shall have approval by the Engineer, prior to grouting and embedding the base in concrete.

The steel shall be erected true to the alignment shown on the Drawings. Temporary bracings, supports and reinforcement and temporary bolt connection shall be strong enough to carry the load exerted by the dead load of the steel, wind and others. Any misalignment of members shall be brought to the attention of the Engineer for approval of corrective measures.

The Contractor shall be responsible for ensuring that no part of the building structures is subject to erection loads which would in any way damage, or cause permanent distortion to that part or any other part of the structure. The Contractor shall take necessary safety measurements to protect the steels, workmen, equipment, property of not only his but other parties to the satisfaction of the Engineer.

(f) Painting and Cleaning

All metals to be painted shall be cleaned of loose mill scale, loose rust and other foreign matter by approved mechanical means. Oil and grease deposit shall be removed by solvents. Any part of metal to be embedded in concrete and the friction surface for high tensile bolt connection shall not be painted but shall be cleaned in the same manner.

Immediately after fabrication, all ungalvanized steel surfaces, unless otherwise provided in the Specifications, shall be cleaned and one shop coat of approved red lead primer paint shall be applied without delay as recommended by the paint manufacturer. After prime painting at the shop, the final 2 coats of approved oil paint shall be applied to exposed surfaces of metal. The minimum dry thickness of each coat of paint shall be more than 0.038 mm.

9-05 CONCRETE BLOCK MASONRY

(a) Materials

Concrete block shall be concrete masonry units conforming to the requirements of the local standard. The dimensions of the hollow concrete block unit shall be 15 cm x 45 cm x 23 cm (6" x 18" x 9") and 23 cm x 45 cm x 23 cm (9" x 18" x 9") in size as shown on the Drawing.

(b) Masonry Unit Laying

The masonry units shall be laid with 1:5 cement mortar of about 1 cm thick. Reinforcement steel shall be arranged at least per every two units vertically and horizontally.

(c) Lintel

Where openings for doors, windows and others have large widths, reinforced concrete lintels shall be provided in concrete block wall as shown on the Drawings. The lintels shall be extended into the adjacent walls 1.5 times the height of the lintels.

(d) Foundation and Girder

Foundation shall be continuous footing on the base having sufficient bearing capacity. Continuous Girder frame of reinforced concrete shall be provided on top of the masonry.

9-06 PLASTERING WORKS

(a) Cement Mortar

The sand to be used in the cement mortar shall be clean, hard, solid and durable and shall not contain harmful amounts of dust, mud, organic matters or other objectionable matter. The grading of the sand shall be within the following limits:

For rendering coat	Max. granule size	: 5 mm
For tile bed	Max. granule size	: 5 mm
For finishing coat	Max. granule size	: 2.5 mm

The mix proportion of the cement mortar by volume shall be as follows:

For rendering coat	Cement : Sand = 1 : 5
For tile bed	Cement : Sand = 1 : 5
For finishing coat	Cement : Sand = 1 : 5

Lime powder may be mixed in the mortar for finishing coat at 10% of sand by volume.

(b) Waterproof Cement Mortar

Waterproof cement mortar shall be made by mixing a waterproof agent into ordinary cement mortar. The Contractor shall be responsible for selection and quality of the waterproof agent. The mixing and application shall be in accordance with the manufacturer's instructions.

(c) Expanding Grout

As expanding grout shall be used around any pipe or embedded metals passing through a concrete wall where water may stand on one or both sides of the wall and where the pipe or embedded metals are not embedded in the initially constructed structure. The grout shall

expand upon setting to effect bonding of the grout to the main concrete and the pipe or embedded metals. An approved expanding agent shall be mixed in cement mortar conforming to the manufacturer's instructions.

(d) Application

The surfaces which are to receive a rendering coat shall be free from all laitance, scum, loose carbonate scale, loose aggregate, dirt and other foreign matters. In case of cement mortar, concrete block or brick surfaces, they shall be sufficiently and uniformly dampened immediately before the application of mortar. Concrete surfaces shall be kept thoroughly wet for 24 hours prior to the application of mortar. Cement mortar shall be used within 30 minutes from the time of mixing. Retempering shall not be permitted.

The rendering for tile works shall be made 18 mm thick and its surface shall be cross scratched. In case of cement mortar finish, the total thickness of rendering plus finishing coat shall be 25 mm for the floors, exterior walls and interior walls. Cement mortar finish shall be trowel finished unless otherwise specified. When the finishing coat is applied, the entire surface of floor, wall or ceiling shall be finished in one operation in order to minimize joint marks.

The finished surface shall be perfectly plumb or level as the case may be except where otherwise specified without any bulging, runs, bruises or stains. After application of the finishing coat, the surfaces shall be kept continuously damp for not less than 48 hours, and then allowed to become thoroughly dry. Moistening shall be started as soon as the surface has hardened sufficiently not to cause displacement or damage.

9-07 CARPENTRY AND JOINERY WORKS

(a) Materials

Timber shall be of suitable kinds for the purposes and of common grade of each kind which are available locally. Selection of timber shall be subject to the approval of the Engineer.

All timber shall be well-seasoned and shall be free from large knots, flaws, shakes or blemishes of any kind. Timber with loose, rotten or dead knots will not be accepted. Sawn timber shall have the shape and size shown on the Drawings and twisted or warped materials shall not be used.

Timber that splits, shrinks or warps after construction from lack of seasoning, unsoundness or bad workmanship shall be removed. The whole of the timber stored on the Site must be protected from the weather and properly stacked to afford free circulation of air around all faces.

(b) Workmanship

All work, whether factory made or job made, shall be executed by qualified workmen, well skilled in the trade, and shall be strongly, neatly and accurately fitted, framed and finished throughout, in keeping with the best trade practice. All work shall be accurately spiked, nailed, anchored, strapped or bolted, using hardware of ample gauge and length. All finishing lumber shall be secured with

approved quality finishing nails, well and truly set. Running members shall be in the longest lengths attainable, aligned and carefully matched for grain and color.

Mechanical and electrical works shall be checked so that important framing timbers shall not be cut. The wood members shall be properly framed together so that pipe shall run between them. Wood members not to be painted and having direct contact with concrete or cement mortar shall receive a coat of approved wood preservative.

(c) Joinery Works

Fabrication of all joinery works shall comply with the best practice of the trade in the region and the joiner shall ensure that all weatherings and throatings are properly executed. Framed work shall not be wedged or pinned until immediately prior to fixing. Mortise and tenon joints shall be wedged up solid and projecting pins not flushed off until ready for fixing.

Nails shall be punched and puttied, and skirtings, door frames and all other joinery accurately scribed to fit the contours against which they abut. Dimensions for built-in work shall be checked on the building structure, and tolerances shall be provided at connections to compensate for irregularities. The Contractor shall provide and maintain temporary covers as necessary and protect finished work liable to damage.

(d) Wood Doors, Windows, Louvers and Frames

Before fabricating wood doors, louvers and frames, the Contractor shall prepare and submit shop drawings in large scales showing necessary details for approval of the Engineer.

All wood faces exposed to view shall be planned, sanded and putty filled to a smooth surface to receive painting. Frames shall be fixed to the opening in concrete block, or concrete walls using wood wedges, synthetic adhesive, nails and clamps as required.

Wood doors shall be of flush swing door having 40 mm thick, or top-railed sliding door, as shown on the Drawings. The flush door and sliding door shall be finished either with water resistant type plywood, 4 mm thick. The plywood shall be of single piece.

(e) Finish Hardware

The Contractor shall supply and install all necessary hardwares for doors as specified below. Samples or catalogues of all hardwares shall be submitted to the Engineer for approval.

The hardwares shall comply with the following requirements:

- Hinges : Bronze or steel heavy butt hinges, minimum 10 cm long, 3 pieces for each door leaf
- Knobs : Stainless steel or chromium plated bronze
- Lock sets : Bronze, cylindrical lock, with 2 sets of key
- Door bolts : Bronze, surface or flush type
- Door stops : Wall or floor mounted type with rubber bumper and

holder

Door closer : Rack and pinion type, oil or spring activated with 90° or 180° with stop device

The Contractor shall supply master key sets for groups of the key sets as directed by the Engineer.

9-08 METAL DOORS, WINDOWS AND FRAMES WORKS

(a) Materials

Materials for all doors and frames shall be free from defects impairing their strength, durability or appearance and shall be the best of their respective kinds. They shall be made to sustain safely strains or stresses to which they may normally be subjected.

(b) Shop Drawings

The Contractor shall submit shop drawings of all works for approval of the Engineer. He shall carefully verify all dimensions at the Site so that proper adjustments can be made. Shop drawings shall show in large scale the details of the various parts indicating the methods of anchoring and securing the Work, its reinforcement, and the schedule listing the quantities of each kind of door and its location.

(c) Priming

All steel work shall be thoroughly cleaned of rust, oil, grease and other impurities and then given one shop coat of a primer.

Parts inaccessible after assembly shall be primed in the shop before assembly. All shop primed surfaces damaged in the field shall be cleaned and reprimed with the same paint.

(d) Steel Door Leaves and Frames

Hollow steel door leaves shall be fabricated from cold rolled sheet steel. The minimum metal thicknesses shall be as follows:

Panel : 1.6 mm

Stile, rail, anchor plates : 2.1 mm

The door leaves shall be full flushed seamless panel, 36 mm thick unless otherwise specified.

Doors shall be mortised and reinforced for hinges, locks and interlocking lockstrips. Doors shall be reinforced for closers and other surface supplied hardware where required.

Door frames shall be formed of cold rolled sheet steel. The minimum metal thickness shall be as follows:

Frame : 1.6 mm

Architrave : 1.2 mm

Threshold, anchor plate : 2.1 mm

The frames shall be blanked, reinforced, drilled and tapped to receive template hinges and lockset strikes. They shall be reinforced for surface mounted closers where required.

All frames shall be prepared with rubber bumpers and all strike and hinge reinforcement shall be protected on all sides. Adjustable anchors shall be provided as required by wall conditions. The frames shall be furnished with a spreader bar attached to the underside of the jambs; where no floor finish occurs to conceal these spread bars, stainless steel channel shall be used, welded to the back of the jambs. Frames shall have weathering strips as shown on the Drawings. The frames shall be extended to accommodate transoms where necessary.

(e) Aluminium Doors, Windows, Louvers and Frames

The Contractor shall obtain the approval of the Engineer on the manufacturer of aluminium doors and windows. Aluminium doors, windows, louvers and frames shall be fabricated of extruded aluminium sections and aluminium plates. Fastening devices such as screws, bolts, nuts, rivets etc. shall be of aluminium or stainless steel. Washers shall be neoprene rubber, aluminium or stainless steel. Insect screen shall be aluminium gunmetal. Sealing materials shall be polysulfide rubber. Glazing bead shall be preformed vinyl spline or equivalent.

All external faces of aluminium shall be applied with peelable protection film or the like before dispatching from the factory. All aluminium faces shall be clear anodized and have a protective coating of clear lacquer having thickness required by an applicable industrial standards.

Where aluminium faces come in contact with steel, masonry, or other materials, they shall be treated with a coat of zinc chromate or alkali-resistant bituminous paint before installation.

(f) Installation

Along the rims of the opening in concrete, brick and concrete block structures for the door, window and louver anchor metals shall be pre-embedded in a proper interval as the work progresses. Before installing the frames of door, the rim of the opening which come in contact with them shall be cleaned of all loose and foreign matters and the pre-embedded anchor metals shall be exposed and extended.

The frames shall be set in place with suitable wedges plumb and true to line and then rigidly fixed to the structure through the fixing lugs. The space between the frame and the structure shall be plugged with cement mortar. Exterior perimeters of the frame shall be sealed with approved calking compound.

After painting works have been completed, all movable parts of the door shall be adjusted to ensure proper fitting and functioning.

(g) Finish Hardware

The Contractor shall supply and install all necessary hardware for doors and windows as shown on the Drawings and as specified below. Samples or catalogues of all hardware shall be submitted to the Engineer for approval.

The hardware shall comply with the following requirements:

Hinges	:	Bronze or stainless steel, minimum 13 cm long, 3 pieces for each door leaf
Knobs and lever handles	:	Stainless steel or chromium plated bronze
Lock sets	:	Bronze, cylindrical lock, with 2 sets of key
Door bolts	:	Bronze, surface or flush type
Door stops	:	Wall or floor mounted type with rubber bumper and holder
Door closer	:	Rack and pinion type, oil or spring activated with 90° or 180° stop device

The Contractor shall supply master key sets for groups of the key sets as directed by the Engineer.

9-09 GLAZING WORKS

(a) Materials

Classes shall be the product of an approved manufacture in Nigeria and shall conform to all respects to BS 952. Glazing compound shall be of elastic type having uniform mixtures of pigment, suitable oils and resinous vehicles. The compound shall have a long lasting plastic qualities. Before delivery, samples of glass and glazing materials shall be submitted to the Engineer for approval.

(b) Glazing

Glass shall be accurately cut to fit in the frames with suitable clearance all around. Unless otherwise specified or approved by the Engineer, glass shall be set in glazing mastic applied on all four sides for the full length and using spacer shims and vinyl setting blocks at intervals recommended by the glass manufacturer except where glazing beads are used. Glass jalousie window shall be applied with steel lattice as shown on the Drawings.

All door and window panes shall be cleaned and polished when building work is completed.

9-10 ROOFING WORKS

Corrugated asbestos cement sheet to be used shall be obtained from an approved manufacturer in Nigeria and shall conform in all respects to BS, having a dimension of 100 x 200 cm and a thickness of not less than 6 mm. Samples of the sheet shall be submitted for approval of the Engineer. The sheets shall be free from smear, cracks, waves, breakage and other defects. Corners shall be cut off to avoid concentration of lapping and holes for fixing bolt shall be drilled on the ground ready for installation.

The sheet shall be laid over steel or wood purlins with an end overlap of 20 cm and side overlap of one corrugation. The sheets on steel structure shall be jointed together and fixed to the purlins with cadmium or zinc coated hook bolts of J-type 6 mm in diameter employing approved plastics washer. The bolt shall not be set in a manner to cause sagging of the sheet by its weight after installation.

Suitable mould sheets to ridge, barge and eaves shall be used where shown on the Drawings or as directed by the Engineer. Finished surfaces shall be uniform, lines of corrugations straight and parallel and the cut off corners shall not be visible.

9-11 PAINTING WORKS

(a) Materials

All painting materials to be used shall be obtained from an approved manufacturer and shall conform in all respects to BS. The Contractor shall submit samples and specifications of all paints to be used to the Engineer for his approval.

(b) Application

All metal surface shall be oil painted unless other paints are specified. All steel components other than galvanized steel shall be prepared and primed in the shop and finish painted after erection.

All metal surfaces to be painted shall, prior to application of paint, be prepared in the following manner:

1. All soil or other foreign matter (other than grease and oil) shall be removed by brushing or scraping;
2. Oil or grease shall be removed by wiping the surface with rags or brushes wetted with an approved solvent;
3. Excessive rust scale shall be removed by hand chipping or by power impact tools;
4. Rough welds and sharp steel edges shall be ground smooth, and all weld spatter shall be removed; and
5. The whole surface shall be cleaned by means of powered steel scrapers or steel brushes.

Immediately after completion of the surface preparation, approved primer shall be applied; two coat for the structural steels and one coat for other steels unless otherwise specified.

All wood surface to receive paint shall be cleaned of all dirt, grease, dust or any other deleterious matters. All surface shall be thoroughly sanded and all nail holes, cracks and any other defects shall be puttied, re-sanded to a smooth and flush finish. The putty shall be colored to match the color of the finish paint.

Painting shall not be done in rain, fog or mist, or at any other time considered unsuitable by the Engineer. All the surrounding works shall be protected in a suitable manner from paint drops and overspray.

Color shall be later designated by the Engineer. The color of primer and each finish coat shall be contrasting in order to clarify the work progress. The finished surface shall show a smooth and uniform finish, free from any stains and shall be uniform in color and shade.

(c) Oil Paint to Steel Surface

Painting shall comprise one coat of anti-corrosive paint and two coats of oil paint. Sufficient time shall be allowed for drying between each new coat.

(d) Oil Paint to Wood Surface

Paints shall be applied in 3 coats including one coat of primer paint. Sufficient time shall be allowed for drying between each new coat.

(e) Vinyl Paint to Exterior Part

The cement plaster shall be left to dry for a minimum period of 3 weeks after application. The waterproof vinyl emulsion paint shall be applied in 3 coats including a primer coat. Minimum 12 hours shall be allowed before application of each successive coat.

(f) Emulsion Paint to Interior Part

The acrylic emulsion paint shall be applied in 3 coats including a primer coat to interior part of testing room and toilet. Minimum 12 hours shall be allowed before application of each successive coat.

9-12 INTERIOR FINISH WORKS

(a) General

In interior finishing materials to be used in ceiling works of testing room and toilet, the followings, unless otherwise directed by the Engineer, shall be obtained from local market in Nigeria:

Asbestos Cement Sheet (conforming to BS 690)

Plywood (conforming to BS 1203)

Ceiling and soffit suspension system shall be constructed of wood, steels or aluminium complete with anchors, hangers, clips, main runners, furring strips, and such other accessories as ceiling trimmings. Main runner shall be provided at intervals of approximately 90 cm, installed with allowance for adequate camber. They shall be designed for ceiling loads of 100 kg/m².

Furring strips shall be provided at intervals of 30 cm or according to the ceiling material manufacturer's requirements. Adequate reinforcing and metal framing shall be provided for mounting the lighting fixtures and ceiling access holes.

Ceiling access holes shall be provided in the rooms as directed by the Engineer. The access hole covers shall match the surrounding ceiling and continuity of the ceiling pattern shall be maintained as much as possible.

The entire suspended ceiling shall be to the level shown on the Drawings with adequate camber and shall not have a deviation in levels and lines more than 3 mm in 4 m.

(b) Asbestos Cement Sheet

The asbestos cement sheets for ceiling and soffit shall be 5 mm thick and fixed to the ceiling suspension frame with flat head screws or nails. Holes for the screws shall be pre-drilled to suit the counter sunk screws. Joints shall be of open joints 5 mm in width, straight and uniform unless otherwise instructed by the Engineer.

(c) Plywood (for Interior Use Only)

The plywood sheets for interior use shall be 4 mm thick and fixed to the ceiling suspension frame with flat head nails. Joints shall be of open joints 4 mm in width, straight and uniform unless otherwise instructed by the Engineer.

PART 10 PLUMBING AND VENTILATING WORKS

10-01 GENERAL

(a) Scope of Work

The work under this Clause shall comprise water supply to the testing room and toilet, waste water and sewage drainage for the field managing house and the washing bay for machinery.

Water will be obtained from water tank lorry and be stored in an underground water tank.

Stored water shall be lifted from the water storage tank to an elevated tank by a small pump unit, and be distributed to each requirement as shown on the Drawings.

Extent of the waste water and sewage drainage work shall be up to the points shown on the Drawings.

Ventilation system shall be provided to maintain adequate quantity of necessary ventilating air for the testing room and toilet in the field managing house.

(b) General

Because of the small scale of the Drawings, it is not possible to indicate all offsets, fittings and accessories that may be required. The Contractor shall carefully investigate the structural and finish conditions affecting all his work and shall arrange such work accordingly.

The general arrangement of the plumbing shall be as indicated. Detailed drawings of proposed departures due to actual field conditions, shop drawings and other causes shall be submitted for approval of the Engineer. Materials and equipment installed in the plumbing system shall be suitable for the pressures and temperatures encountered. Installation shall be as required by applicable British Standard or other authorized standards and specified herein. The installation shall be accomplished by workmen skilled in this type of work.

(c) Cutting and Repairing

The work shall be carefully laid out in advance, and no excessive cutting of construction shall be permitted. Damage to buildings, piping, wiring or equipment as a result of cutting for installation shall be repaired by mechanics skilled in the trade involved at no additional cost to the Employer.

(d) Protection to Fixtures, Materials and Equipment

Pipe openings shall be closed with caps or plugs during installation. Fixtures and equipment shall be tightly covered and protected against dirt, water and chemical or mechanical injury. Upon completion of all work, the fixtures, materials and equipment shall be thoroughly cleaned, adjusted and operated.

(e) Painting

Painting required for pipes, hangers, supports and other iron work in concealed spaces and painting of exposed items shall be as specified in PART 9 Architectural Work hereto.

(f) Types of Fixtures and Fixture Trimmings

Types of fixtures and fixture trimmings specified herein shall be furnished and installed complete with all trimmings and fittings unless otherwise specified under the item.

(g) Excavation, Trenching and Backfilling

Excavating, trenching and backfilling work shall be as specified in PART 9 Architectural Work hereto. Bell holes shall be excavated so that the entire length of the pipe will rest on solid ground.

(h) Floor, Wall and Ceiling Escutcheons

Escutcheons shall, where directed by the Engineer, be provided at finished surfaces where exposed piping, bare or insulated, passes through floor, walls or ceilings. Escutcheons shall be fastened securely to pipe or pipe covering and shall be of chromium-plated iron or chromium-plated brass, either one-piece or split-pattern, held in place by internal spring tension or setscrew.

10-02 PLUMBING AND VENTILATION MATERIALS AND INSTALLATION

(a) General

All pipes, fittings and fixtures shall be of the kind, grade, type and qualities as shown on the Drawings and as indicated by the Engineer. All pipes shall be jointed with fittings compatible with the pipe and of the suitable type for the intended service. Union joints shall be properly provided in piping to allow disassembly of the piping into reasonable length or handling.

Unless otherwise directed by the Engineer, flanges shall be provided for pipes $\phi 75$ mm and larger where differential settlement is not expected. The flanges shall be compatible with and shall have the same rating as the companion flange of the valve or the fittings. Full face rubber gasket shall be provided to all flanged joints.

All piping shall be fitted and assembled to introduce minimum stress to the pipe and fittings. All pipe shall be supported where shown on the Drawings and as required. PVC pipe shall be supported at the spacing recommended by the pipe manufacturer. The same standard of thread shall be used throughout the Work. All piping to be embedded shall be tested and approved by the Engineer prior to being embedded.

Sleeves shall be provided where pipe passes through concrete structure, concrete block or brick structure. The space shall be filled or calked with suitable materials. In case that pipe passes through a wall or floor where watertightness is required, the space shall be filled with yarn and lead or with approved expanding grout.

Cleanout and manhole shall be provided as shown on the Drawings or as directed by the Engineer. All pipes embedded in the ground shall be at the pipe top minimum 30 cm below the grade of the ground where no

heavy traffic is expected and minimum 90 cm below the grade crossing the road and where heavy traffic is expected. Pitch of the pipeline shall comply with the applicable code or regulations or as directed by the Engineer.

Change in pipe diameter shall be made with reducers, and use of bushings will not be allowed.

Exposed piping shall be run parallel with the lines of the building unless otherwise indicated.

Connections between ferrous and nonferrous metallic pipe installed underground shall be made with unions or valve sockets, or as ordered by the Engineer.

(b) Water Supply Pump Unit

Water supply pump unit shall consist of pump, motor, check valve, sluice valve, switch and common base. The capacity of the pump unit shall be shown on the Drawing or as directed by the Engineer.

(c) Pipes

1. PVC Pipes

Polyvinyl chloride pipes shall conform to BS, JIS or Nigerian Standard and shall be laid and jointed in accordance with the manufacturer's instructions and to the Engineer's satisfaction. After the pipes have been laid they shall be left exposed, haunched or surrounded in concrete or covered with soil as required on the Drawings. Soil covering shall be taken carefully enough to prevent damage from stone striking the pipe. Large stones shall be removed from the layer of spoil immediately against the pipe.

2. Galvanized Steel Pipes

Water service pipes shall be of standard weight galvanized screwed and socketed pipe conforming to BS, JIS or Nigerian code.

Screwed joints shall be sealed with an approved graphite compound or with polytetra-fluoroethylene tape applied to the male threads only.

(d) Valves

Gate valves and check valves in $\varnothing 50$ mm and smaller pipe shall be of brass or bronze construction. Valves $\varnothing 65$ mm and larger in the pipeline shall have cast iron body and brass trim. Valves $\varnothing 75$ mm and larger shall be flanged.

Gate valves shall be of solid wedge disk type and shall have rising stem or non-rising stem. Check valves shall be horizontal swing type having a lightweight brass disk. Globe valves shall have replaceable resilient plugs and shall have rising stem. Globe valves for use in regulating flow shall have replaceable seats.

All valves throughout this Clause shall be of the same manufacture in principle.

(e) Unions, Hose Faucets

Unions on ferrous pipe 50 mm in diameter and smaller shall be malleable iron zinc-coated. Unions shall not be concealed in walls, ceilings or partitions. Hose faucets shall be brass or bronze with male inlet threads, hexagon shoulder and hose connection.

(f) Flexible Joints

The flexible joint shall be either of the following:

1. a rubber tube type formed with a flexible reinforced rubber tube with bolted flanges and split backing flanges for attachment to the pipe; and
2. a bellows type formed with copper or stainless steel, activated by internal pressure and retained by flange rings and tension lug bolts.

(g) Plumbing Fixtures

Plumbing fixtures shall be obtained from a reputable supplier and the Contractor shall submit catalogues for approval of the Engineer.

Generally, all fixtures except water closets shall have the water supply above the rim. Angle stops, straight stops, stops integral with the faucets, or concealed type of lock-shield, loose-key pattern stops for supplies shall be furnished and installed with fixtures. Exposed traps and supply pipes for all fixtures and equipment shall be connected to the rough piping systems at the wall, unless otherwise specified under the item. Exposed fixture trimmings and fittings shall be chromium-plated or nickel-plated brass with polished, bright surfaces.

1. Fixture Connections and Support

Where space conditions will not permit standard fittings in conjunction with the cast iron floor flange, special short-radius fittings shall be provided. Connections between earthenware fixtures and flanges on soil pipe shall be made absolutely gastight and watertight with a closet-setting compound or with a neoprene gasket and seal. Bolts shall be equipped with chromium-plated nuts and washers.

Wall-hung fixtures shall be fastened to the wall by through bolts where appearance of the bolts is not objectionable. On solid concrete or masonry where bolting is objectionable, fixtures shall be fastened with machine-bolt expansion shields or stud-type expansion bolts. For concrete block masonry, fixtures shall be fastened with through bolts or toggle bolts as required. Exposed bolt heads in finished areas shall be hexagonal. Exposed nuts shall be chromium-plated hexagonal cap nuts. Washers shall be painted or chromium-plated to match bolt heads or nuts.

2. Connections to Equipment and Fixtures

The supply line to each item of equipment or fixture, except faucets, flush valves, or other control valves which are supplied with an integral stop, shall be equipped with a cutoff valve to enable isolation of the item for repair and

maintenance without interfering with operation of other equipment or fixtures. Supply pipe connecting to fixtures shall be anchored not to move.

(h) Traps

Each fixture, floor drain and piece of equipment requiring connections to the drainage system, except grease interceptors, shall be equipped with a trap. Each trap shall be placed as near the fixture as possible, and no fixture shall be double-trapped. Traps installed on steel pipe or copper tube shall be recess-drainage pattern, or tube type. Traps for acid-resisting waste shall be of the same material as the pipe.

(i) Pipe Cleanouts

Pipe cleanout shall be the same size as the pipe except that cleanout plugs larger than 100 mm will not be required. A cleanout installed in connection with cast iron pipe shall consist of a long-sweep 1/4 bend or one or two 1/8 bends extended to the place indicated. Cleanouts in connection with other pipe, where indicated, shall be T-pattern, 90-degree branch drainage fittings with screw plugs. Cleanout tee branches with screw plug shall be installed at the foot of soil and waste stacks. Cleanout tee branches may be omitted on stacks in single-story buildings with slab-on-grade construction. Cleanouts on pipe concealed in partitions and walls and where installed in finished floors subject to foot traffic shall be provided with chromium plated cast-brass covers secured to plugs.

(j) Pipe Insulation and Coating

Steel pipes for water supply shall be insulated with either of the following with approval of the Engineer:

1. Asphalt with jute;
2. Glass wool cloth impregnated with waterproof insulation compound;
3. Vinyl tape with adhesive;
4. Caulking finish; and
5. Other standardized method.

(k) Pipe Hangers, Inserts and Supports

The Contractor shall submit for approval of the Engineer detailed drawings of the type of inserts, hangers and supports for the piping he proposes to provide.

Inserts shall be installed in correct locations before the concrete is poured.

For steel construction, joists shall be bridged where required to support the expected load.

The location of hangers and supports shall be coordinated with the structural work to assure that structural members will support the intended load.

Hangers and supports shall be provided at intervals specified below, at locations not more than 1.0 m from the ends of each runout and not over 30 cm from each change in direction of piping. Hangers shall be adjustable.

Vertical cast iron and steel pipe shall supported at each floor, or at intervals of not more than 4.5 m and at not more than 2.5 m from end of riser. Horizontal cast iron pipe shall be supported near each hub and hubless joint. Horizontal steel pipe shall be supported at not more than the following intervals:

<u>Pipe dia.</u>	<u>Interval</u>
ø20 - ø25 mm	1.8 m
ø32 - ø40 mm	2.0 m
ø50 - ø80 mm	3.0 m
ø90 - ø150 mm	4.0 m
over ø200 mm	5.0 m

Underground piping shall be laid on a firm bed for its entire length, except where support is otherwise provided.

(l) Painting

All hangers, supports and other iron work shall be painted with one coat anti-corrosive paint and with two coats of synthetic enamel paint. All galvanized steel pipes exposed to view shall be painted with two coats of synthetic enamel paint. Color code shall be as directed by the Engineer.

(m) Testing of Pipelines

The Contractor shall test all pipelines as directed by and in the presence of the Engineer. If the pipe fails in test the Contractor shall repair, replace and retest the piping until accepted by the Engineer. All piping system shall be flushed clean before testing.

The Contractor shall provide all personnel, water and equipment for testing. The cost for the test shall be included in the Contract Price.

1. Pressure Testing of Water Service Pipe

Pipes of each part shall be subject to a hydraulic pressure test of 2 kg/cm². If piping is tested in sections, temporary cap shall be fitted. Each section shall be slowly filled with water, and air inside the pipe shall be carefully expelled. For acceptance, the test pressure shall remain constant for one hour without additional water.

2. Testing of Sewage and Waste Water Pipe

No pipe shall be covered or concealed before it is tested. If any sections of pipelines are tested, the Contractor shall obtain approval of the Engineer. All openings and pipe ends shall be securely plugged and filled up with water up to the top of the highest opening. This water shall remain at the same level for 2 hours.

All pipes shall also be inspected visually to ensure that there is no projections in the pipe and the pipeline is straight and void of abrupt kinks. At least three-quarters of the pipe opening of any sections between manholes shall be visible when viewed from opposite end of the pipe section.

Exposed pipes shall further be subject to a leakage test. Leakage tests shall be made only after a minimum of 24 hours after the pipe has been filled with water. No leakage shall be found for duration of another 2 hours on the pipeline.

3. Cleaning and Adjusting

Equipment, pipes, valves, fittings and fixtures shall be cleaned of grease, metal cuttings and sludge that may have accumulated from operation of the system during the test. Any stoppage, discoloration or other damage to the finish, furnishings or parts of the building, due to the Contractor's failure to properly clean the piping system, shall be repaired by the Contractor without cost to the Employer. Flush valves and automatic control devices shall be adjusted for proper operation.

(n) Water Tank

Two water tanks with manhole covers shall be constructed for water supply.

(o) Septic Tank

Septic tank shall be of factory-assembled aeration type with aeration blower and fiberglass reinforced plastic tank or as approved by the Engineer. The size, aeration treatment capacity and location are as shown on the Drawings or as indicated by the Engineer.

(p) Ventilation and Air Conditioning

The ventilation system for the testing room and toilet shall be of wall mounted exhaust fan and fresh air shall be supplied through wooden louver which made to door.

Air conditioner shall be provided for the testing room as shown on the Drawings or as directed by the Engineer.

PART 11 ELECTRICAL WORKS

11-01 GENERAL

(1) Scope of Work

The work under this Clause shall include the following major work items:

- (a) Generator and Connecting cable;
- (b) General lighting of interior of the building;
- (c) Power supply for convenience outlets;
- (d) Power supply and controls for equipment in plumbing, ventilation facilities and other electric equipment and instruments;
- (e) Grounding systems; and
- (f) Outdoor lighting.

(2) Codes and Standards

All electric equipment, materials and installation shall comply with the requirements of the latest safety codes in British Standard, Industrial Standard of Japan or Nigerian conditions.

(3) Shop Drawings

The Contractor shall prepare the following shop drawings in large scales for approval of the Engineer showing all necessary details of equipment and installation:

- (a) All distribution, control and terminal panels and boxes with complete electrical connection diagram; and
- (b) Other shop drawings as required by the Engineer.

If departures from the Drawing are necessary by the Contractor, details of such departures and the reasons therefor shall be submitted with the drawings. Approval of departures shall be made at no additional cost to the Employer.

(4) Data and Samples

The Contractor shall submit for approval of the Engineer a complete list of materials and equipment which he intends to incorporate in the work including sufficient descriptive materials such as catalogs, cuts, diagrams, performance curves, charts, layout drawings and other data published by the manufacturer to demonstrate conformance to the Specifications and Drawings.

The Contractor shall submit samples of conduit, cables, cabling devices, finish plates, outlet boxes and of any other items as may be required by the Engineer.

(5) Operating and Maintenance Instructions

The Contractor shall submit to the Engineer for approval, as early as possible, before dispatch of the equipment, 6 sets of instruction manuals in English concerning the correct manner of assembling, operating and maintaining the work with special references to any recently developed features.

(6) Coordination

The general arrangement of the equipment and cabling shall be as indicated. Detailed drawings of proposed departures due to actual field conditions or other causes shall be submitted for approval.

The Contractor shall carefully investigate the structural and finish conditions affecting all his work and shall arrange such work accordingly, at no additional cost to the Employer.

(7) Working Stresses and Design

The design, dimensions and materials of all parts shall be such that they will not suffer damage under the most adverse conditions nor result in deflections and vibrations which might adversely affect the operation of the equipment.

All equipment shall be designed to minimize the risk of fire and consequential damage, to prevent ingress of vermin, dust and dirt, and accidental contact with electrically energized or moving parts. The equipment shall be capable of continuous operation with minimum attention and maintenance in the exceptionally severe conditions likely to encounter under a tropical climate.

Suitable structural steel bases or frames shall be provided where necessary to transmit all loads imposed by the various parts of the equipment to the building structures and concrete foundations.

(8) Grounding

All electrical equipment fixtures and fittings shall substantially be grounded. Adequate size of annealed copper conductor shall be used based on the maximum fault grounding current in the circuit.

11-02 WORKMANSHIP

(1) General

All materials shall be new, the best of their respective kinds and of such as are usual and suitable for the work of similar character.

All workmanship shall be of the highest class throughout to ensure smooth and vibration free operation under all possible operating conditions.

(2) Shop Assembly

All items of equipment shall be assembled in the shop prior to dispatch and tests shall be performed by the Contractor, as may be required to demonstrate to the satisfaction of the Engineer for the adequacy of the equipment and its components. All tests shall simulate normal operating conditions as closely as possible. All

dismantled parts shall be properly matchmarked and dowelled to ensure correct assembly in the field.

(3) Welding

All welding shall be done in accordance with the methods approved by the Engineer.

(4) Cutting and Repairing

The work shall be carefully laid out in advance, and no excessive cutting of construction will be permitted. Damage to buildings, piping, wiring, or equipment as a result of cutting for installation shall be repaired by mechanics skilled in the trade involved, at no additional expense to the Employer.

(5) Protection to Fixtures, Materials and Equipment

Conduit openings shall be closed with caps or plugs during installation, and fixtures and equipment shall be tightly covered and protected against dirt, water, and chemical or mechanical injury. Upon completion of all work, the fixtures, materials, and equipment shall be thoroughly cleaned, adjusted, and operated.

(6) Embedded Inserts and Supports

The Contractor shall design, supply and install support system for his equipment and materials. The Contractor shall design the support system to distribute concentrated loads to the insert capacity and shall supply the clamping bar used for distributing the load with the support.

(7) Safety Precautions

Prior to any of the work being energized, the Contractor shall be responsible for supplying and fixing in prominent positions near to each item of the work concerned, large multilingual temporary signs giving clear warning of danger in areas which might previously have been regarded as safe.

During erection and commissioning, the Contractor shall provide all temporary scaffolding, ladders, platforms with the boards and handrails essential for safe and convenient access of workmen, inspectors and other authorized persons employed about the work. All dangerous openings or holes in floors shall be provided with handrails or covers.

(8) Protection, Cleaning and Painting

All parts which will ultimately be buried in concrete shall be cleaned and protected before leaving the manufacturer's plant by a cement wash or other approved method. Before being installed, they shall be thoroughly descaled and cleaned of all rust and adherent matter.

All machined parts or bearing surface shall be cleaned and protected from corrosion before leaving the manufacturer's plant by the application of an approved rust preventive lacquer, or a peelable plastic film or grease.

All parts of factory made equipment, other than machined parts and parts applied with coal tar epoxy resin and epoxy resin paints, which will be exposed after erection, shall be thoroughly cleaned and given one coat of best quality primer and two coat of best quality approved finish paint before leaving the manufacturer's plant.

Exposed conduit pipes, pull box, pipe frame and other steel faces shall be painted with one coat of anticorrosive primer and two coats of oil paint.

11-03 ELECTRICAL EQUIPMENT AND MATERIALS (INDOOR)

(1) Lighting Distribution Panel and Power Control Panel

Unless otherwise ordered by the Engineer, panels shall be of dead-front, circuit breaker type and shall be suitable for operation. Circuit breakers shall have one, two, three or four poles, and minimum interrupting rating suitable to each circuit. The panels shall completely be wired and equipped with starters, instruments, protective relays, switches, lamps, etc. as required.

All wiring from hinged door panels to the fixed panels shall be done with flexible conductor of equivalent size. Exposed wiring shall be kept to a minimum but where used shall be formed into compact groups suitably bound together and properly supported.

Terminal blocks shall be mounted inside each panel to terminate all cables to the panel. Cable supports and clamp type terminal lugs shall be provided for all incoming power wiring terminating at each panel. All panel wires shall be marked near each terminal end with circuit or wire designation. These markers shall be of an approved type and permanently attached to the conductor insulation.

Grounding shall be provided on the back side of each panel.

(2) Instruments and Meters

All instruments and meters shall be of approximately 110 mm dial with scale arc of about 240 degrees, and shall be of heavy-duty, industrial type suitable for extreme shock and severe vibration applications. Precision shall be 1.5% of full scale range.

(3) Wires and Cables

(a) Insulated Wires

Unless otherwise directed by the Engineer, insulated wires shall be of 600 V, PVC insulated, single-core, and copper wires where indicated as IV wire. The conductor shall have a minimum sectional area of 2.0 mm².

(b) Cables

Cables indicated as CV cable shall be of 600 V or as approved by the Engineer, cross-linked polyethylene insulated and PVC sheathed copper cables with suitable cable ends. The conductor shall have a minimum sectional area of 2.0 mm² and shall be stranded in 5.5 mm² and larger conductors. Chemicals for anti-termite protection shall be added to the sheath.

(4) Conduits

Conduits shall be of rigid steel conduits. The conduit shall be galvanized inside and outside.

(5) Outlet, Switch and Junction Boxes, and Fittings

The boxes to be concealed in the concrete shall be of galvanized sheet steel and shall be fitted with appropriate covers, where necessary, to set flush with the finished surface of structure. The boxes in the exposed work shall be of galvanized cast steel or alloy fitted with appropriate covers.

(6) Convenience Outlet

Convenience outlet shall be of 3-blade or 4-blade grounded type prevailing in the region for single-phase or three-phase, 250 V, 5 A, 13 A, 30 A located as shown on the Drawings or as required and provided with suitable outlet box and cover plates.

(7) Tumbler Switch

Unless otherwise indicated by the Engineer, wall switches shall be of enclosed flush or surface mounting tumbler type, single-pole, 250 V, 5 A and shall be fully recessed within the box fitted with suitable plates for covering them.

(8) Lighting Fixtures

Lighting fixtures shall be, unless otherwise ordered by the Engineer, complete with lamps and as follows:

- (a) Fluorescent lighting fixtures for A.C. 240 V shall be equipped with ballasts of high power factor and of rapid-start type;
- (b) Incandescent lighting fixtures shall have lamp holders in accordance with Industrial Standard of Japan or the local standards; and
- (c) Mercury lighting fixtures for A.C. 240 V shall be equipped with ballasts of high power factor type.

The lighting fixtures for damp places shall be of moisture-proof type. Outdoor use fixtures shall be of weather-proof type.

11-04 INSTALLATION WORK (INDOOR)

(1) Lighting Fixtures

Exact location and height of fixtures shall be determined by the structural and mechanical limitations of buildings, and fixtures shall be installed in such a manner as to avoid obstructions and to give the proper illumination results. Fixtures shall be installed in such a manner as not to injure outlet boxes, conduit tubes, wall, ceiling, etc. by their weights. Lamps shall be applied after completion of construction work.

(2) Conduit Work

Conduits shall be concealed within or pierced through the structure without effects on their construction and strength. The cut ends of conduit shall be smoothed. Pull boxes shall be provided for the conduit system to give an easy leading in or replacement of the wires. The bending radius of conduit tube shall not be less than 6 times of the diameter.

Exposed runs of conduit shall have saddles or sheet steel supports spaced not more than 1.5 m apart and also shall be supported at least 2 positions. They shall be installed with runs parallel or perpendicular to walls, structural members, or intersections of vertical planes and ceilings, with right-angle turns.

Switch boxes or outlet boxes with appropriate covers shall be installed at the places of switches, convenience outlets and lighting fixtures. When necessary, the Contractor shall relocate outlets so that, when fixtures or other fittings are installed, they will be symmetrically located according to the room layout and will not interfere with other work or equipment.

Conduit shall be installed in such a manner as to insure against trouble from the collection of trapped condensation. U-shaped piping shall be avoided as far as possible. Conduits shall be connected mutually by means of screwed or non-screwed couplings and also shall be securely fastened to all sheet-metal outlet, junction and pull boxes with galvanized lock-nuts and bushings. Conduits in exposed work shall be screwed with boxes and other fittings. Connected portions of conduit system shall be coated with anti-corrosive paint. Exposed runs of conduit including boxes, supports and all other fittings shall be complete with finished paint, of which color will be instructed by the Engineer.

The Contractor shall exercise the necessary precautions to prevent the lodgement of dirt, plaster, trash or damp in conduit tubes, fittings, and boxes during the course of installation. A run of conduit which has become clogged shall be entirely freed of these accumulations or shall be replaced.

All joints and terminations shall comply with the weatherproof or explosion proof requirements as applicable.

(3) Cable Laying

Exposed cables shall be securely fastened along the structure with saddles or other suitable supports spaced not more than 1.5 m apart, but spaced not more than 1 m apart where is likely to contact with persons. Metallic racks and the like shall be installed in cable ducts and shafts for laying, where necessary.

Conduits shall be used where indicated or where the cables may be injured. Cables shall be laid in conduit where they are concealed in the concrete structure to protect the cables and to give an easy replacement thereof. In this case, the bore of conduits shall be not less than 1.5 times against the outside diameter of cables.

The bending radius of cables shall be not less than 5 times of their outside diameter. The cables, when drawn into conduit, shall not be bent more than 2 portions and these bending angles shall not be more than 180° in total.

Cable splicing shall be completely made by means of sleeve jointing, lapped with insulating tape, without increase of electrical resistance, deterioration of insulation strength and decrease of tensile strength. No splices shall be made except within distribution boards, outlet boxes and junction boxes.

Grounding conductors where required to run with other conductors shall run inside the conduit piping.

No oil or grease shall be used for wiring as a lubricant. The interior of conduit system shall be fully cleaned up before wiring.

(4) Switches

Tumbler switches shall not be inserted in neutral lines. Single-pole 3-way switches shall be used where indicated on the Drawings or by the Engineer. The height of switches above floors shall be 1.5 m unless otherwise directed by the Engineer.

(5) Outlets

The Contractor shall study the general building plans in relation to the spaces around each outlet to ensure that this work may fit in with the other work. Whenever necessary, the Contractor shall relocate outlets, under the instructions of the Engineer, so that when fixtures or other fittings are installed they will be sensibly located according to room layout and will not interfere with other equipment installations.

Fixture outlet boxes on plastered ceiling shall be provided with appropriate covers. Pull boxes on the floor shall be furnished with screw-fastened brass or stainless steel covers. Where several feeders pass through a common pull box, they shall be tagged to clearly indicate their electric circuit according to working drawings.

(6) Panelboards

The panelboards shall be mounted in principle so that the height from the floor to the top of panels will not exceed 200 cm.

11-05 OUTDOOR CABLING

(1) Materials and Equipment

Unless otherwise directed by the Engineer, outdoor power distribution cable shall be of 600 V CV-TAZV grade, single or multi-core copper, moisture and heat resistant cross-linked thermosetting polyethylene insulated and thermoplastic sheathed steel tape armored and corrosion-proof type cable with suitable cable ends. Anti-termite chemicals shall be added in the sheath.

(2) Cable Laying

Cables shall be laid in conduits or direct burying as shown on the Drawing. The embedded depth in direct burying system shall not be less than 60 cm below the graded ground face and shall not be less than 120 cm at crossing the road or where heavy traffic is expected. Where cables are concealed in concrete, conduits shall be used for easy replacement of cables. For direct buried cables, backfilled

soil shall be of selected soil or sand which does not contain any harmful materials to the cable, large stone shall be removed from the layer of spoil immediately against the cable.

Markers for underground cables shall be provided at an interval of 20 m, at each change in direction, at each underground entrance and exit from ducts or conduits and at each splice. Markers shall be of concrete having identifying legend on their top to indicate what is underground and direction.

11-06 TESTS

(1) General

The Contractor shall submit to the Engineer for approval the procedure for each test as respectively specified. The procedure shall define the sequence of the tests, the equipment preparation and operation procedures to be followed and the detail procedure for conducting the tests.

(2) Tests

The following tests shall be carried out by the Contractor in the presence of the Engineer at the manufacturer's premises before dispatching and on the Site after the completion of the work at the Contractor's expenses.

(a) Shop Tests

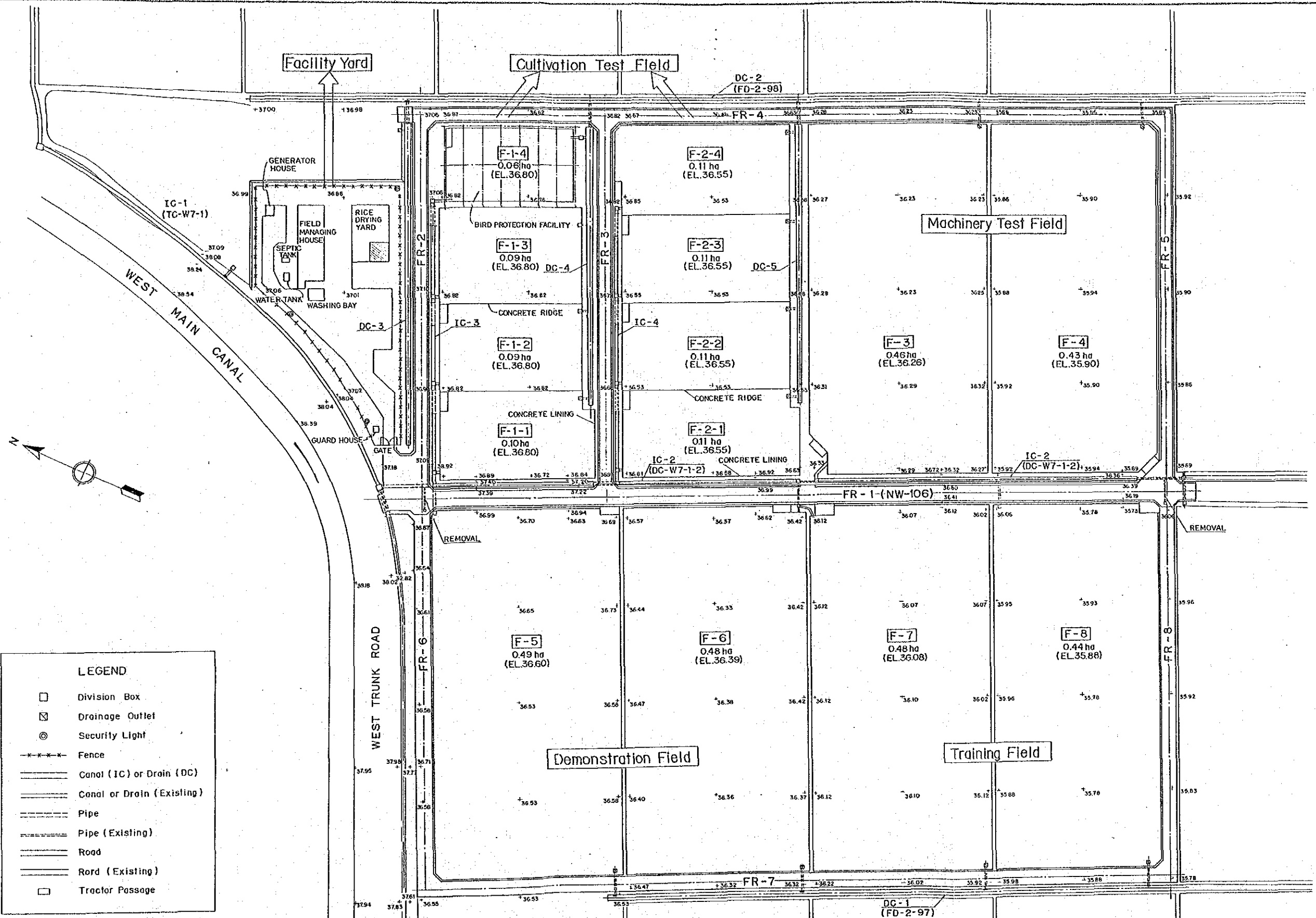
The tests required by applicable standards.

(b) Site Tests

- (1) Operation test,
- (2) Measurement of insulation resistance,
- (3) Setting up of all relays and protective equipment, and
- (4) Circuit contingency tests.

No part of the work shall be considered acceptable until it has successfully complied with these tests to the satisfaction of the Engineer.

CHAPTER 6 DRAWING

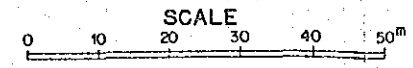


LEGEND	
	Division Box
	Drainage Outlet
	Security Light
	Fence
	Canal (IC) or Drain (DC)
	Canal or Drain (Existing)
	Pipe
	Pipe (Existing)
	Road
	Road (Existing)
	Tractor Passage

Note : Altitude is based on the bench mark (39.066 m) on the turnout TO-W7.

Existing Canals (TC-W7-1, DC-W7-1-2) shall be improved as IC-1 and IC-2.

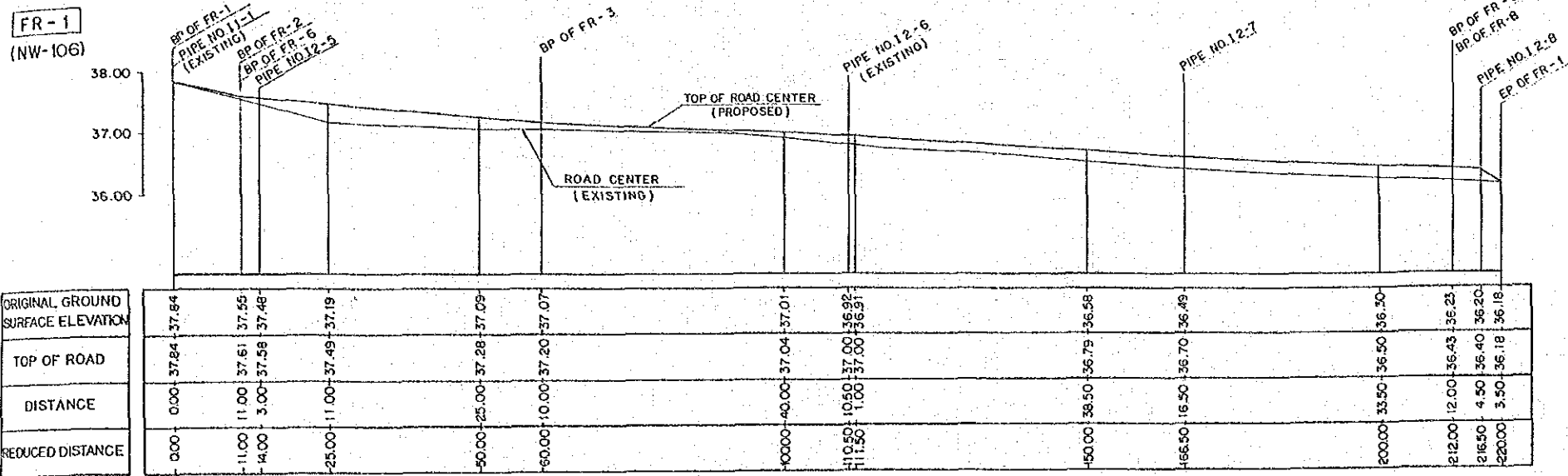
Existing Drains (FD-2-97,98) and Form Road (NW-106) shall be improved as DC-1,2 and FR-1



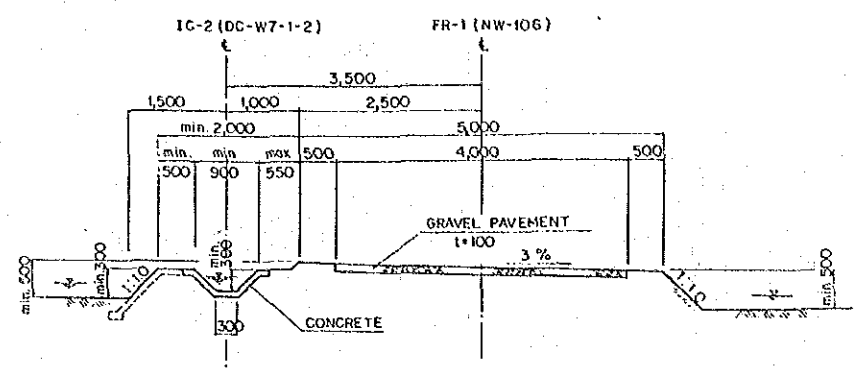
FEDERAL REPUBLIC OF NIGERIA
 THE LOWER ANAMBRA IRRIGATION PROJECT
 MODEL INFRASTRUCTURE IMPROVEMENT WORKS

GENERAL LAYOUT

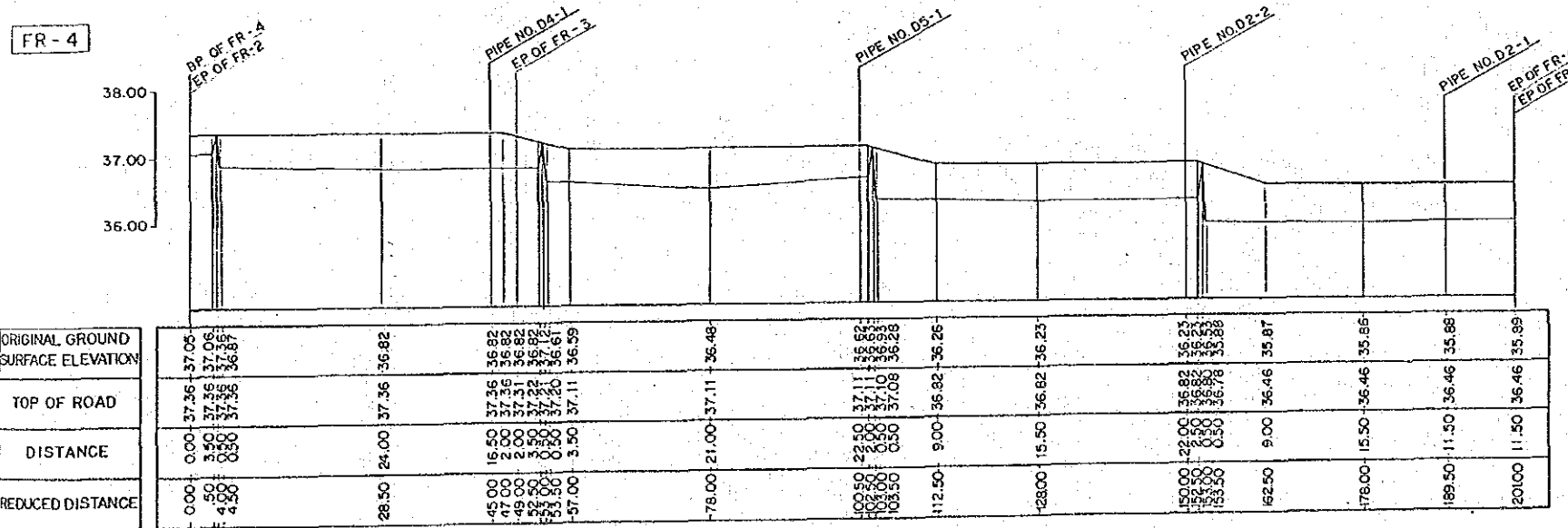
JAPAN INTERNATIONAL COOPERATION AGENCY DWG NO. 1



ORIGINAL GROUND SURFACE ELEVATION	37.84	37.55	37.48	37.19	37.09	37.07	37.04	37.01	36.98	36.79	36.68	36.49	36.30	36.23	36.20	36.18
TOP OF ROAD	37.84	37.61	37.58	37.49	37.28	37.20	37.04	37.01	36.98	36.79	36.68	36.49	36.30	36.23	36.20	36.18
DISTANCE	0.00	11.00	3.00	11.00	25.00	10.00	40.00	10.50	1.00	38.50	16.50	16.50	33.50	12.00	4.50	5.50
REDUCED DISTANCE	0.00	-11.00	-14.00	-25.00	-50.00	-60.00	-100.00	-110.50	-111.50	-150.00	-166.50	-166.50	-200.00	-212.00	-216.50	-220.00

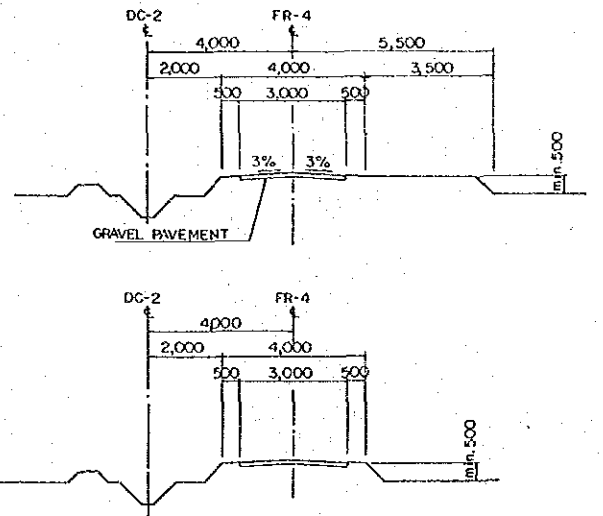


TYPICAL CROSS SECTION OF FARM ROAD FR-1 (TYPE-I)

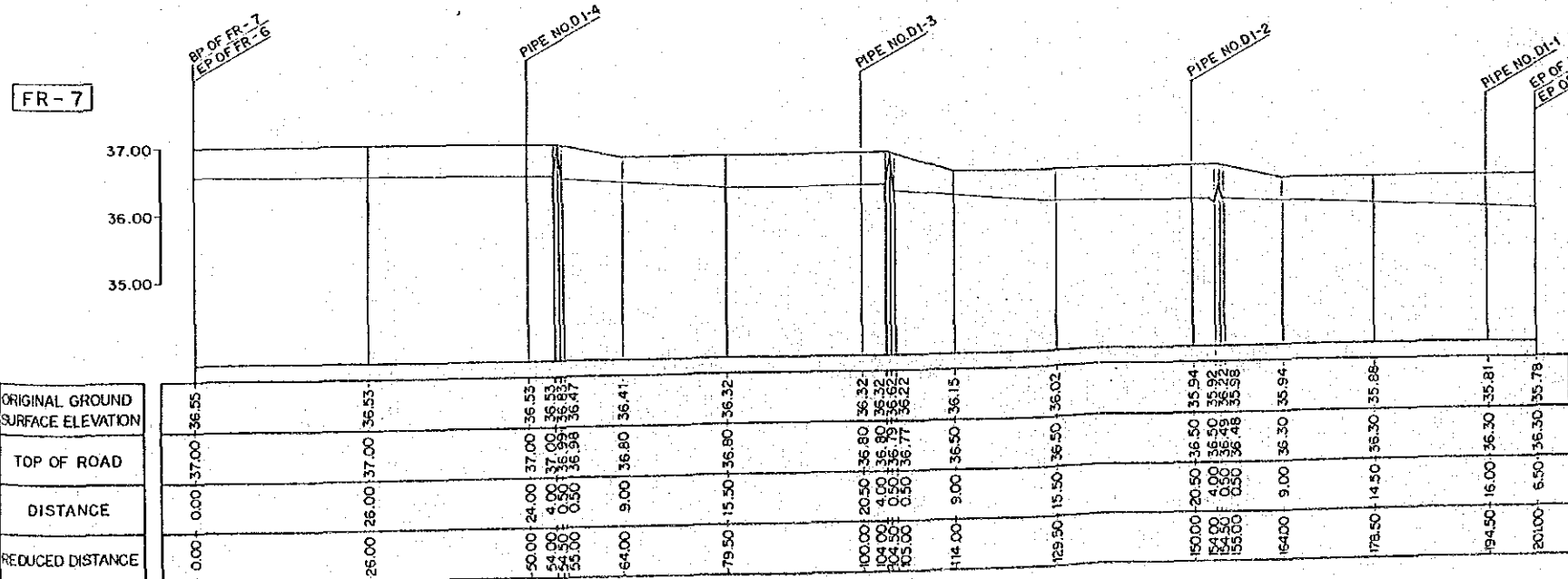


ORIGINAL GROUND SURFACE ELEVATION	37.06	37.06	37.36	36.82	36.82	36.82	36.82	36.82	36.82	36.82	36.82	36.82	36.82	36.82	36.82	36.82
TOP OF ROAD	37.36	37.36	37.36	37.36	37.36	37.36	37.36	37.36	37.36	37.36	37.36	37.36	37.36	37.36	37.36	37.36
DISTANCE	0.00	3.50	0.50	24.00	15.50	2.00	2.00	0.50	0.50	22.50	2.00	0.50	9.00	15.50	11.50	11.50
REDUCED DISTANCE	0.00	3.50	4.00	28.50	44.00	46.00	48.00	48.50	49.00	70.50	72.50	73.00	81.50	97.00	108.50	120.00

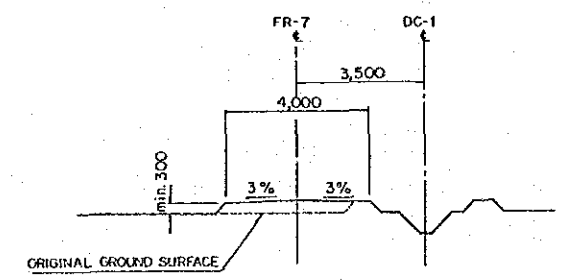
ROAD NO.	PIPE NO.	STRUCTURE
FR-1	I 1-1	IRRIGATION CULVERT NO. 1-1
FR-1	I 2-5	IRRIGATION CULVERT NO. 2-5
FR-1	I 2-6	IRRIGATION CULVERT NO. 2-6
FR-1	I 2-7	IRRIGATION CULVERT NO. 2-7
FR-1	I 2-8	IRRIGATION CULVERT NO. 2-8
FR-4	D 4-1	DRAINAGE CULVERT NO. 4-1
FR-4	D 5-1	DRAINAGE CULVERT NO. 5-1
FR-4	D 2-2	DRAINAGE OUTLET NO. 2-2
FR-4	D 2-1	DRAINAGE OUTLET NO. 2-1
FR-7	D 1-4	DRAINAGE OUTLET NO. 1-4
FR-7	D 1-3	DRAINAGE OUTLET NO. 1-3
FR-7	D 1-2	DRAINAGE OUTLET NO. 1-2
FR-7	D 1-1	DRAINAGE OUTLET NO. 1-1



TYPICAL CROSS SECTION OF FARM ROAD FR-4 (TYPE-II)



ORIGINAL GROUND SURFACE ELEVATION	36.55	36.53	36.53	36.53	36.53	36.53	36.53	36.53	36.53	36.53	36.53	36.53	36.53	36.53	36.53	36.53
TOP OF ROAD	37.00	37.00	37.00	37.00	37.00	37.00	37.00	37.00	37.00	37.00	37.00	37.00	37.00	37.00	37.00	37.00
DISTANCE	0.00	26.00	4.00	26.00	4.00	0.50	0.50	0.50	0.50	20.50	4.00	0.50	9.00	15.50	14.50	16.00
REDUCED DISTANCE	0.00	26.00	30.00	34.00	38.00	38.50	39.00	39.50	40.00	60.50	64.50	65.00	73.50	89.00	103.50	119.50

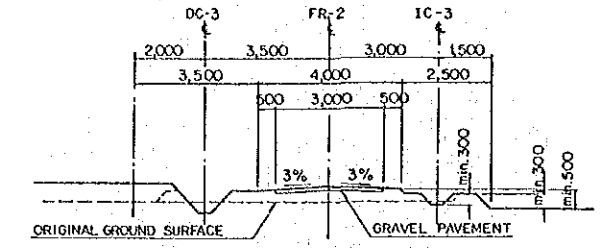
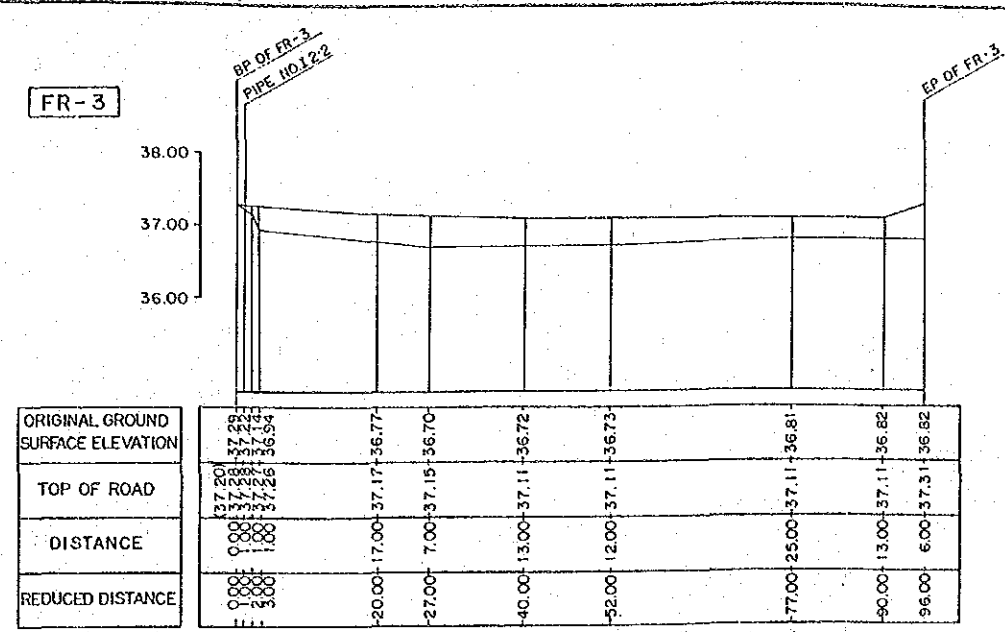
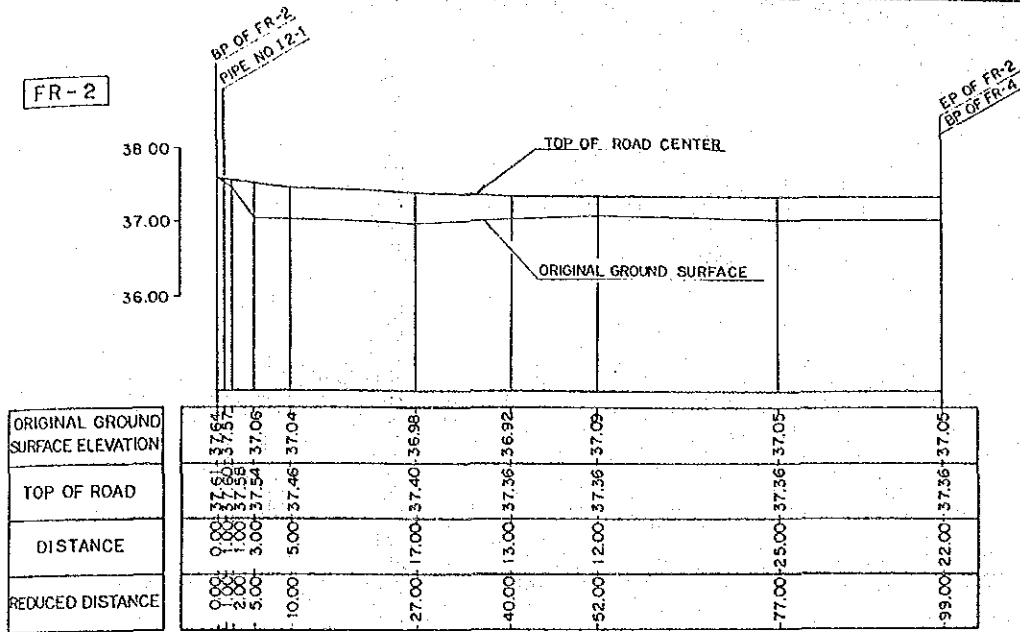


TYPICAL CROSS SECTION OF FARM ROAD FR-7 (TYPE-III)

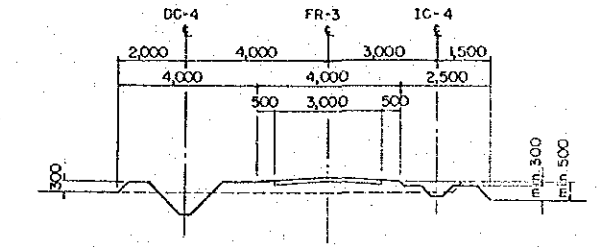
FEDERAL REPUBLIC OF NIGERIA
THE LOWER ANAMBRA IRRIGATION PROJECT
MODEL INFRASTRUCTURE IMPROVEMENT WORKS

FARM ROAD (1/2)

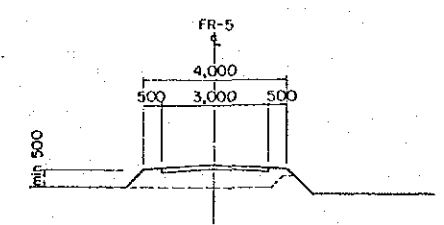
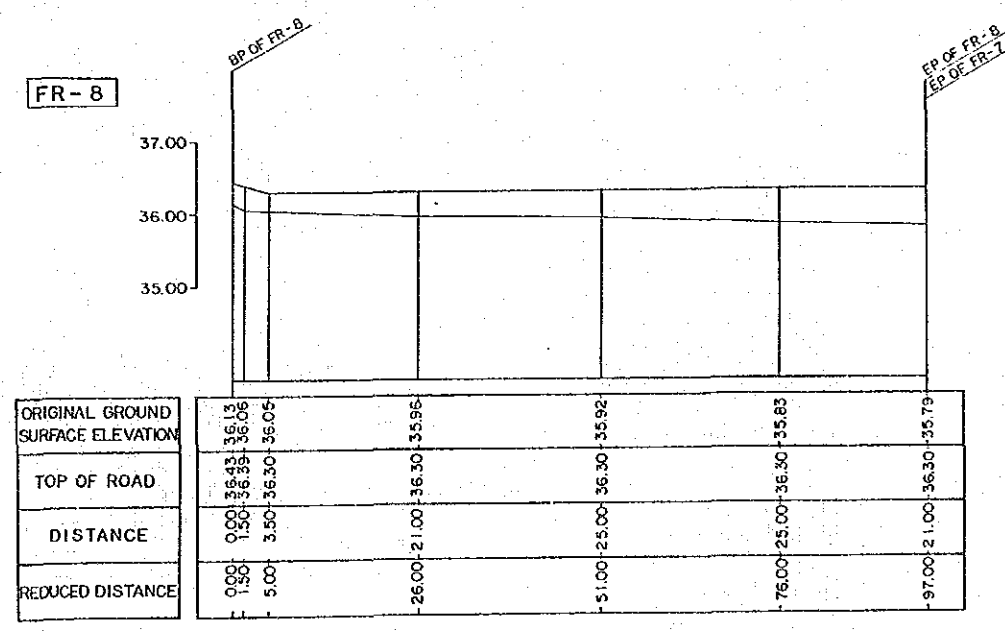
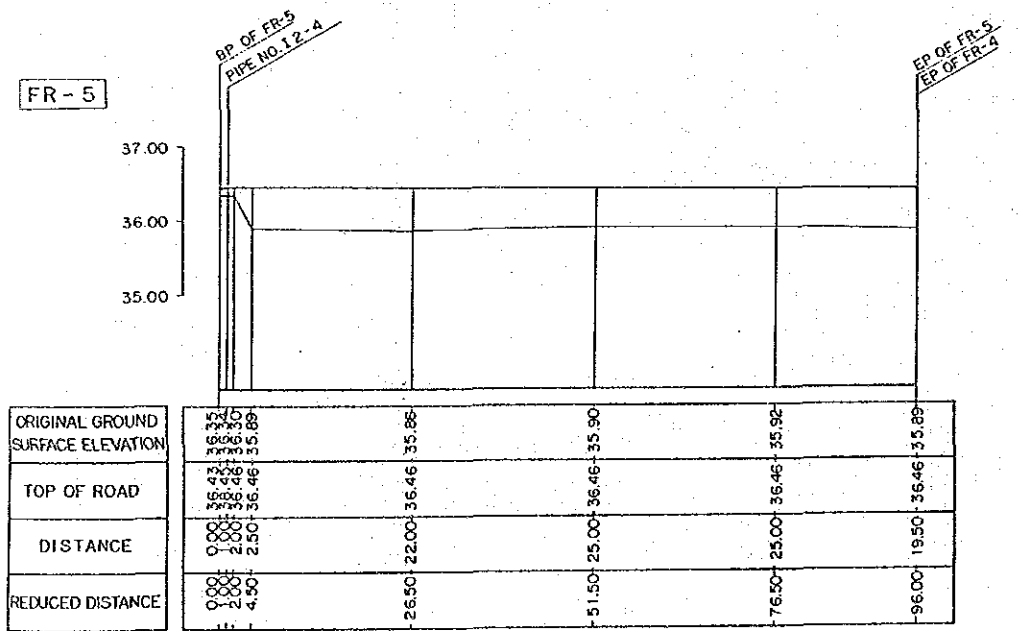
JAPAN INTERNATIONAL COOPERATION AGENCY | DWG NO. 2



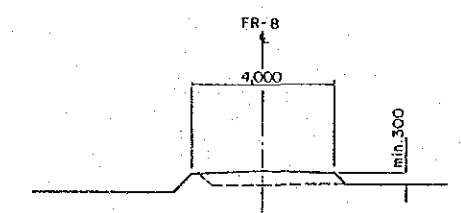
TYPICAL CROSS SECTION OF FARM ROAD FR-2 (TYPE - II)



TYPICAL CROSS SECTION OF FARM ROAD FR-3 (TYPE - II)

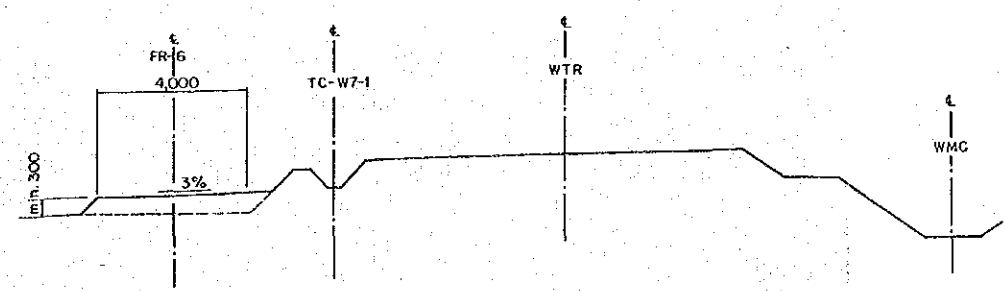
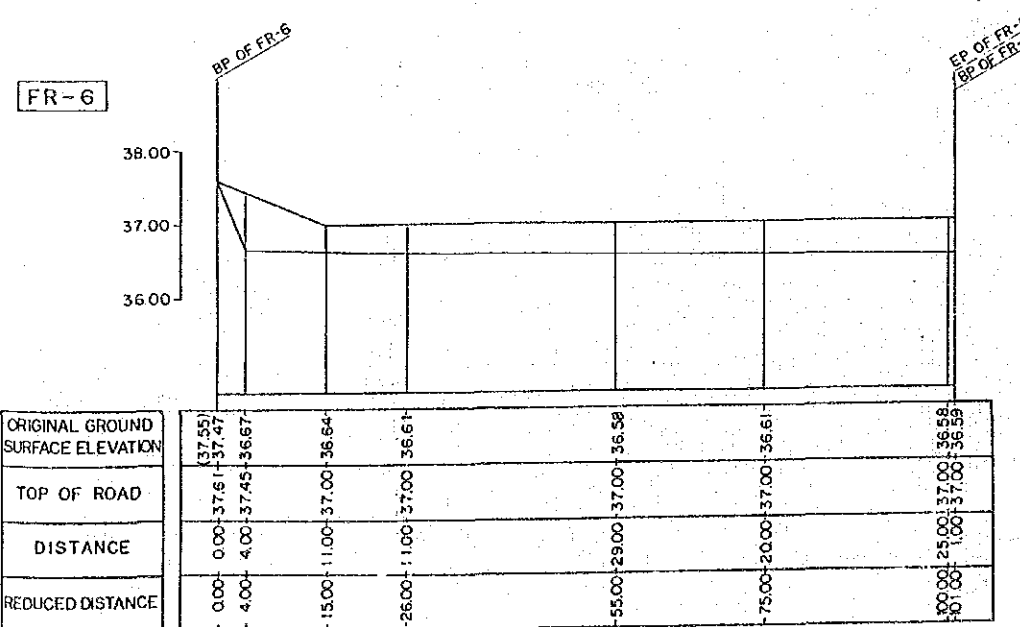


TYPICAL CROSS SECTION OF FARM ROAD FR-5 (TYPE - II)



TYPICAL CROSS SECTION OF FARM ROAD FR-8 (TYPE - III)

ROAD NO.	PIPE NO.	STRUCTURE
FR-2	1 2-1	IRRIGATION CULVERT NO.2-1
FR-3	1 2-2	IRRIGATION CULVERT NO.2-2
FR-5	1 2-4	IRRIGATION CULVERT NO.2-4

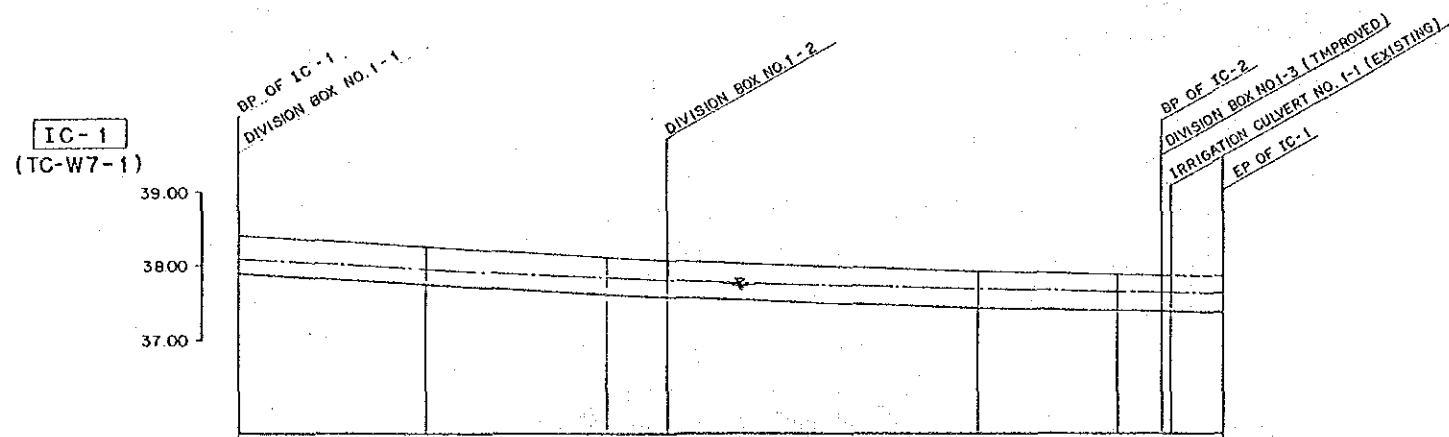


TYPICAL CROSS SECTION OF FARM ROAD FR-6 (TYPE - III)

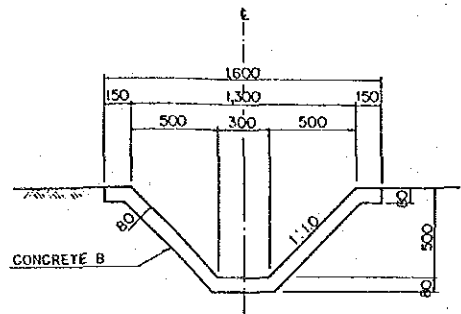
FEDERAL REPUBLIC OF NIGERIA
 THE LOWER ANAMBRA IRRIGATION PROJECT
 MODEL INFRASTRUCTURE IMPROVEMENT WORKS

FARM ROAD (2/2)

JAPAN INTERNATIONAL COOPERATION AGENCY dwg NO. 3

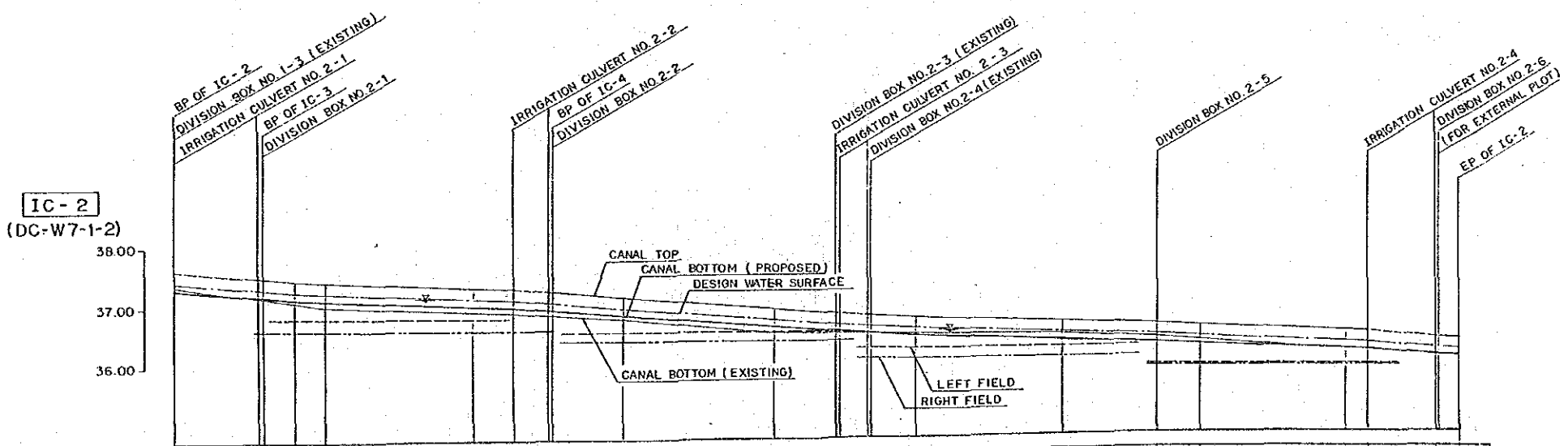


DESIGN CANAL BASE ELEVATION									
DESIGN WATER SURFACE ELEVATION	38.10	37.97	37.83	37.82	37.80	37.78	37.75	37.75	37.41
EXISTING CANAL BASE ELEVATION	37.90	37.77	37.63	37.60	37.54	37.45	37.42	37.41	37.41
DISTANCE	0.00	25.00	25.00	8.00	17.00	25.00	25.00	6.83	7.20
REDUCED DISTANCE	0.00	25.00	50.00	58.00	75.00	100.00	125.00	131.83	139.03
STATION	B.P	NO.1	NO.2	+8.00	NO.3	NO.4	NO.5	+6.83	+14.65

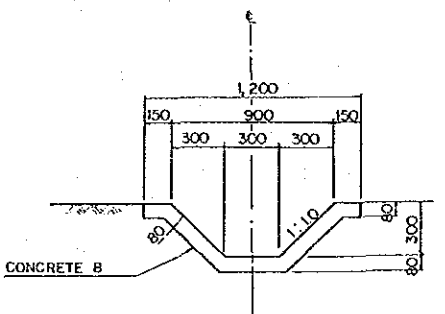


TYPICAL CROSS SECTION OF IRRIGATION CANAL (TYPE-I)

- NOTE
1. Contraction and expansion joints shall be filled with elastic filler or sealer, unless otherwise directed by the Engineer.
 2. Contraction joints shall be set per each 3m run.
 3. Precast concrete flume unit can be acceptable if approved by the Engineer.



DESIGN CANAL BASE ELEVATION																			
DESIGN WATER SURFACE ELEVATION	37.75	37.40	37.22	37.22	37.16	37.31	37.21	37.16	37.09	37.28	37.16	37.14	37.03	36.94	37.15	37.03	36.89	37.12	37.00
EXISTING CANAL BASE ELEVATION	37.41	37.36	37.17	37.32	37.16	37.31	37.21	37.16	37.09	37.28	37.16	37.14	37.03	36.94	37.15	37.03	36.89	37.12	37.00
DISTANCE	0.00	14.00	0.50	5.50	5.00	5.00	5.00	5.00	12.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00
REDUCED DISTANCE	0.00	14.00	14.50	20.00	25.00	30.00	35.00	40.00	52.00	77.00	102.00	127.00	152.00	177.00	202.00	227.00	252.00	277.00	302.00
STATION	B.P	+14.00	+14.50	+20.00	NO.1	NO.2	+6.50	+12.50	+13.00	+18.00	NO.3	NO.4	+11.00	+11.50	+16.50	NO.5	+17.00	NO.6	+16.50

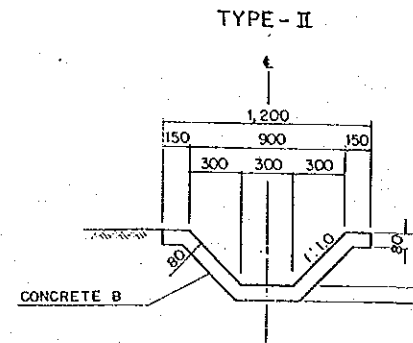
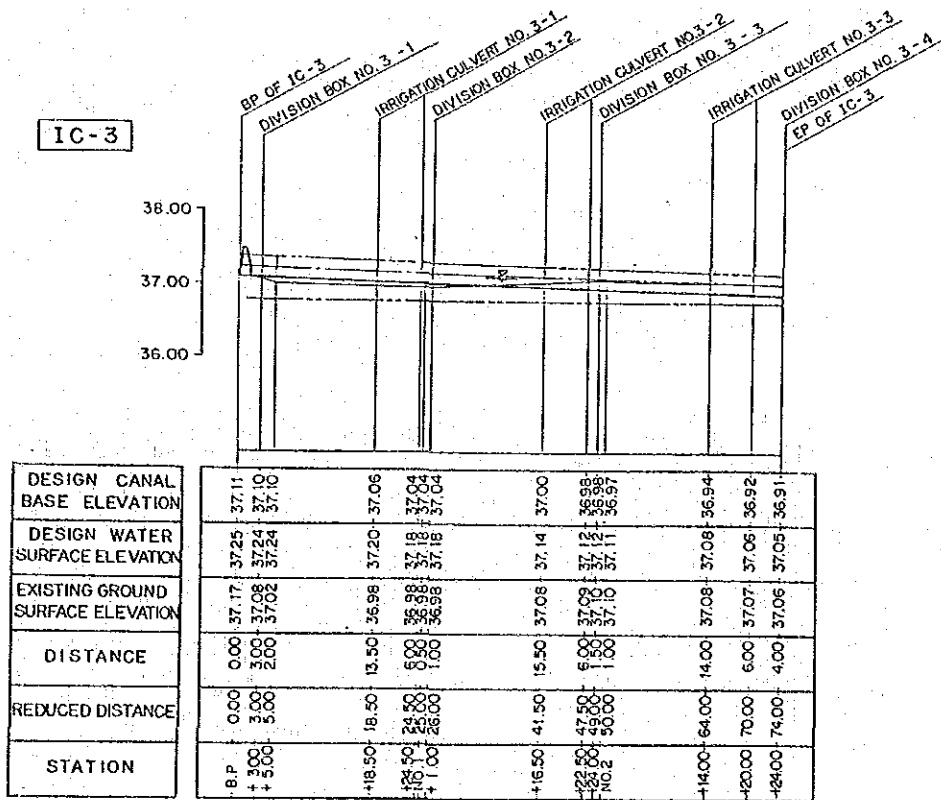


TYPICAL CROSS SECTION OF IRRIGATION CANAL (TYPE-II)

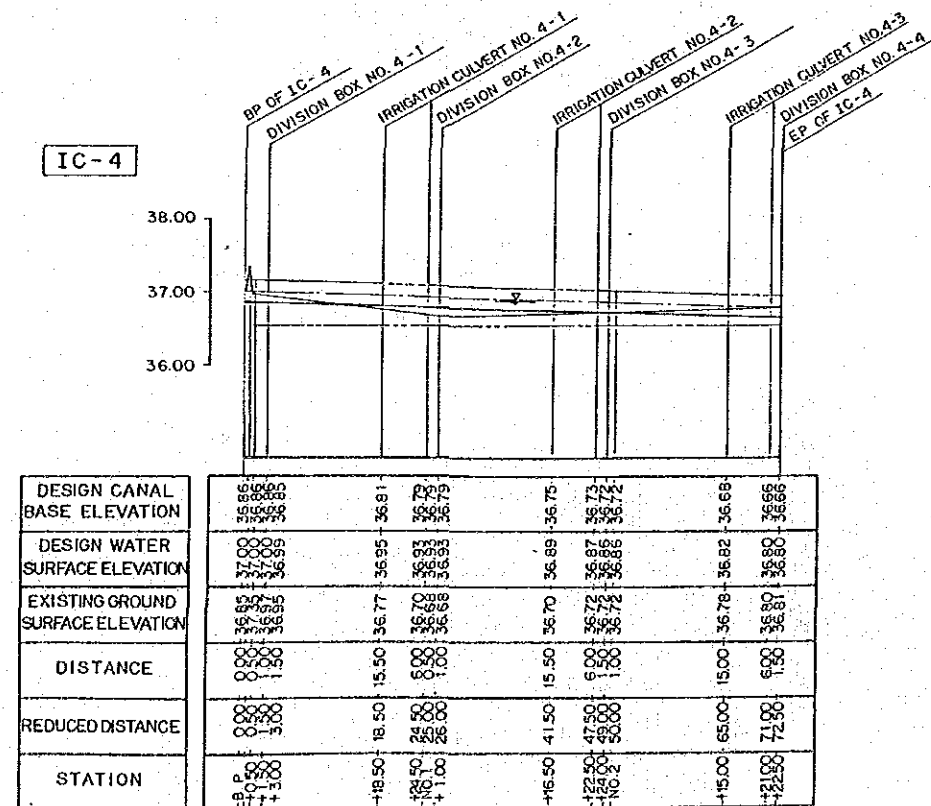
FEDERAL REPUBLIC OF NIGERIA
 THE LOWER ANAMBRA IRRIGATION PROJECT
 MODEL INFRASTRUCTURE IMPROVEMENT WORKS

IRRIGATION CANAL (1/2)

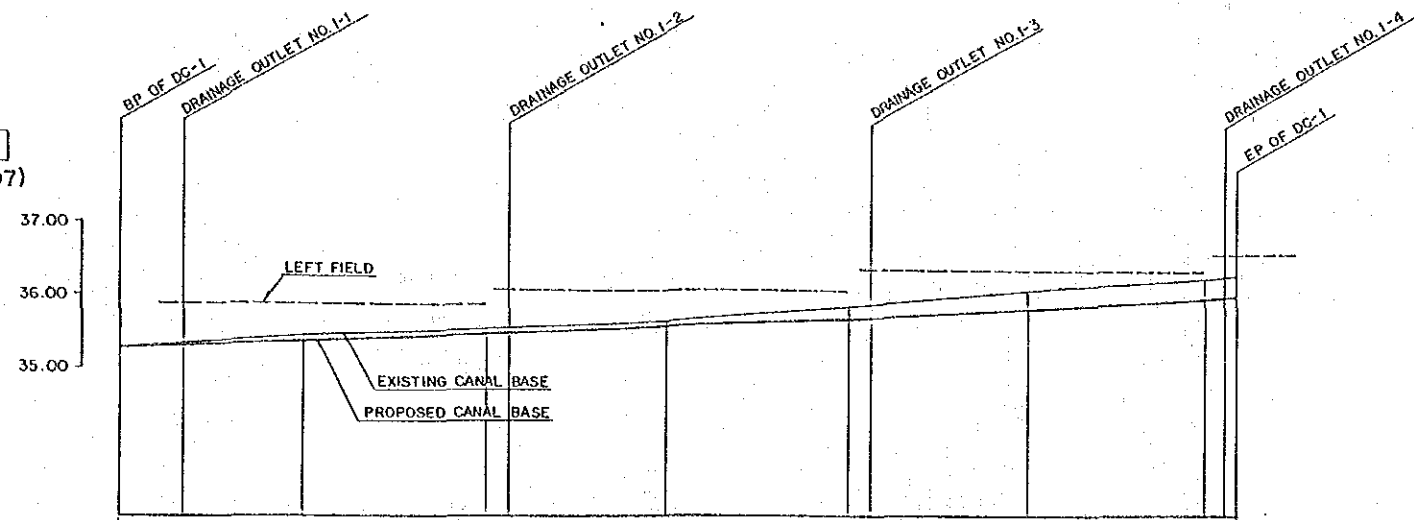
JAPAN INTERNATIONAL COOPERATION AGENCY DWG NO. 4



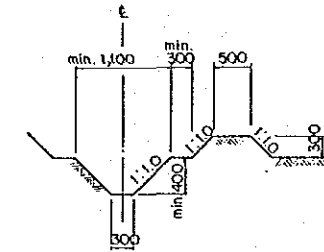
TYPICAL CROSS SECTION OF IRRIGATION CANAL



DC-1
(FD-2-97)

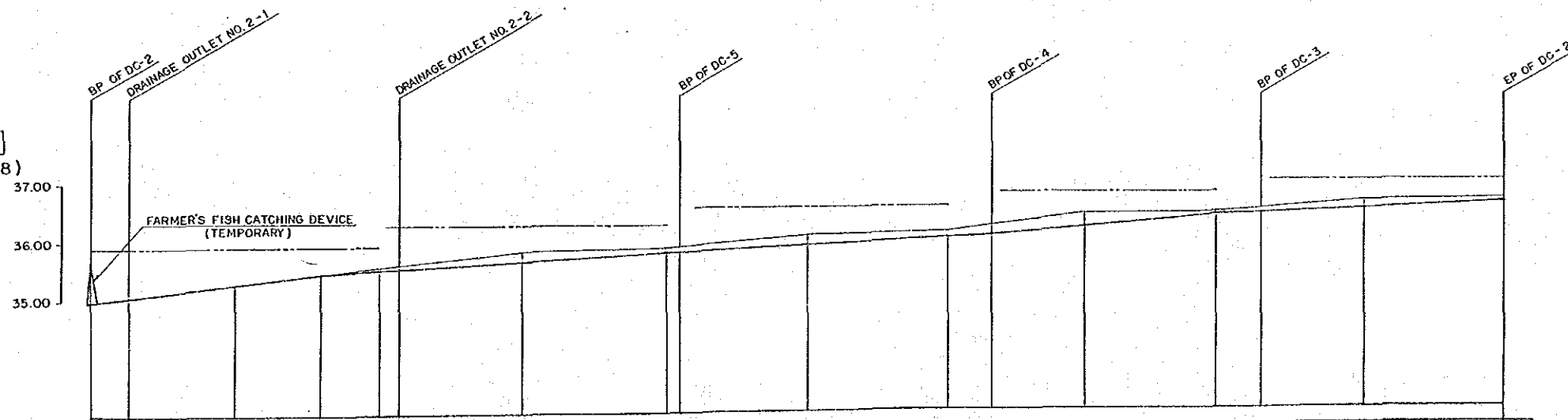


DESIGN CANAL BASE ELEVATION	35.29	35.32	35.39	35.48	35.58	35.68	35.83	35.99	36.02
EXISTING CANAL BASE ELEVATION	35.28	35.35	35.46	35.56	35.66	35.86	35.89	36.07	36.01
DISTANCE	0.00	8.50	16.50	25.00	33.00	41.00	49.00	57.00	65.00
REDUCED DISTANCE	0.00	8.50	25.00	50.00	75.00	100.00	125.00	150.00	175.00
STATION	B.P.	+ 8.50	+ NO. 1	+ NO. 2	+ NO. 3	+ NO. 4	+ NO. 5	+ NO. 6	+ NO. 7



TYPICAL CROSS SECTION OF DRAINAGE CANAL

DC-2
(FD-2-98)



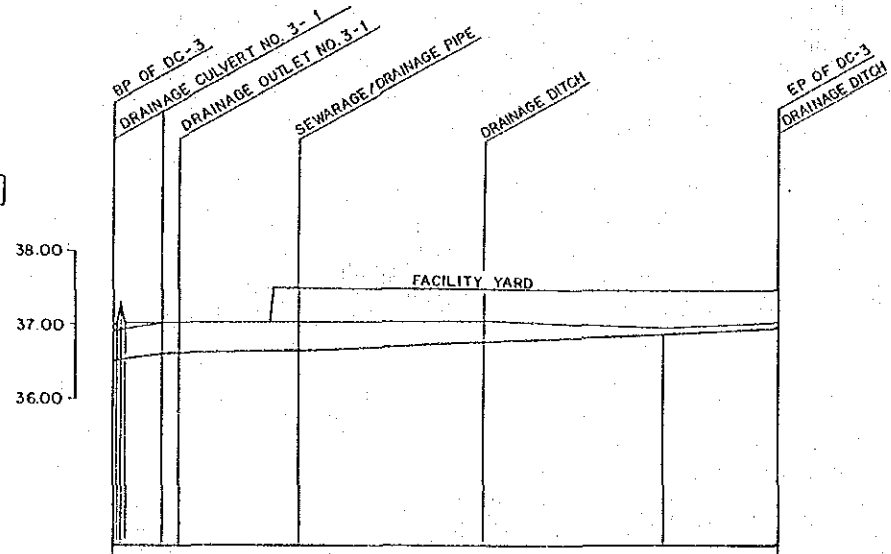
DESIGN CANAL BASE ELEVATION	35.00	35.10	35.28	35.45	35.65	35.79	35.90	36.02	36.13	36.40	36.44	36.51	36.60
EXISTING CANAL BASE ELEVATION	35.67	35.07	35.27	35.45	35.81	35.87	36.06	36.11	36.20	36.43	36.44	36.53	36.65
DISTANCE	0.00	8.50	16.50	25.00	33.00	41.00	49.00	57.00	65.00	73.00	81.00	89.00	97.00
REDUCED DISTANCE	0.00	8.50	25.00	40.00	55.00	70.00	85.00	100.00	115.00	130.00	145.00	160.00	175.00
STATION	B.P.	+ 8.50	+ NO. 1	+ NO. 2	+ NO. 3	+ NO. 4	+ NO. 5	+ NO. 6	+ NO. 7	+ NO. 8	+ NO. 9	+ NO. 10	+ NO. 11

FEDERAL REPUBLIC OF NIGERIA
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DRAINAGE CANAL (1/2)

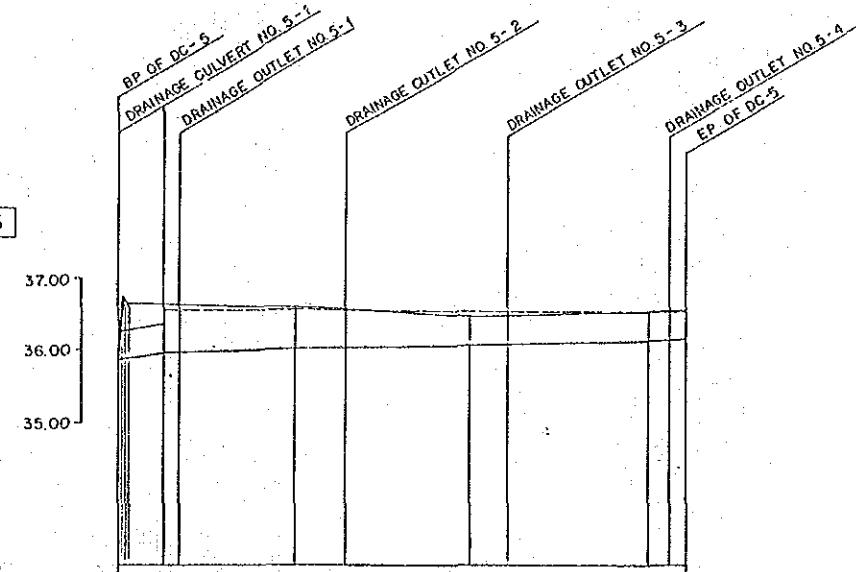
JAPAN INTERNATIONAL COOPERATION AGENCY DWG NO. 6

DC-3



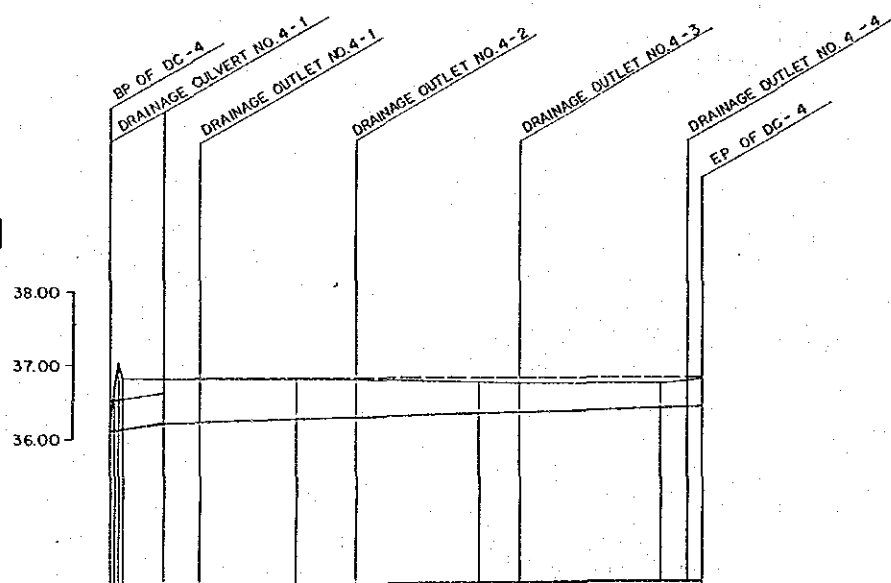
DESIGN CANAL BASE ELEVATION	36.00	36.57	36.80	36.92	37.00
EXISTING GROUND SURFACE ELEVATION	36.23	37.04	37.08	36.99	37.05
DISTANCE	0.00	19.50	25.00	25.00	15.50
REDUCED DISTANCE	0.00	19.50	25.00	25.00	15.50
STATION	B.P. +0.50 +1.50 +6.00	NO.1	NO.2	NO.3	EP OF DC-3

DC-5

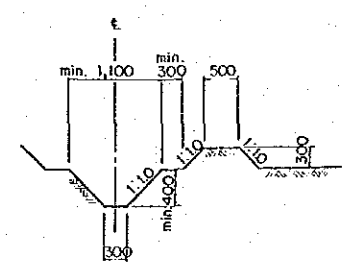


DESIGN CANAL BASE ELEVATION	35.85	36.00	36.02	36.07	36.08	36.14	36.14	36.15
EXISTING GROUND SURFACE ELEVATION	35.91	36.58	36.55	36.49	36.49	36.63	36.64	36.55
DISTANCE	0.00	16.50	7.50	17.50	5.50	19.50	3.50	2.00
REDUCED DISTANCE	0.00	16.50	24.00	41.50	47.00	66.50	70.00	72.00
STATION	B.P. +0.50 +1.50 +6.50	NO.1	NO.2	NO.3	NO.4	NO.5	NO.6	EP OF DC-5

DC-4



DESIGN CANAL BASE ELEVATION	36.10	36.25	36.32	36.38	36.40
EXISTING GROUND SURFACE ELEVATION	36.23	36.80	36.75	36.74	36.76
DISTANCE	0.00	13.50	17.00	5.50	2.00
REDUCED DISTANCE	0.00	13.50	30.50	36.00	38.00
STATION	B.P. +0.50 +1.50 +7.00	NO.1	NO.2	NO.3	EP OF DC-4

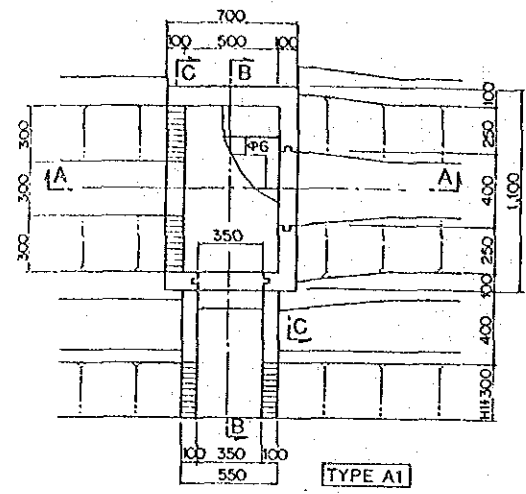


TYPICAL CROSS SECTION OF DRAINAGE CANAL

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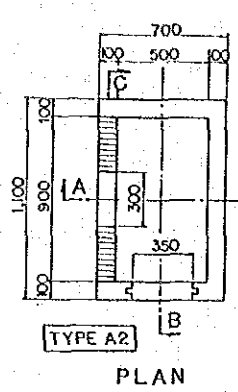
DRAINAGE CANAL (2/2)

JAPAN INTERNATIONAL COOPERATION AGENCY DWG NO. 7



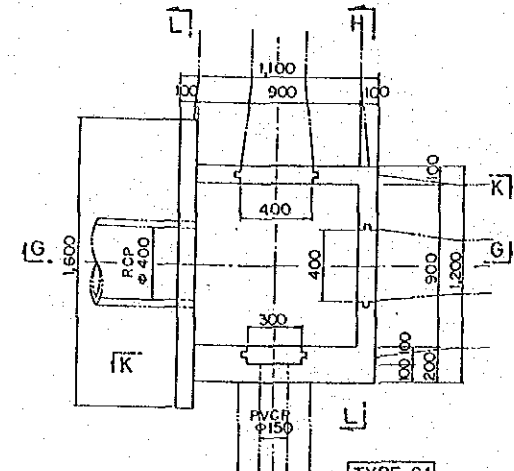
PLAN

TYPE A1



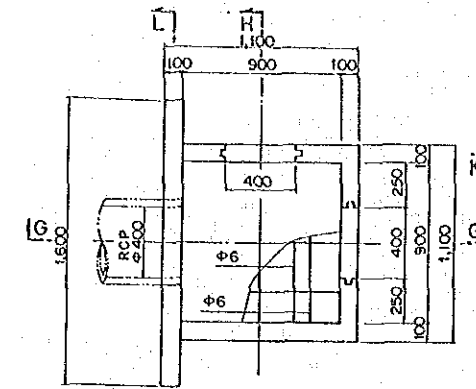
PLAN

TYPE A2



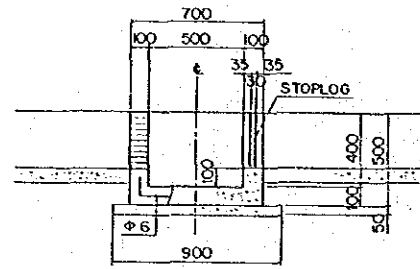
PLAN

TYPE C1

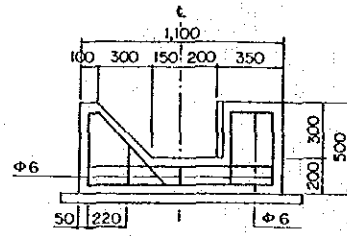


PLAN

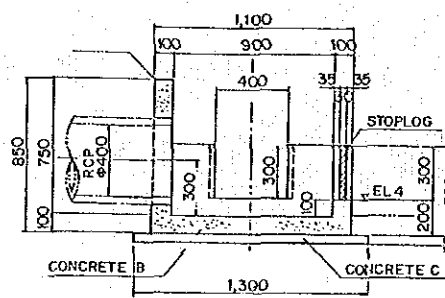
TYPE C2



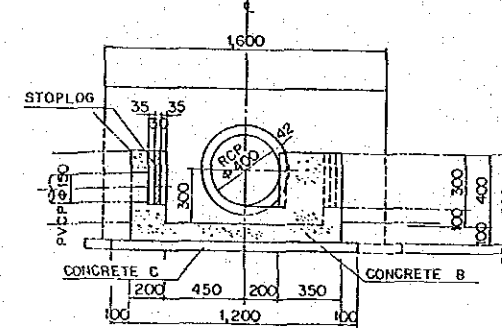
SECTION A-A



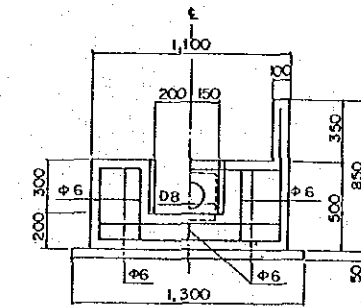
SECTION C-C



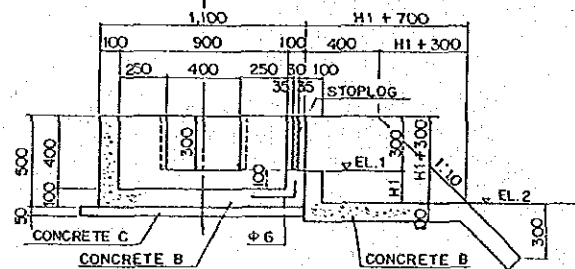
SECTION G-G



SECTION H-H

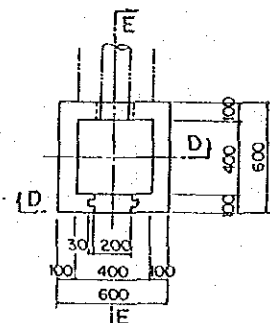


SECTION K-K

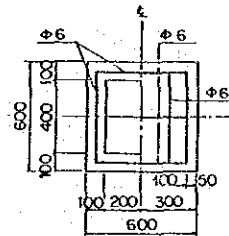


SECTION B-B

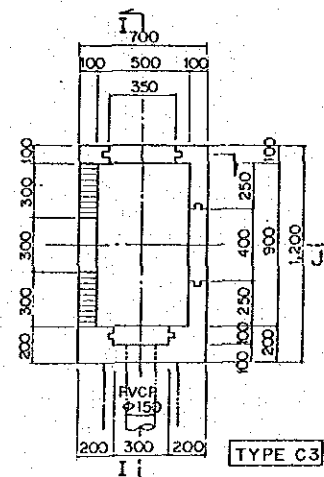
TYPE A



PLAN

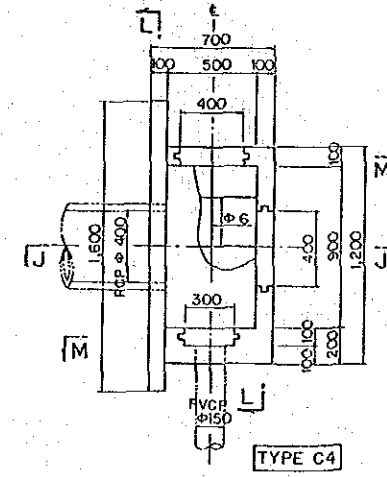


SECTION F-F



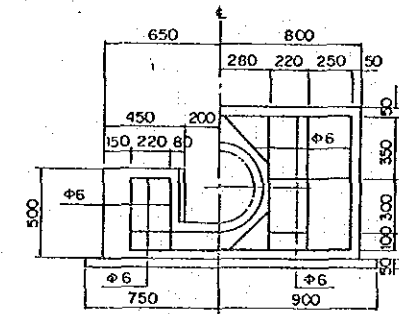
PLAN

TYPE C3

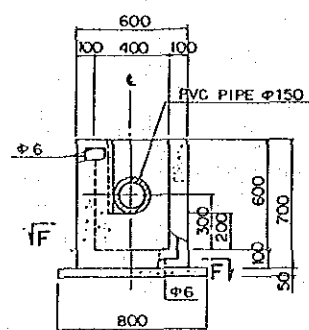


PLAN

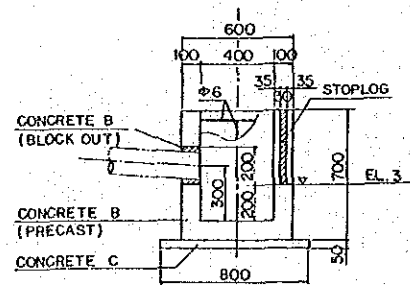
TYPE C4



SECTION L-L

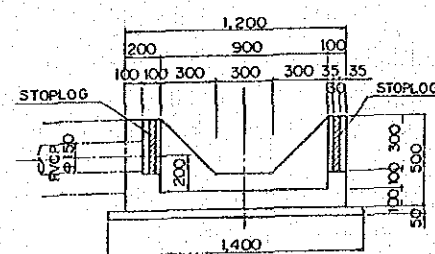


SECTION D-D

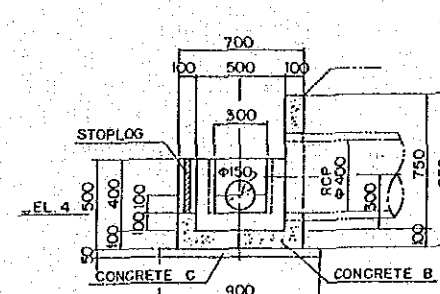


SECTION E-E

TYPE B

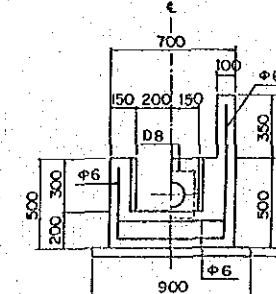


SECTION I-I



SECTION J-J

TYPE C

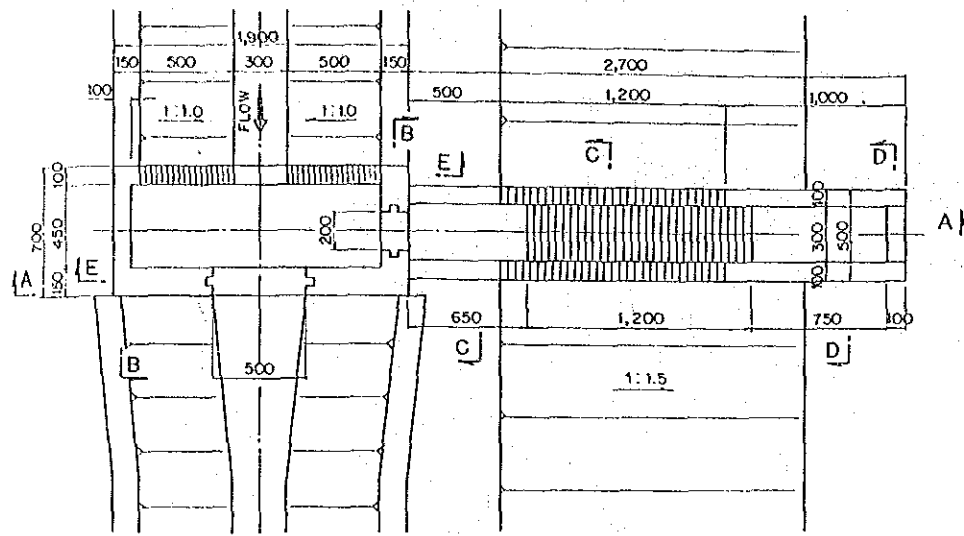


SECTION M-M

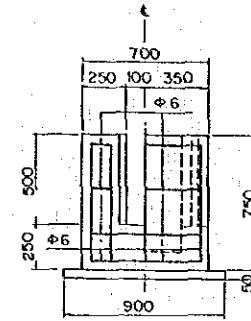
FEDERAL REPUBLIC OF NIGERIA
THE LOWER ANAMBRA IRRIGATION PROJECT
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DIVISION BOX (1/2)

JAPAN INTERNATIONAL COOPERATION AGENCY DWG NO. 8



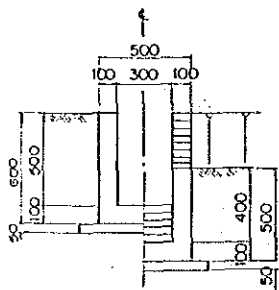
PLAN



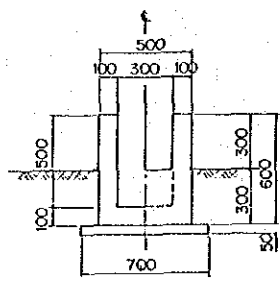
SECTION B-B



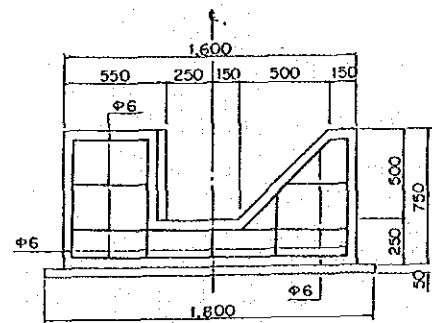
SECTION A-A



SECTION C-C

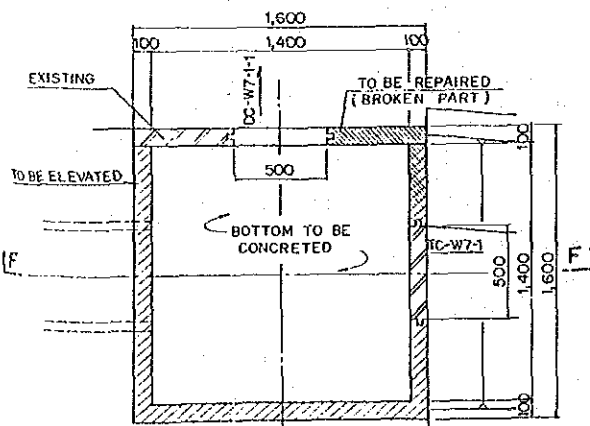


SECTION D-D

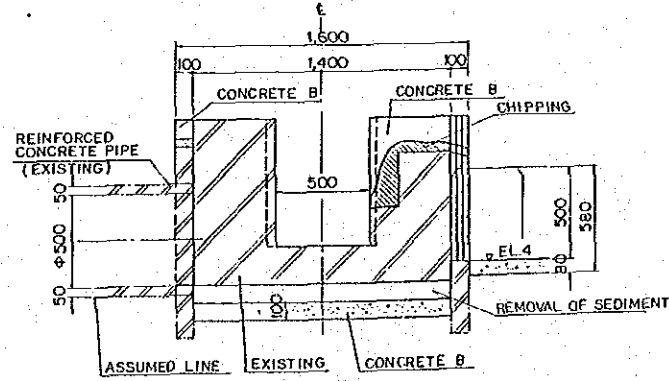


SECTION E-E

TYPE D

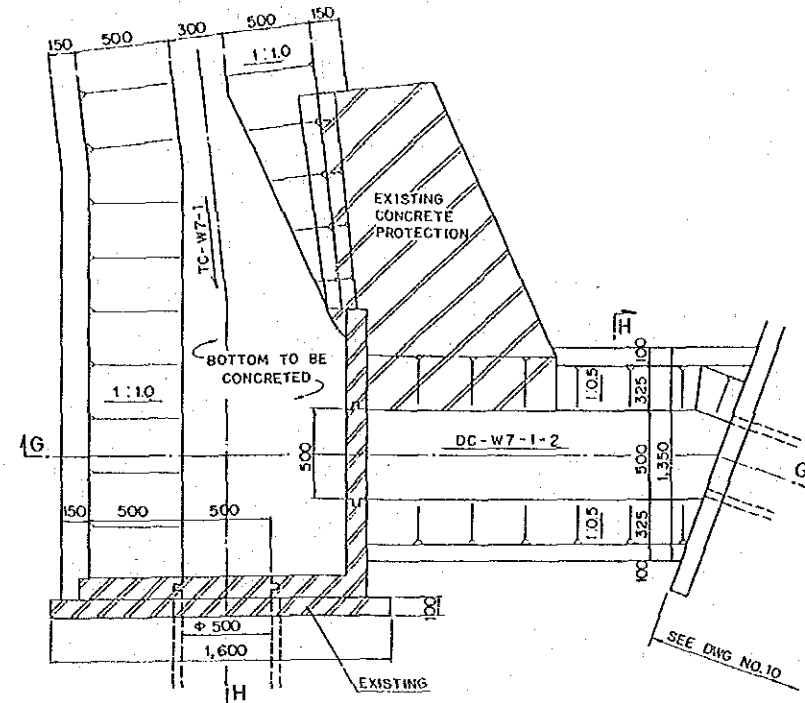


PLAN

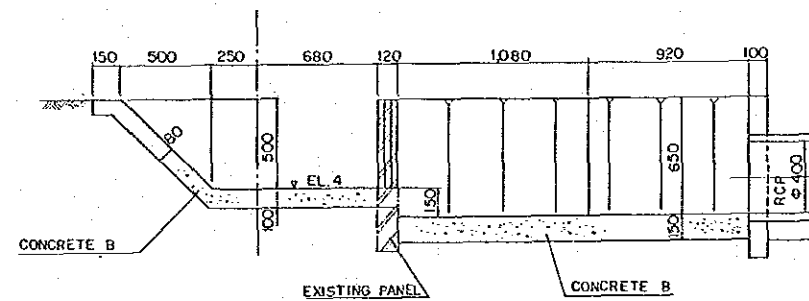


SECTION F-F

TYPE E

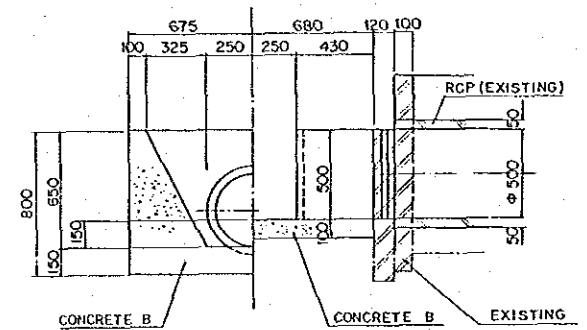


PLAN



SECTION G-G

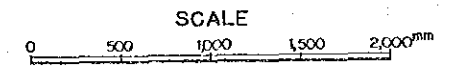
TYPE F



SECTION H-H

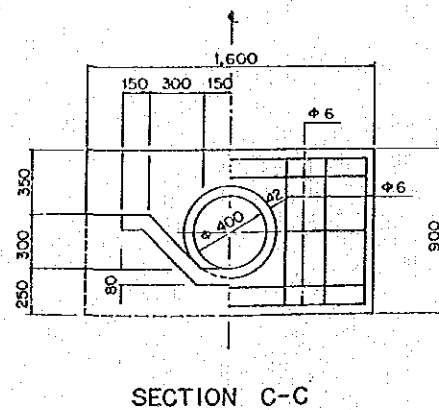
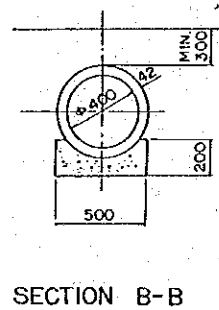
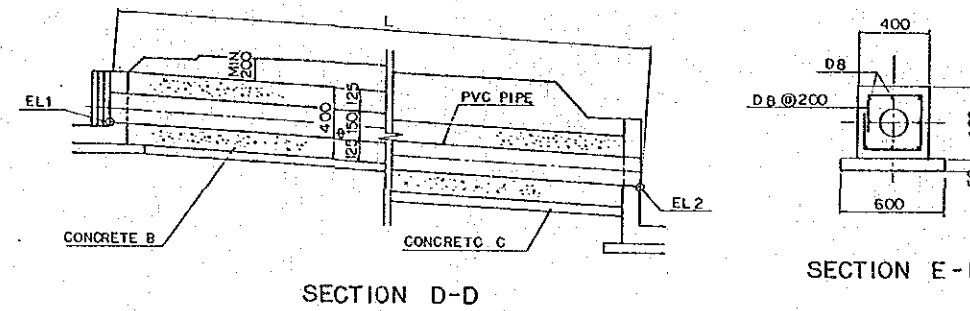
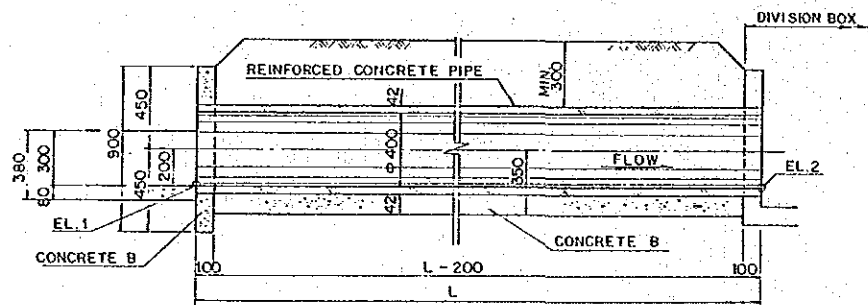
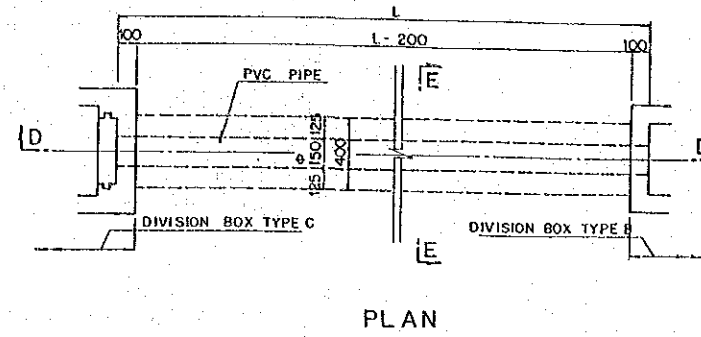
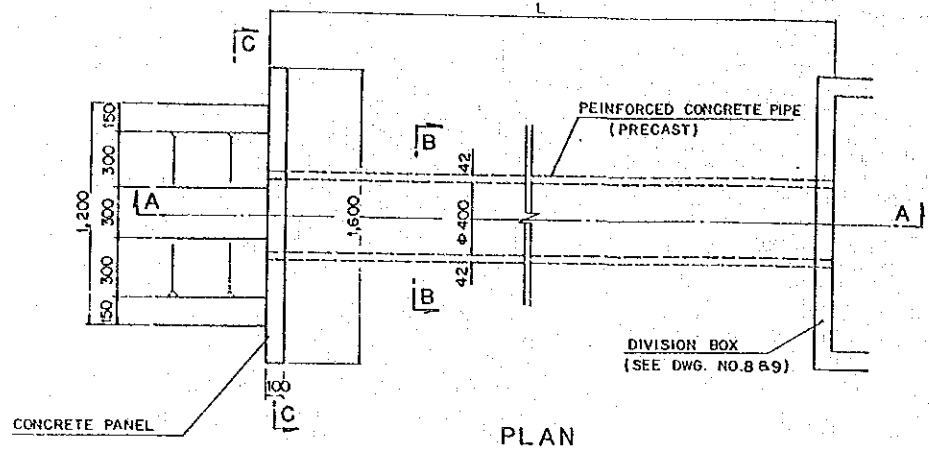
LIST OF DIVISION BOX

Canal Name	Division Box No.	Station No.	Type	Elevation (m)				Connecting Structure				Remarks	
				EL 1	EL 2	EL 3	EL 4	Upstream	Downstream	Right	Left		
(D B)													
IC-1	1-1	No.0 + 0.00	E	--	--	--	37.90	TC-W7-1	--	--	--	DC-W7-1-1	
	1-2	No.2 + 8.00	D	37.60	37.00	--	--	--	--	--	--	--	CV: Irrigation
	1-3	No.5 + 6.25	F	--	--	--	37.45	--	CV 1-1	--	--	CV 2-1	Culvert
IC-2	2-1	No.0 + 14.50	C1	--	--	--	37.21	CV2-1	--	--	CV2-5	IC-3	
	2-2	No.2 + 13.00	C2	--	--	--	36.95	CV2-2	--	--	--	IC-4	
	2-3	No.4 + 11.00	*	--	--	--	(36.55)	--	--	--	CV2-6		* Existing
	2-4	No.4 + 17.00	*	--	--	--	--	CV2-3	--	--	--		* Existing
	2-5	No.6 + 16.50	C3	--	--	--	36.30	--	--	--	CV2-7		
	2-6	No.8 + 16.50	C4	--	--	--	36.05	CV2-4	--	--	CV2-8		
	2-7	(No.0 + 14.50)	B	--	--	--	36.60	--	CV2-5	--	--		
	2-8	(No.4 + 11.00)	*	--	--	--	(36.39)	--	CV2-6	--	--		* Existing
	2-9	(No.6 + 16.50)	B	--	--	--	35.88	--	CV2-7	--	--		
	2-10	(No.8 + 16.50)	B	--	--	--	*35.70	--	CV2-8	--	--		* Approx.
IC-3	3-1	No.0 + 3.00	A1	37.10	36.80	--	--	--	--	--	--		
	3-2	No.1 + 1.00	A1	37.04	36.80	--	--	--	--	--	--		
	3-3	No.1 + 24.00	A1	36.98	36.80	--	--	--	--	--	--		
	3-4	No.2 + 24.00	A2	36.91	36.80	--	--	--	--	--	--		
IC-4	4-1	No.0 + 3.00	A1	36.85	36.55	--	--	--	--	--	--		
	4-2	No.1 + 1.00	A1	36.79	36.55	--	--	--	--	--	--		
	4-3	No.2 + 24.00	A1	36.72	36.55	--	--	--	--	--	--		
	4-4	No.2 + 22.50	A2	36.66	36.55	--	--	--	--	--	--		



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DIVISION BOX (2/2)

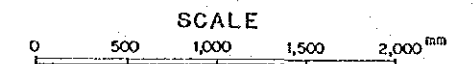


TYPE A1 : WITH 2 PANELS
 TYPE A2 : WITH 1 PANELS
 TYPE A3 : WITHOUT PANEL

TYPE A

LIST OF IRRIGATION CULVERT

Canal Name	Irrigation Culvert No.	Station No.	Type	Pipe Diameter	L (m)	Elevation (m)		Remarks
						EL 1	EL 2	
IC-1	1-1	No. 5 + 7.45	*	RCP ϕ 500	7.20	37.41	37.40	* Existing
IC-2	2-1	No. 0 + 2.00	A2	RCP ϕ 400	12.00	37.30	37.22	
		No. 2 + 6.50	A3	RCP ϕ 400	6.00	37.00	36.96	
	2-3	No. 4 + 11.50	*	RCP ϕ 300	5.00	36.53	36.52	* Existing
	2-4	No. 8 + 4.00	A3	RCP ϕ 400	12.00	36.15	36.06	
	2-5	No. 0 + 14.50(R)	B	PVCP ϕ 150	6.00	37.23	36.62	
	2-6	No. 4 + 11.00(R)	*	RCP ϕ 150	6.00	36.55	36.42	* Existing
	2-7	No. 6 + 16.50(R)	B	PVCP ϕ 150	6.00	36.32	35.90	
	2-8	No. 8 + 16.50(R)	B	PVCP ϕ 150	6.00	36.07	* 35.72	* Approx.
IC-3	3-1	No. 0 + 18.50	A	RCP ϕ 400	6.00	37.06	37.04	
	3-2	No. 1 + 16.50	A	RCP ϕ 400	6.00	37.00	36.98	
	3-3	No. 2 + 17.00	A	RCP ϕ 400	6.00	36.94	36.92	
IC-4	4-1	No. 0 + 18.50	A	RCP ϕ 400	6.00	36.81	36.79	
	4-2	No. 1 + 16.50	A	RCP ϕ 400	6.00	36.75	36.73	
	4-3	No. 1 + 15.00	A	RCP ϕ 400	6.00	36.68	36.66	

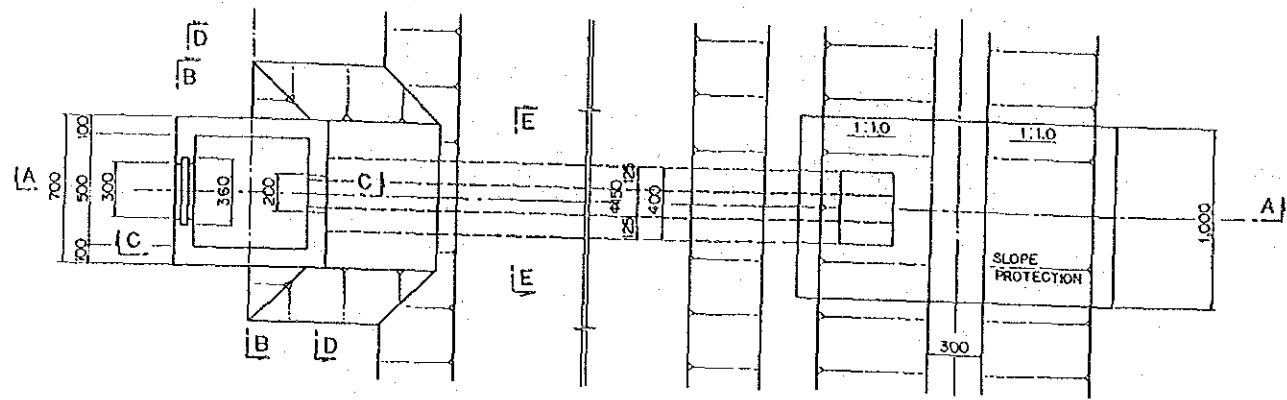


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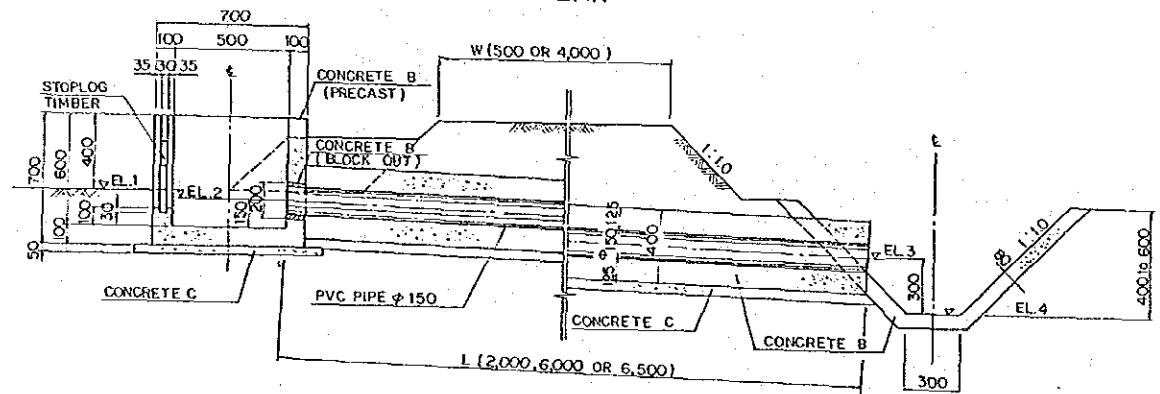
IRRIGATION CULVERT

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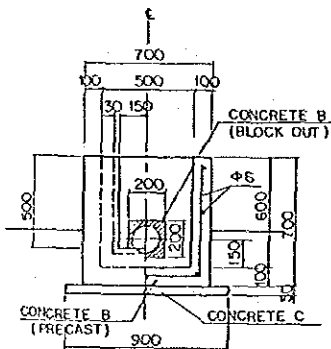
DRAINAGE OUTLET



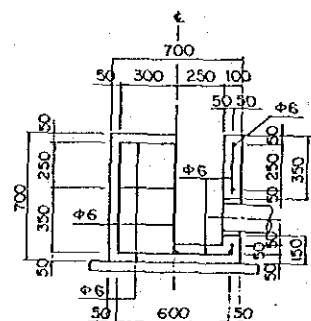
PLAN



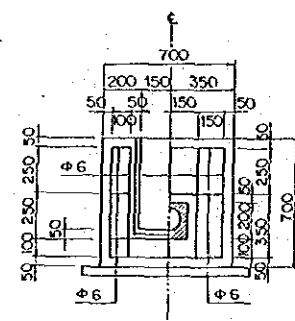
SECTION A-A



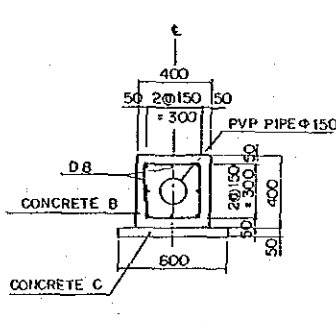
SECTION B-B



SECTION C-C



SECTION D-D

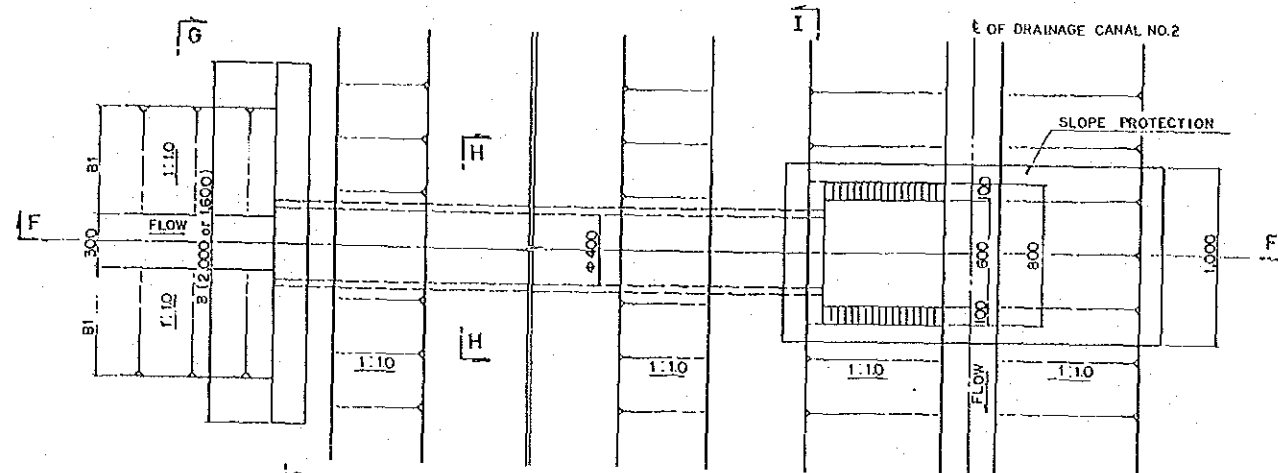


SECTION E-E

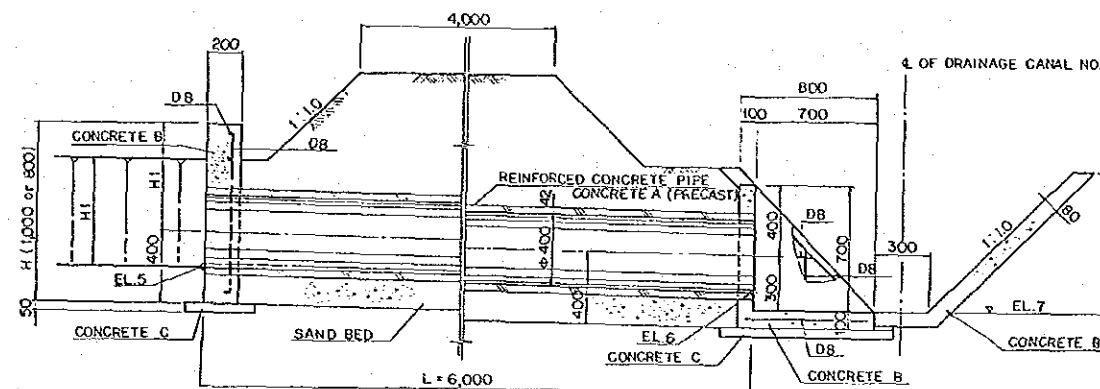
DIMENSION TABLE

Canal Name	Drainage Outlet No.	Station No.	Type	Dimension (mm)		Elevation (m)			
				W	L	EL. 1	EL. 2	EL. 3	EL. 4
DC-1	1-1	No. 0 + 8.50	A	4,000	6,000	35.88	35.83	35.62	35.32
	1-2	No. 2 + 3.00	A	4,000	6,000	36.08	36.03	35.79	35.49
	1-3	No. 4 + 3.00	A	4,000	6,000	36.39	36.34	35.99	35.69
	1-4	No. 6 + 3.00	A	4,000	6,000	36.60	36.55	36.31	36.01
DC-2	2-1	No. 0 + 8.50	B	4,000	6,500	35.90	35.85	35.40	35.10
	2-2	No. 2 + 3.00	B	4,000	6,500	36.26	36.21	35.82	35.52
DC-3	3-1	No. 0 + 8.50	C	500	2,000	37.00	36.95	36.90	36.60
DC-4	4-1	No. 0 + 11.50	C	500	2,000	36.80	36.75	36.51	36.21
	4-2	No. 1 + 8.00	C	500	2,000	36.80	36.75	36.57	36.27
	4-3	No. 2 + 5.50	C	500	2,000	36.80	36.75	36.63	36.33
	4-4	No. 3 + 3.50	C	500	2,000	36.80	36.75	36.69	36.39
DC-5	5-1	No. 0 + 8.50	C	500	2,000	36.55	36.50	36.26	35.96
	5-2	No. 1 + 7.50	C	500	2,000	36.55	36.50	36.32	36.02
	5-3	No. 2 + 5.50	C	500	2,000	36.55	36.50	36.38	36.08
	5-4	No. 3 + 3.50	C	500	2,000	36.55	36.50	36.44	36.14

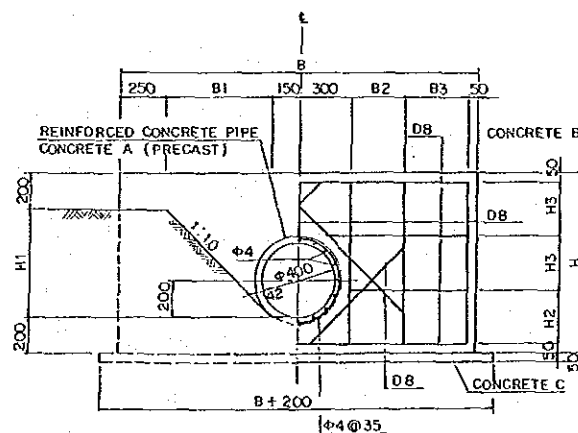
DRAINAGE CULVERT



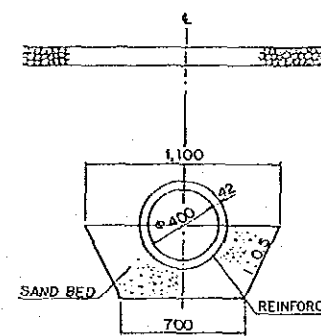
PLAN



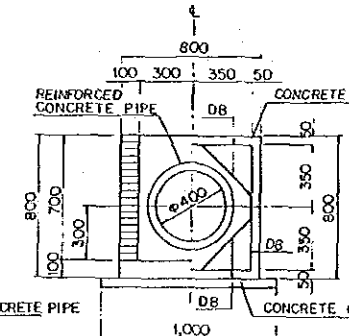
SECTION F-F



SECTION G-G



SECTION H-H



SECTION I-I

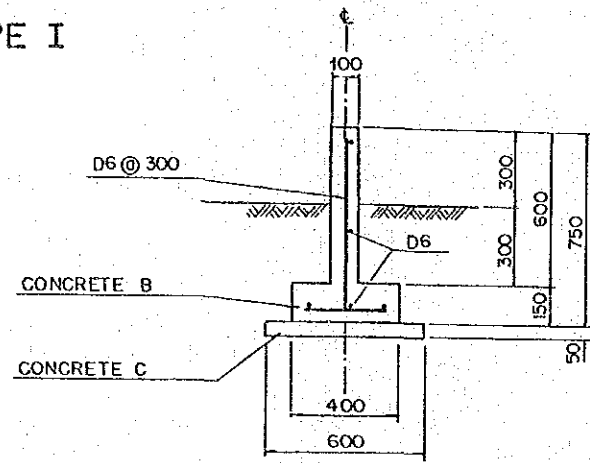
DIMENSION TABLE

Canal Name	Drainage Culvert No.	Station No.	Type	Elevation (m)			Dimension (mm)								
				EL. 5	EL. 6	EL. 7	B	H	B1	B2	B3	H1	H2	H3	
DC-3	3-1	No. 0 + 0.00	B	36.59	36.49	36.44	1,600	800	400	200	250	400	200	250	
DC-4	4-1	No. 0 + 0.00	A	36.20	36.10	36.05	2,000	1,000	600	300	350	600	300	300	
DC-5	5-1	No. 0 + 0.00	A	35.95	35.85	35.80	2,000	1,000	600	300	350	600	300	300	

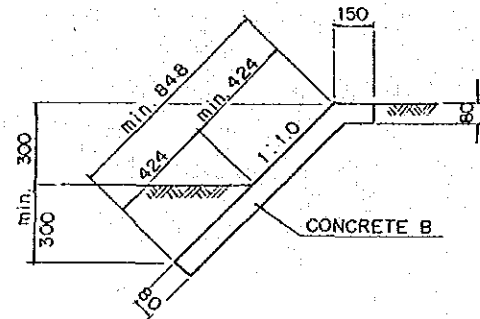
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DRAINAGE OUTLET AND CULVERT

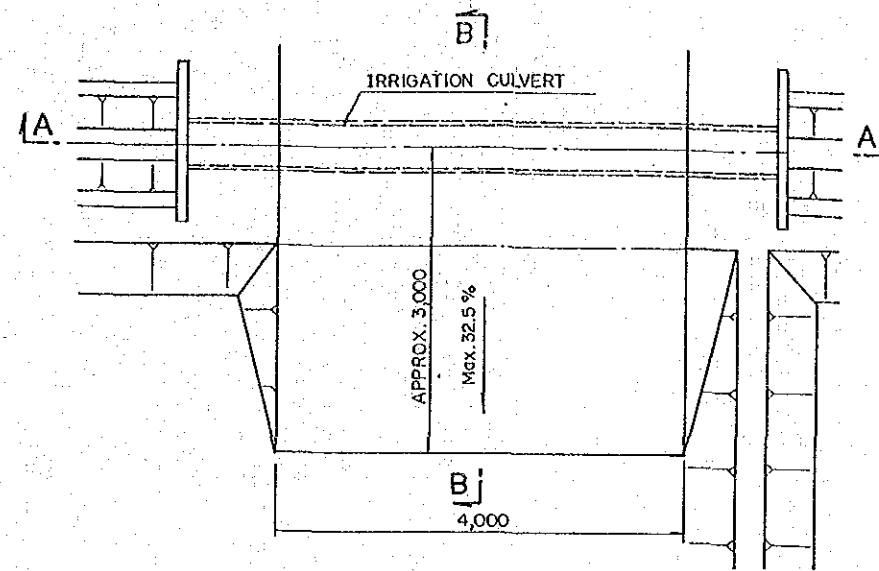
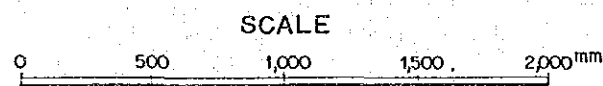
TYPE I



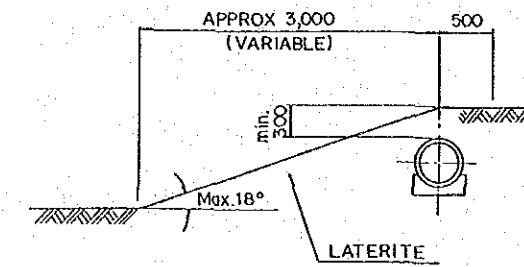
TYPE II



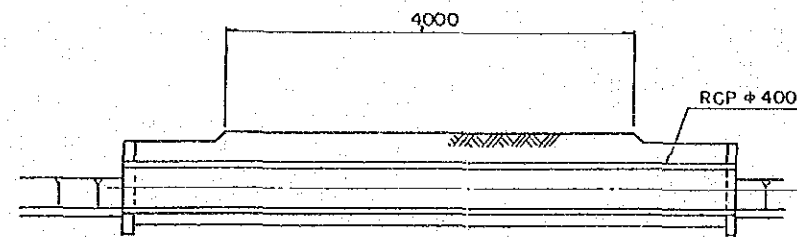
TYPICAL CROSS SECTION OF CONCRETE RIDGE



PLAN

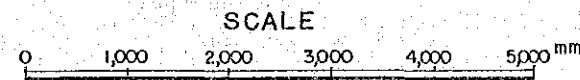


SECTION B-B



SECTION A-A

TRACTOR PASSAGE



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 MODEL INFRASTRUCTURE IMPROVEMENT WORKS
**CONCRETE RIDGE AND TRACTOR
 PASSAGE**
 JAPAN INTERNATIONAL COOPERATION AGENCY DWG NO. 12