The requirement of agricultural chemicals will increase to a considerable extent.

To supply these agricultural input materials sufficiently and smoothly, the organizational arrangement for this purpose should be strongly promoted in parallel with the implementation of the Project.

7. Research, Experimentation and Extension Services

The Project aims to bring about newly the irrigated agriculture in the Project Area in place of the present rainfed agriculture without irrigation, therefore, only civil engineering works to construct irrigation facilities would not be enough to achieve the objective of the Project. To materialize the irrigated agriculture, the agriculture-supporting programmes as listed below should be formulated before the commencement of civil works and should be put into action in time;

i) Field trials and demonstration activities;
ii) Strengthening of organizations for extension services and guidance of farmers;
iii) Establishment of organizations for terminal water management;
iv) Supply of seeds and agricultural input materials;
v) Securing of agricultural credit;
vi) Expansion of farm machinery operation services;
vii) Strengthening of organizations and expansion of facilities for processing and marketing of agricultural products.

Various Governmental organizations will be involved in the agricultural supporting activities, therefore, the executing body of the Project shall work out, as described below, the above-mentioned agriculture supporting programmes with close coordination of the related Governmental organizations.

7.1. Experimental Cultivation of Selected Crops

As mentioned above, the accumulation of experimental results and technical knowledge on the irrigated agriculture is extremely poor in the Project Area at present. Under the situations, field trials on various varieties of selected crops in respect of cropping systems, irrigation methods, irrigation discharges, control and prevention methods, rotational irrigation methods should be completely conducted in the Project Area. AC and the executing body should be jointly responsible for these tests which would be conducted with the participation of such research and experimental organizations as ARI, the Hmawbi Central Farm, etc.

7.2. Strengthening of Organizations for Extension Services and Demonstration

Extension workers of the irrigated agriculture should undergo a special training for this purpose. It is proposed to nominate one Project Extension Manager who will be responsible for overall extension services and guidance required for the irrigated agriculture in the Project Area. The Project Extension Manager will be posted in Taikkyi township and will render his services under the control of AC Divisional Manager.

In addition, it is proposed to appoint four Subject Matter Specialists, that is, Soil and Fertilizer Specialist, Paddy Cultivation Specialist, Upland Crops Cultivation Specialist and Vegetable Cultivation Specialist.

In principle, extension services in the village tract and village levels will be carried out by the existing organizations, however, it is proposed to increase the number of Village Managers so that one Village Manager will be responsible for extension services in 1,000 ac. Furthermore, the number of Village Trace Managers should be increased by about 20% of the existing one.

A detailed extension service programme for the irrigated agriculture will be drawn up focussing on the above-mentioned organizations and line-up, and will be put into practice by such organizations.

The Project Extension Manager and Subject Matter Specialists will undergo a home training given by an expert under the Project, and an overseas training as well. They will be responsible for the above-mentioned field trials as well as demonstration of successful results of tests.

It would be the most effective way of demonstration to show successful results of tests at actual farm fields of farmers, therefore, some farmers' farm lands will be selected and used for demonstration. Such a farm land shall be selected evenly in each irrigation block. Before the implementation of the Project, sufficient preparatory works should be made for the operation of such demonstration farms.

7.3. Farmers' Organization for Terminal Water Management

Terminal level water management should be carried out, based on framed rules, by a farmers' organization to be established in each irrigation water distribution block. It will be difficult to have similar irrigation and drainage conditions all over the Project Area where the distribution and topographic conditions of farm lots are quite different each other because the improvement of irrigation and drainage conditions can be made only within an allowable extent of cost. It will be, therefore, required to establish voluntarily rules for the terminal water management not only among the related farmers within a terminal water management block but also among farmers' organizations for the terminal water management.

In this aspect, the following should be realized in the Project;

i) To prepare detailed cadastal maps and cultivation block maps, and based upon these maps, to design the best-suited terminal water management blocks with irrigation and drainage facilities;

ii) To organize farmers' organizations and give farmers guidances in the terminal water management.

7.4. Supply of Seeds and Agricultural Input Materials

The Project will require a larger amount of seeds and the other agricultural input materials than the present amount. AC should formulate, with full responsibility, an agricultural input materials supply programme. In this case, the supply should be made for all the selected crops instead of the present supply for the limited crops.

7.5. Expansion of Agricultural Credits

The agricultural credit should be rendered by the Government to farmers in procurement of seeds of a high quality, necessary fertilizers and agricultural chemicals and for executing farm management.

7.6. Expansion of Farm Machinery Operation Services

For a high cropping intensity, scheduled farming and soil improvement, the expansion of farm machinery operation is required. The AMD tractor station concerned with the Project Area considers that it will be possible to expand their services of farm machinery operation and others in parallel with the Project implementation.

7.7. Strengthening of Organizations and Expansion of Facilities for Processing and Marketing of Agricultural Products

The Government agencies concerned with the marketing and processing of agricultural products, Farm Produce Corporation (AFPTC) for rice and other cereals and Textile Industries Corporation (TIC) will be responsible for strengthening their organizations and for expanding their warehouse capacity.

8. Agricultural Administration

As mentioned in Chapter III-D-11, the present agricultural administration system is quite different from that in the other countries, however, it is effectively functioning in this country. After completion of the Project, therefore, it might be unnecessary to change their agricultural administrative structure.

For implementation of the Project, however, a strong branch of the Irrigation Department should be newly established in the Project Area which will function as the executing agency of the Project and be responsible for construction of the proposed facilities during the construction period as well as for operation and maintenance of the constructed facilities after implementation of the Project. (Details of this organization are shown in Chapter V- C) At the same time, extension services should be strengthened in order to achieve the proposed agricultural development after construction of the irrigation facilities. (Details of strengthening of the extension services are mentioned in the previous paragraph.) It is strongly requested that the both organizations should make close cooperation and strong coordination under the supervision of the People's Council. For this purpose, a strong Coordination Committee may be recommended to be organized in the Tsp People's Councils concerned. Needless to say, the both Tsp Coordination Committees should hold a joint meeting as occasion demands.

On the other hand, it should be recommended to newly organize "the WATER MANAGEMENT ASSOCIATION" on the farmers' level in every irrigation block of about 50 ha commanded by a water course after completion of the Project. All the farmers to be benefited from each water course should be a member of the association. The main purpose of this organization is to make effective irrigation and accordingly to operate and maintain its water canals properly. If water charge is imposed, its collection also should be carried out by this association, although an issue of water charge is now under consideration of the Goverment. Anyway, from ancient time, water-utilizing farming has brought farmers concerned into solid combination, and on the other hand, without such combination of farmers concerned, any success could not be expected in irrigation farming.

In this sense, it is further proposed that this organization should become the core of the irrigation farmers to introduce modern techniques jointly into their farming practices. At the same time, it is suggested that extension workers should contact farmers through this organization. As such, it will be easy to make so-called "group training" for extension of modern farming, which makes extension services more effective.

Lastly, strengthening of agricultural credit system should be hoped because farming will become more intensive not only from the view point of labor input but also from that of capital input, after completion of the Project. As pointed out already (in Chapter III-D-8), present limited agricultural credit should be increased, for example, up to Ks.150/ac in case of paddy cultivation, and so on. Moreover, advance distribution of fertilizers should be made completely to a large extent.

D. Project Facilities

1. Dam

1.1. Dam Site and Dam Axis

Based on a comparative study on two potential dam sites, the downstream dam site, which is located about 1.8 km (1.15 miles) downstream of the confluence of the Okkan chaung and the Da chaung, has been proposed in the Project. The dam will be constructed across a narrow valley carved in sandy shale that belongs to the Obogon alternation.

The bottom elevation of the valley at the dam site is about 120 ft. Showing dendritic shapes, the reservoir will mainly extend to north-south directions along the above-mentioned chaungs.

In determining the dam axis, a straight axis has been selected taking into account the topographical and geological conditions at the site, the idea in seismatic designing and easy construction of the dam. (Refer to Appendix 4D-1.)

1.2. Dam Site Geology

Four boreholes with the total length of 97.5 m were drilled along the proposed dam axis, and the permeability tests were conducted simultaneously with the borehole drillings.

According to the drilling results, the foundation of the dam site is composed mainly of sandy shale and partially of thin sand stone layers. The fresh rock surfaces lay about six meters, eight meters and zero meter deep from the ground surface at the left abutment, right abutment and on the river bed, respectively.

Results of permeability tests made in the fresh rock show a relatively low value ranging from 6×10^{-5} cm/sec to zero.

Outcrops of the bed rock can be observed on the river bed and at lower portions of the right abutment. (Refer to Appendix 4D-1.)

1.3. Construction Materials and Dam Type

Alluvium terrace materials and deluvial soils are sporadically distributed along the Okkan chaung and the Migyaung chaung upstream of the dam site. According to result of the soil survey and tests, the above-mentioned materials are composed of sandy clay and clayey sand which belong to CL type under the Unified Soil Classification System, and can be utilized as impervious and semi-pervious materials of the dam body. The hauling distance of the materials will be about 1.4 km.

Sand and gravel materials for concrete aggregate and the filter and drain of the fill dam should be hauled, after screening, from the deposit materials of the Irrawaddy formation that exist around San Ywe village located some 10 km distant from the dam site.

Rock and riprap materials might be borrowed from a mountain body near the confluence of the Okkan chaung and the Miygaung chaung that is situated about 2.5 km upstream of the dam site.

At the Okkan dam site, a homogeneous type of fill dam with a central impervious zone has been proposed as the most suitable dam type taking into account the chord-height ratio, topographical and geological conditions and the distribution of embankment materials around the dam site. (Refer to Appendix 4D-1.)

1.4. Dam Design and Foundation Treatment

The dam crest elevation is determined by adding the freeboard, which is decided in the detail study, to the full water surface level of the reservoir, and adopted by 205 ft above mean sea level. Therefore, the height of Okkan dam is about 29 m (95 feet) from the im-

pervious zone surface. The distribution of embankment materials around the dam site is an important factor in design of a fill type dam. Borrow areas for embankment materials such as impervious materials (Zone 1) and random materials (Zone 2) have been determined at the terraces along the Okkan and Migyaung chaungs that are located about 1.4 km north of the dam site.

Cenozoic sandstone of the Kyaukkok formation is distributed near the confluence of the Okkan chaung and the Migyaung chaung. The distance from the dam site to the confluence is about 2.5 km. The quarry site for rock and riprap materials will be located here. However, it is noted that the utilization of these materials should be limited from the economic and lithologic points of view.

The design values of embankment materials as derived from the soil tests and data are summarized below;

Zone and Materials	Density			Shearing Strength		Permeability Coefficient
	γd [1] (t/m³)	γt [2] (t/m³)	γsat [3] (t/m³)	ϕ [4] (°)	C [5] (t/m²)	(cm/sec)
Zone 1 (Impervious)	1.61	1.93	2.01	21°00'	4.0	4.0×10^{-8}
Zone 2 (Random)	1.61	1.93	2.01	21°00'	4.0	8.0×10^{-8}
Zone 3 (Rock)	1.58	1.66	1.91	42°00'	0.0	

Note: 1/ Dry density, 2/ Wet density, 3/ Saturated density
4/ Angle of internal friction, 5/ Cohesion

Stability computations of the dam body have been carried out by the effective stress analysis method, one of the slip circle methods, taking into consideration the pore pressure and earthquake acceleration.

Based on the stability analysis result for the dam body, the upstream and downstream slopes of the dam have been determined at one vertical to 3.8 and 2.8 horizontal, respectively, as shown in Drawing D-1002. The cases taken into consideration and the factors of safety obtained in the stability analysis are tabulated below;

Reservoir Condition	K[3]	Slope	F.S.[4]	Pore Pressure
After completion, with F.W.S.[1]	0.15	Upstream	1.229	Steady flow
	0.15	Downstream	1.365	Steady flow
Rapid drawdown from F.W.S. to D.W.S.[2]	0.075	Upstream	1.716	Unsteady flow

Notes: 1/ Full water surface level in the reservoir adopted by EL 195 ft.

2/ Dead water surface level in the reservoir adopted by EL 155 ft.

3/ Horizontal seismicity adopted by 0.15 in usual case and 0.075 in special case

4/ Factor of safety

The riprap with 0.6 m thick shall be hand-placed on the upstream surface in order to dissipate the wave energy and to decrease the uprushing height of waves in the reservoir. At the downstream surface of Zone 1 (impervious zone), the filter zone of three meters thick shall be placed in order to prevent fine materials contained in the impervious zone from washing out.

As regards the foundation treatment of Okkan dam, a stripping depth for the entire dam base will not exceed one meter inclusive of removal of all vegetal soils although a deep excavation of 1.5 to 10 m will be required for the impervious zone base so as to reach the bed rock and to avoid the differential settlement of the dam body.

Judging from the permeability test results, the fresh bed rocks at this site are observed to be semi-impervious showing a smaller permeability than 6×10^{-5} cm/sec.

In this view, the grouting treatment in two rows will be sufficient to improve the bearing capacity with uniformity and to obtain an impervious curtain in the dam bed-rocks and the foundation of spillway crest. (Refer to Appendix 4D-1.)

1.5. Spillway

A no-control open-type spillway will be installed on a skinny mountain ridge at the right bank of the dam site independently, taking into account the applicability of topographic features, non-resistance of fill-type dams against overtopping of unexpected floods, hydraulic characteristics of this type of spillway, avoidance of risk caused by the gate control, and geological conditions at the spillway site.

From the comparative study on design flood discharges of the spillway, the running discharge of 150 cu.m/sec through the spillway in peak has been adopted in designing the spillway taking into consideration the storage effect of the reservoir above its full water level when a 1,000-year probable flood of 1,143 cu.m/sec flows into the reservoir. Due to the above-mentioned fact, the reservoir formed by Okkan dam will play a great role in flood control.

A complete overflow-type of crest with the arc-shape alignment of which curve length is 60.5 m will be installed at the entrance of the spillway from which a concrete-lined discharge carrieir including a rectangular chute of 15 m wide will be constructed to connect a stilling basin type of an energy dissipator to prevent excessive erosion and scouring. At the downstream of the stilling basin, a tail race canal without lining will extent to the existing river course of the Okkan chaung.

If the ultimate flow-out capacity of the spillway is defined as the allowable inflow discharge to the reservoir when the maximum water level reaches the dam crest which is computable in consideration of the storage effect and discharge through the spillway, the said inflow discharge is estimated at 13,900 cu.m/sec, which will be unforeseeable in terms of excess probability. (Refer to Appendix 4D-1.)

1.6. Irrigation Outlet

Okkan dam will be constructed not only for irrigation but also for hydroelectric power generation, and almost all storage water will be used for the both purposes. The storage water which will be released through the outlet facilities will flow into the existing river.

A cylindric drop inlet-type of intake with a trush-rack which will be installed near the upstream toe of the dam body and an inner steel lining conduit of 2.4 m inside diameter having a bifurcation pipe have been designed as the outlet facilities. To control the maximum discharge at 22.5 cu.m/sec to meet the irrigation demand, a corn valve of 1.43 m diameter will be installed. It will function both for discharge control and energy disipation at the end of irrigation conduit. During the operation of the hydroelectric power plant, the maximum discharge of 15 cu.m/sec will be diverted for hydro-electric power generation from the irrigation conduit through a bifurcation pipe to the plant, and this water will be used for irrigation purpose again. (Refer to Appendix 4D-1.)

1.7. Diversion Facilities

The construction works of dam body will be made in two stages, that is, works for the river channel portion and works for the Wadi channel portion taking into account the topographic features, construction method and schedule and diversion of the Okkan chaung river flow. During the construction at the river channel portion,

the Okkan chaung flow will be diverted to the unlined open canal which will be constructed along the wadi channel located at the left side of the dam site, and this canal should be filled by embankment materials in the last dry season of the construction period.

A coffer dam of about 10 m high should be constructed at the upstream of the dam body, and a smaller temporary coffer dam with a crest elevation of 130 ft will be also necessary at the downstream of the dam body in order to fully protect the construction site. The upstream coffer dam is designed as a part of the main dam body so as to save the embankment works.

The design flood discharge of the diversion facilities such as the open canal and the coffer dam has been decided at 100 cu.m/sec based upon a comparative study in consideration of the storage effect of the upstream coffer dam when a 10 year probable flood discharge of 515 cu.m/sec flows into the reservoir. (Refer to Appendix 4D-1.)

2. Diversion Dam

2.1. Selection of Dam Site

The proposed diversion dam has been planned to divert at the nearest point to the service areas inflows to the downstream reaches of Okkan dam and a released water from the said dam. In general, diversion dam sites should be selected to minimize the damming-up height. In the Project it is desirable to select a river bed of which elevation is as high as the highest service area of EL.21.00 m (70.0 ft). The site with the elevation of 70.0 ft can be, however, found along the Okkan chaung only at the point 28.0 km upstream from the expected service area. Hence, the canal construction would be costly although a low damming up meet the requirement.

The both banks have a height of more than 25.5 m (85.0 ft), which corresponds to NWL of 22.5 m (75.0 ft) plus the free board of

3.0 m (10.0 ft), at the point of the Okkan chaung about 200 m upstream of San Ywa village and about 17 km downstream of the Okkan dam site. The lowest river bed elevation at this site is about EL.13.5 m (45.0 ft), resulting in the necessary damming-up height as follows;

WL.22.5 - EL.13.5 = 9.0 m (30.0 ft)

The proposed site is, however, located at a considerably straight river course with a sufficient river width for smooth discharging of floods in the terms of river training.

2.2. Diversion Dam Type and Geology of the Dam Site

In general, a fixed type weir is more economical than a movable one of a similar capacity. However, no fixed type weir could be employed in the Project from the viewpoint of river training since the weir crest of EL.23.4 m (78.0 ft) and the ground surface inside the river banks of EL.25.5 m (85.0 ft) have a so small difference as 2.1 m (7.0 ft). In due consideration of the above mentioned topographic conditions, a movable weir should be adopted in spite that its construction will be costly.

Geologically the river bed at the proposed diversion dam site consists of the following;

- Surface layer: Silty sand or sand layer of three of six meters thick (10 to 20 ft)
- Second layer: Weathered sandstone layer of 0.9 m thick (3.0 ft) of which N value ranges from 10 to 25
- Deep layer: Fresh sandstone layer of which N value is more than 100

Under the conditions, the proposed weir body should be a fixed type. The related intake facilities should be installed at the left bank in consideration of the convenience in supplying irrigation water to service areas extending on the left bank.

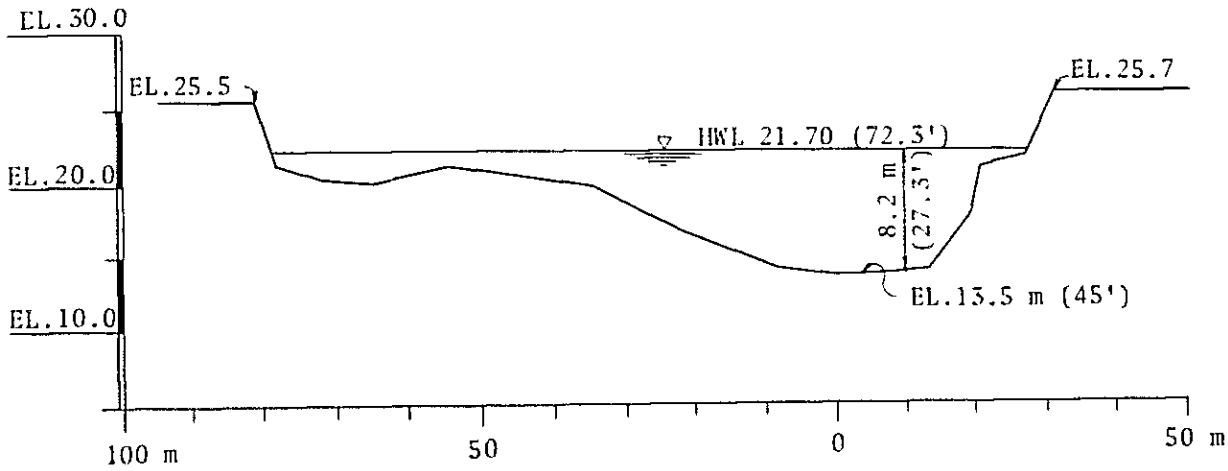
2.3. River Water Level

(1) Design Conditions

Based on data and information shown in Chapter IV-2 of this report as well as results of the surveys, the design flood, river bed slope and the roughness coefficient have been determined as follows;

* Design Flood: Qf = 370 m^3/sec (100 - year probability)
* River Bed Slope: I = 1/3,000
* Roughess Coefficient: n = 0.040

(2) Present Highest High-water Level



A = 358.6 m^2

P = 100.7 m

R = 358.6/100.7 = 3.56 m

$$V = \frac{1}{0.040} \times 3.56^{2/3} \times (1/3{,}000)^{1/2} = 1.06 \text{ m/s}$$

Q = 358.06 x 1.06 = 380 m^3/s > 370 m^3/s

Therefore, the present highest high-water level is decided by HWL 21.70 m (72.3 ft).

2.4. Highest High Water Level with Diversion Dam

The designed highest high water level has been determined at HWL 23.4 m (78.0 ft), that is, a difference between the elevation inside the both river banks at the proposed diversion dam site (25.5 m or 85.0 ft) and the freeboard of 2.1 m (7.0 ft).

On the other hand, a river width to be required for smooth discharging of the design flood discharge of Qf = 370 cu.m/sec is determined by 370 ÷ 8.7 = 42.5 m ≒ 42.6 m (142 ft) in consideration of the present maximum unit width discharge of 8.2 m x 1.06 cu.m/sec = 8.7 cu.m/sec/m in designing.

In this case, complete overflow is expected to take place, and since the over flow depth is computed by

$$H = \left(\frac{Q}{C.B.}\right)^{2/3} = \left[\frac{370}{1.7 \times (42.6 - 4.2)}\right]^{2/3} = 3.18 \text{ m}$$

= 3.30 m (11.0 ft), the elevation of the gate sill can be determined by HWL 23.4 m (78.0 ft) - 3.3 m (11.0 ft) ≒ 20.1 m (67.0 ft).

The lowest low-water level was determined by
FWL 23.4 - 1.65 m = LWL 21.75 m (72.5 ft).

2.5. Spanning of Movable Portion

Based on the necessary river width of 42.6 m, the total length of span can be obtained by
42.6 m + 2.1 m = 44.7 m.

Therefore, three gates are required as follows;
15.0 m x 3 units = 45.0 m (150.0 ft)

The gate dimensions required can be determined by

Net one span 12.9 m (43.0 ft) x Leaf height

3.30 m (11.0 ft) x 3 units = 9.9 m (33.0 ft).

2.6. Bottom Elevation of Intake Structure

To keep the intake water depth at 1.2 m, which is obtained in deducting 1.2 m from the normal water level above the gate sill by 2.4 m, the bottom elevation of the intake structure has been determined by

NWL 22.5 m - 1.2 m = 1.2 m = EL 21.3 m (71.0 ft).

2.7. Width of Intake Structure

According to the data of designed intake amount: 22.5 cu.m/sec, intake water depth: 1.2 m and inflow velocity: 0.9 m/sec, the width of the intake structure has been determined as follows:

$$\text{Width of Intake Structure } \frac{22.5}{1.2 \times 0.9} = 20.8 \text{ m}$$

from which,

2.1 m (7.05 ft) x 10 = 21.0 m (70.0 ft)

2.8. Design of Weir Body

The weir body, being allowed to contact with the foundation rocks only at the cut-off portion, shall be of a semi-fixed type that can be expected to completely prevent groundwater from intruding. As discussed in Appendix 4D-2 to this report, the 28.5 m (95.0 ft) long apron and 66.0 m (220.0 ft) long rip-rap are to be provided at the downstream to protect the weir body against damming-up 9.9 m (33.0 ft) in elevation.

3. Irrigation Canal

3.1. Canal Alignment

A plan of irrigation canal networks has been formulated based on findings during the field survey as well as studies based on the two topographic maps of 1/63,360 (1 inch/1 mile) and 1/[illegible],960 in scale. In planning the networks, care was paid to irrigate the largest areas possible under the topographic restrictions on the Project facilities and service areas.

The canal system consists of main irrigation canals, lateral irrigation canls, sub-lateral irrigation canals, main water courses, supplemental water courses and field ditches in general.

Proposed Length of Irrigation Canal

Description	Length (km)
Main irrigation canal	41.8
Lateral irrigation canal	68.2
Sub-lateral irrigation canal	145.6
Main water course	252.0
Supplemental water course	1,174.0
Total	1,681.6

3.2. Canal Section

Taking into account the soil properties of embankment materials for canal, earth canals without lining have been proposed for irrigation except the main and lateral canals. The main and lateral canal will be provided with brick lining for easy operation and maintenance.

For the safety of canal slopes, all canals will have a trapezoid cross section. The slopes of brick lining canals will be 1:1.25 whereas that of earth canals without lining 1:1.5. The base-depth

ratio of one to two has been employed as a rule taking into consideration the tropographic conditions of the service areas specially the slope of water surface in irrigation canals. The Manning's formula was used in hydraulic computations. The roughness coefficient "n" has been determined at 0.025 for brick-lining canal and at 0.030 for earth canal without lining.

The main, lateral and sub-lateral irrigation canals will have a free board of more than 0.3 m, and the main and supplemental water courses the free board of 0.15 m so that the canal will be able to convey fluctuating discharges therein. The allowable velocity of canal flow has been determined between 0.25 m/sec to 0.90 m/sec to protect canals from silt accumulation and from scouring. A higher velocity than the above-mentioned will be allowed in aqueducts and syphons to meet the requirement of flushing away silt in the structures.

3.3. Related Structure

(1) Related structure for water conveyance

The following structures will be required for conveying irrigation water across the existing rivers, railway and roads.

Aqueduct;	At crossing of a canal with a river
Syphon;	At crossing of a canal with a river or a railway
Culvert;	At crossing of a canal and a road

(2) Related structures for diverting irrigation water

Head gates will be installed to divert irrigation water from the main irrigation canals to lateral irrigation canals. Furthermore, turn-out of the orifice type will be used to divert irrigation water from a lateral irrigation canal to sub-lateral irrigation canals.

(3) Related structure for discharge control

Check gates will be installed on irrigation canals where difficult to maintain an adequate level of canal water without such structures. In addition, drops will be used to keep water velocity in a canal within an allowable limit where the canal has a too steep bed slope. The drops will have the function of a check gate, where possible, to save the construction cost of these structures.

In order to drain to the existing river an excess discharge coming into canals in rainy days and a surplus water in canals caused by the operation of turn-outs, etc., wasteway of a side weir type will be constructed.

A parshall flume will be installed at the upstream most of the main and lateral canals to measure discharge in these canals.

4. Drainage Canal

4.1. Canal Alignment

Canal alignment for drainage has been made based on findings in the field surveys of service areas and the downstream areas of the service areas to which drainage water will be released. In planning drainage canals, two sets of topographic maps. 1/63,360 (one inch/one mile) and 1/3,960 (one inch/330 ft) in scale, were employed. In order to minimize the construction cost of drainage canals, the effective use of the existing river system for drainage purpose has been planned paying attention to the potential drainage capacity of rivers.

Proposed Length of Drainage Canal

Description	Length (km)
Main drainage canal	22.7
Lateral drainage canal	112.8
Sub-lateral drainage canal	145.6
Drainage ditch	236.9
Total	518.0

4.2. Canal Section

Earth canals of the trapezoid shape have been planned for drainage. The canals will have, in principle, a base-depth ratio of 0.8 to 2.0. The Manning's formula was employed in computing drainage discharges in canals. The roughness coefficient n of 0.040 has been applied in planning drainage canals.

5. Roads

The proposed road networks have been planned to utilize the embankment crests of the main canals, main water courses and supplemental water courses so that operation and maintenance of the Project facilities could be effectively carried out.

The width of roads will be 3.6 m (12.0 ft). The O & M roads along the main canals, lateral canals are planned to be paved with gravel, whereas the existing communal roads require rehabilitation paved with concrete.

Extension of Roads

(Unit: km)

Kind of Road	
Gravel paved O & M Roads	110.0
No paved O & M Roads	145.6
Concrete paved Communal Roads	14.0
Total	269.6

6. On-farm

6.1. Selection of Sample Area

In the course of the field survey, two sample areas were selected. One sample area is located in Ohnbinzu village near the Magri weir in the northern part of the Project Area. The other is located in Lathegone village near the national road in the southern part of the Project Area.

6.2. Model Design for Sample Area

Model design of irrigation and drainage canals with their related structures has been carried out for the sample area at Lathegone village of which topographic map with scale of one inch to 200 feet was obtained. Based on this model design, required cost have been estimated.

The results of design and estimate are applied to on-farm development works in the whole Project Area.

(1) Basic concept of facilities

The typical irrigation block consists of five irrigation units, and each unit covers 10 ha (25 ac). A supplemental water course, a division box, off-takes and an end check are provided in each unit. Field ditches will be provided by farmers themselves.

A main water course and a drainage ditch will be constructed in each irrigation block. (Refer to Appendix 4D-6.)

(2) Design of on-farm facilities in the sample area

Required facilities for the sample area are summarized as follows:

Size of Sample Area	100 ha (247 ac)
Number of Irrigation Block	2
Average Area of an Irrigation Block	50 ha (124 ac)

Water Courses (W.C.)

Main W.C.	
Total length	1,200 m (3,937 ft)
Length per ha	12 m (16 ft/ac)
Supplemental W.C.	
Total length	5,592 m (18,346 ft)
Length per ha	56 m (74 ft/ac)
Total of W.C.	6,792 m
Length per ha	68 m (90 ft/ac)
Division Box	
No. of division boxes	16 m
No. per ha	0.16 m (0.06 ft/ac)
Off-take	
No. of off-takes	50 m
No. per ha	0.50 m (0.20 ft/ac)
End check	
No. of end checks	10 m
No. per ha	0.10 m (0.04 ft/ac)

7. Electric Power Plant

The main equipment and facilities to be required for the porposed electric power plant are as follows;

(1) Hydraulic Turbine

Type	:	Vertical Shaft Kaplan
Maximum Output	:	2,450 KW
Revolution	:	429 RPM
Number of Unit	:	1 set

(2) Generator

Type	:	3-phase AC Generator
Output	:	2,700 KVA
Voltage	:	6.6 KV

Power Factor	:	0.85
Frequency	:	50 Hz
Revolution	:	429 RPM
Number of Unit	:	1 set

(3) Main Transformer

Type	:	Outdoor, 3-phase, Oil-filled, Air-cooled (ONAN)
Capacity	:	2,700 KVA
Voltage	:	Primary; 6.6 KV Secondary; 33.0 KV
Frequency	:	50 Hz
Number of Unit	:	1 set

(4) Control Equipment : 1set

(5) Switchyard

Type	:	Indoor, Metal-clad type

(6) Powerhouse

Type	:	Open type
Dimension	:	Approx. $^{L}23.2$ m x $^{W}12.5$ m x $^{H}21.3$ m

(7) Transmission Line

Size of Conductor	:	ACSR 226.8 MCM (26/7 strands)
Line Voltage	:	33 KV
Number of Circuit	:	Single
Length of Route	:	Approx. 32.6 km (20.3 miles)
Route of Line	:	Okkan power station to Tharrawaddy substation

E. Cost Estimate

The total investment cost (financial cost) including the cost for price escalation but excluding the interest during the construction period is estimated at US$54 million (372 million Kyats) of which US$25 million (174 million Kyats) will be the foreign currency component and US$29 million (198 million Kyats) will be the local currency component.

Table 4-2 shows the breakdown of the investment costs by major items, and their detail estimation is given in Appendix 4E-1.

The financial cost of the Project per hectare is estimated at 17,736 Kyats based upon the following conditions:

(1) The procurement cost of construction equipment is involved in the cost estimate whereas depreciation cost of them is excluded from cost of civil works; and,

(2) Price escalation is included.

The annual disbursement schedule for the investment cost is shown in Appendix 4E-2. The Project cost estimate has been made in the following manners:

1. Civil Works

The cost of civil works consists of the construction cost for engineering works in the Project, which is estimated based on unit costs including the cost for construction materials, fuel and oil, and repair of equipment and labour. The depreciation costs of the imported construction equipment and workshop equipment are not included in the item of civil works.

The major items of civil works are as follows:

Preparation	:	to include necessary preparation works for the construction of Okkan dam, diversion dam and irrigation & drainage canals.
Okkan Dam	:	to include diversion works, dam foundation treatment, dam embankment, spillway, outlet works.
Diversion Dam	:	to include foundation treatment, dam body, gates and intake facilities.
Irrigation Canal	:	to include construction works of main, lateral and sub-lateral irrigation canals and their related structures and to include service and on-farm roads along the main, lateral, sub-lateral canals and water courses.
Drainage Canal	:	to include construction works of main, lateral and sub-lateral drainage canals and their related structures.
On-farm	:	to include construction works of main and supplemental watercourses, drainage ditch and related structures.
Road	:	to include improvement of existing roads.
Hydropower	:	to include construction works of the power plant and transmission line.

Pre-Engineering : to include survey works for major facilities such as the dam, diversion dam, irrigation and drainage canals. Descriptions on the required items are given in Appendix 4L-1.

2. Construction Equipment

The construction equipment and spare parts will be imported by the Government on the lump-sum basis except small equipment which will be available in Burma. The cost of construction equipment and spare parts is estimated on the basis of CIF, Rangoon inclusive of the custom duties and other local taxes to be imposed in Burma. Unloading cost at Rangoon Port and transportation cost from the port to the construction site are added to the above purchase cost.

3. Agricultural Development

The costs required for agricultural supporting services are included.

4. Operation and Maintenance

The project cost involves operation and maintenance costs for four years from FY 1985/86 to FY 1988/89, which are required to operate and maintain the Project facilities constructed already during the construction period.

5. Project Facilities and Project Administration

The costs involve those of project facilities such as buildings, furnitures and equipments and of government staff to be engaged in the newly organized project office.

6. Consulting Services

Engineering fee for consulting services covers the implementation of final design and supervision of the Project.

7. Contingency

Allocation for contingencies is included in the total base to cover minor differences in actual and estimated quantities, unforeseeable difficulties in construction, possible changes in plan because of site conditions or uncertainties regarding foundation conditions. The adopted percentage of contingencies on each item for the Project is 15 percent.

8. Price Escalation

Price escalation for foreign currency component is estimated using the following international price index of World Bank and that for local currency component is assumed at a half of each year' index lised below.

Price Escalation Index

(Unit: %)

1982	1983	1984	1985	1986	1987	1988
8.0	7.0	6.7	6.5	6.3	6.2	6.0

9. Unit Cost

The cost of construction materials and labor to be used in the Project are estimated on the basis of the prevailing prices as of March 1981 in Irrigation Department.

Table 4-2. Investment Cost of the Project (Financial Cost)

Description	Total		Foreign Currency		Local Currency	
	$'000	K'000	$'000	K'000	$'000	K'000
A. Final Design	623	4,292	552	3,806	71	486
B. Implementation						
1. Civil Works[1]						
1.1. Preparation	1,122	7,730	96	660	1,026	7,070
1.2. Main Dam	2,865	19,742	1,514	10,430	1,351	9,312
1.3. Diversion Dam	1,161	8,000	533	3,675	628	4,325
1.4. Irrigation & Drainage Canal	14,383	99,100	3,526	24,292	10,857	74,808
1.5. On-farm	533	3,670	19	130	514	3,540
1.6. Road[2]	294	2,029	-	-	294	2,029
1.7. Hydropower Plant	4,506	31,047	2,823	19,451	1,683	11,596
1.8. Pre-Engineering	55	376	-	-	55	376
Sub-total (1.1 to 1.8)	24,919	171,694	8,511	58,638	16,408	113,056
2. Construction Equipment	6,826	47,030	5,418	37,330	1,408	9,700
3. Agricultural Development	721	4,970	399	2,750	322	2,220
4. Operation & Maintenance[3]	623	4,295	208	1,430	415	2,865
5. Project Facilities	464	3,200	21	145	443	3,055
6. Project Administration[4]	1,907	13,138	-	-	1,907	13,138
7. Consulting Services[5]	978	6,737	821	5,657	157	1,080
Sub-total (A to 7)	37,061	255,356	15,930	109,756	21,151	145,600
8. Physical Contingency	5,559	38,304	2,390	16,464	3,169	21,840
Sub-total (A to 8)	42,620	293,660	18,320	126,220	24,300	167,440
9. Price Escalation	11,436	78,791	6,955	47,920	4,481	30,871
Total	54,056	372,451	25,275	174,140	28,781	198,311

Note: [1] Exclusive of depreciation cost of construction equipments.
[2] Inclusive of improvement of existing roads only.
[3] During construction period only.
[4] 10% of (final design + item 1 to 5).
[5] Exclusive of consulting services for final design.

CHAPTER V. PROJECT IMPLEMENTATION AND OPERATION

CHAPTER V. PROJECT IMPLEMENTATION AND OPERATION

A. Executing Agency and Coordination

The Okkan Dam Irrigation Project is an integrated irrigation project which involves irrigation, drainage, on-farm development, road, and hydropower generation. For successful implementation of the Project, the Irrigation Department (ID) is fully responsible for construction and O & M of the irrigation facilities whereas the Electric Power Corporation functions as the executing agency for hydropower components. After construction of the project facilities, extension services should be strengthened to achieve the proposed agricultural development. The administration organization and agencies concerned, such as the Agricultural Corporation (AC) and Agricultural Mechanization Department (AMD) should cooperate very closely with ID.

In order to make a good coordination among them, a coordination committee should be established by those organizations and agencies. The coordination committee should consist of the responsible representatives of the related organizations and agencies in each component.

Under the control of the Project Director in each component the sections such as administration, engineering, construction, material, equipment, extension, applied research will be organized. These sections will keep close cooperation each other as shown in Figure 5-1, which indicates the proposed organization of the Project Office.

B. Implementation Method and Schedule

1. Implementation Method

The Project includes various kinds of civil works such as construction of a main dam, diversion dam, irrigation and drainage canals, roads, and hydropower station, etc.

There are two ways in implementing such civil works, that is, force account and contract basis. The Irrigation Department has carried out the survey, design, construction and supervision of many dams and irrigation facilities throughout the country. Furthermore, the Project includes no specific structures and construction method. Considering these facts, the Okkan Dam Irrigation Project is desirable to be implemented on force account basis.

2. Implementation Schedule

The Project requires relatively large-scaled civil works to command the area of 21,000 ha in net. The implementation schedule is proposed in due consideration of the scale and effective realization of the Project as shown in Figure 5-2.

The full-scale implementation of the project works will be commenced from the dry season in 1984 after completion of detail design for the whole project facilities and financial preparation and be completed in March 1989.

C. Operation and Maintenance

1. Executing Agency and Organization

Upon completion of the Project, the entire Project works will be turned over to the Rangoon Division of the Irrigation Department (ID) and the responsibility for operation and maintenance for all irrigation and drainage facilities will be given to the newly organized Irrigation System Office.

The proposed organization chart for the operation and maintenance is shown in Figure 5-3.

The headquarter and the Irrigation Superintendent would be subdivided into four supporting sections of Administrative Section, Engineering Section, Operation and Maintenance Section and Agricultural Section. The Administrative Section would handle the personnel

and records management, accounting and financial affairs. The Engineering Section would be responsible for design, cost estimates of construction works, supervision, etc. for the small-scale facilities and on-farm facilities. The Operation and Maintenance Section would be responsible for studying and planning the water distribution for carrying out the smooth O & M of the irrigation facilities, and for giving necessary instructions to the working stations to be provided under this office. The Agricultural Section would be responsible for introduction of new water management techniques and forming methods as well as for ensuring necessary agricultural supporting services to be extended to the area.

The Irrigation System Office controls the 12 Working Stations, one of which will be located at the Okkan dam site for O & M of the dam and another one of which will be provided at the proposed diversion dam site as well as a part of the main canals. As for the other 10 stations, each station will be provided to command about 2,000 ha (5,000 ac) for planning, and carrying out water management and O & M of the related facilities in the commanding area. The gate keeper and ditch tenders, who are responsible to conduct O & M services for the canals and other facilities, will be stationed in these working stations.

The Working Stations will have one supervising Water Management Technologist (SWMT) as Station Chief, who administers Water Management Technologists (WMT) by one personnel for every 500 ha (1,200 ac), who will be responsible for O & M and water management in the respective areas in charge. Besides the WMTs, the Gate Keepers (GK), one for every 250 ha (600 ac) and the Ditch Tender (DT), one for every 180 ha (450 ac), will be arranged in the Station, doing the routine works by instructions given by WMT.

One the other hand, it is proposed to establish a power organization control office (provisionally called) and dam site as an infrastructure of the Ministry of Industry (No.2), and the Electric Power Corporation (EPC) for carrying out O & M of the power plant

and proposed transmission line to be laid down between the power station and the Okkan sub-station.

2. Operation and Maintenance Cost

The operation and maintenance costs are summarized as follows:

Annual Operation and Maintenance Cost

Items	O & M Cost (K'000)
Direct Salary	2,819
Cost for Equipment & Materials	2,466
Administration & General Expenditure	849
Total	6,134

D. Consulting Services

The Consulting Services include those for final design and supervision of the Project and are divided into the following three phases:

(1) The final detail design of the Project as well as the preparation of tender documents for procurement of equipment. It will cover 54 man-months periods starting from FY 1983/84.

(2) Construction supervision and training of local counterpart personnel in all aspects of the project activities. The service would cover 90 man-months from FY 1984/85 to FY 1988/89.

(3) Training for irrigated agriculture. It would cover 20 man-months.

The proposed schedule for the Consulting Services is given in Figure 5-4.

FIGURE 5-1 PROPOSED ORGANIZATION OF PROJECT OFFICE

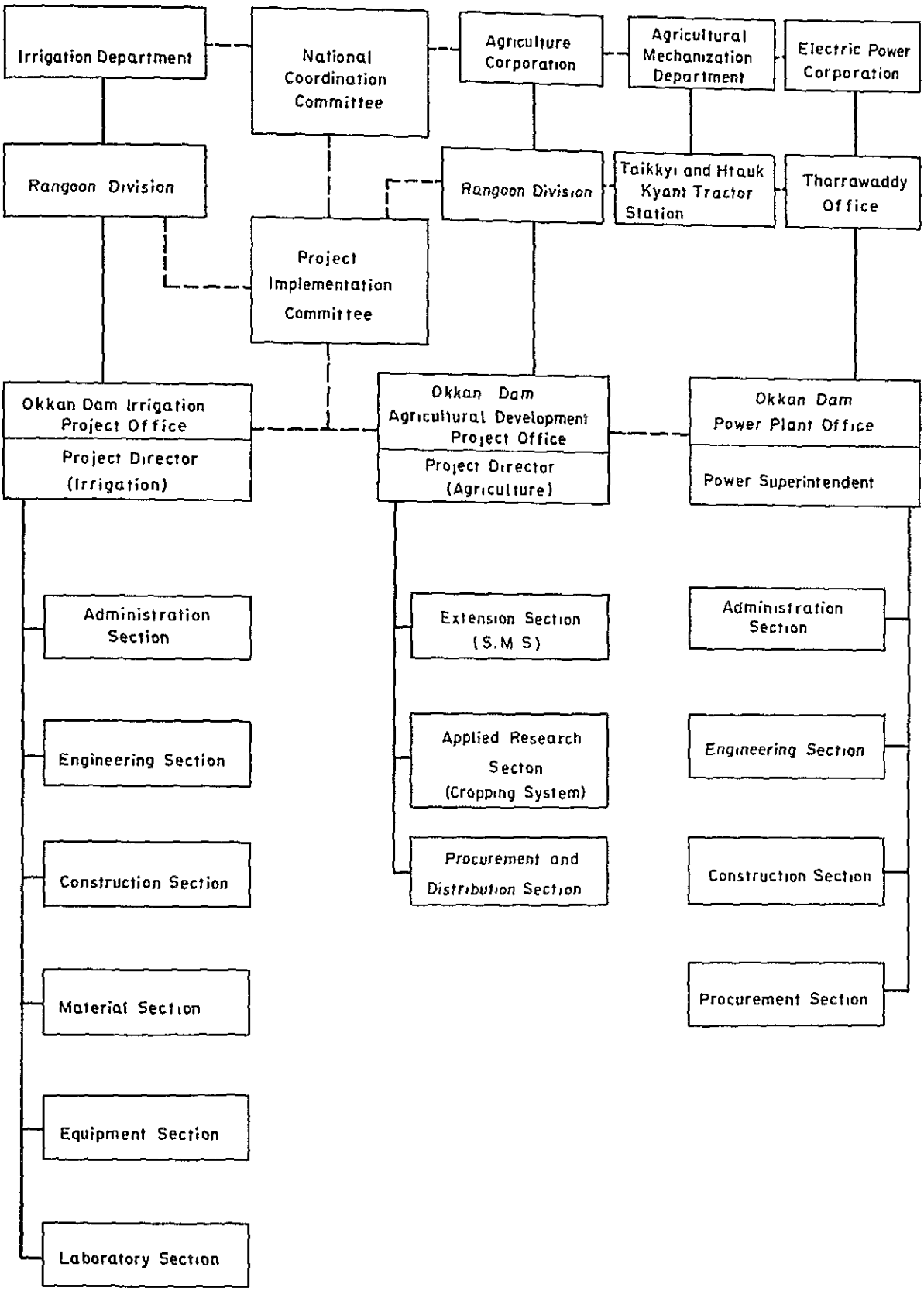


FIGURE 5-2 PROJECT IMPLEMENTATION SCHEDULE

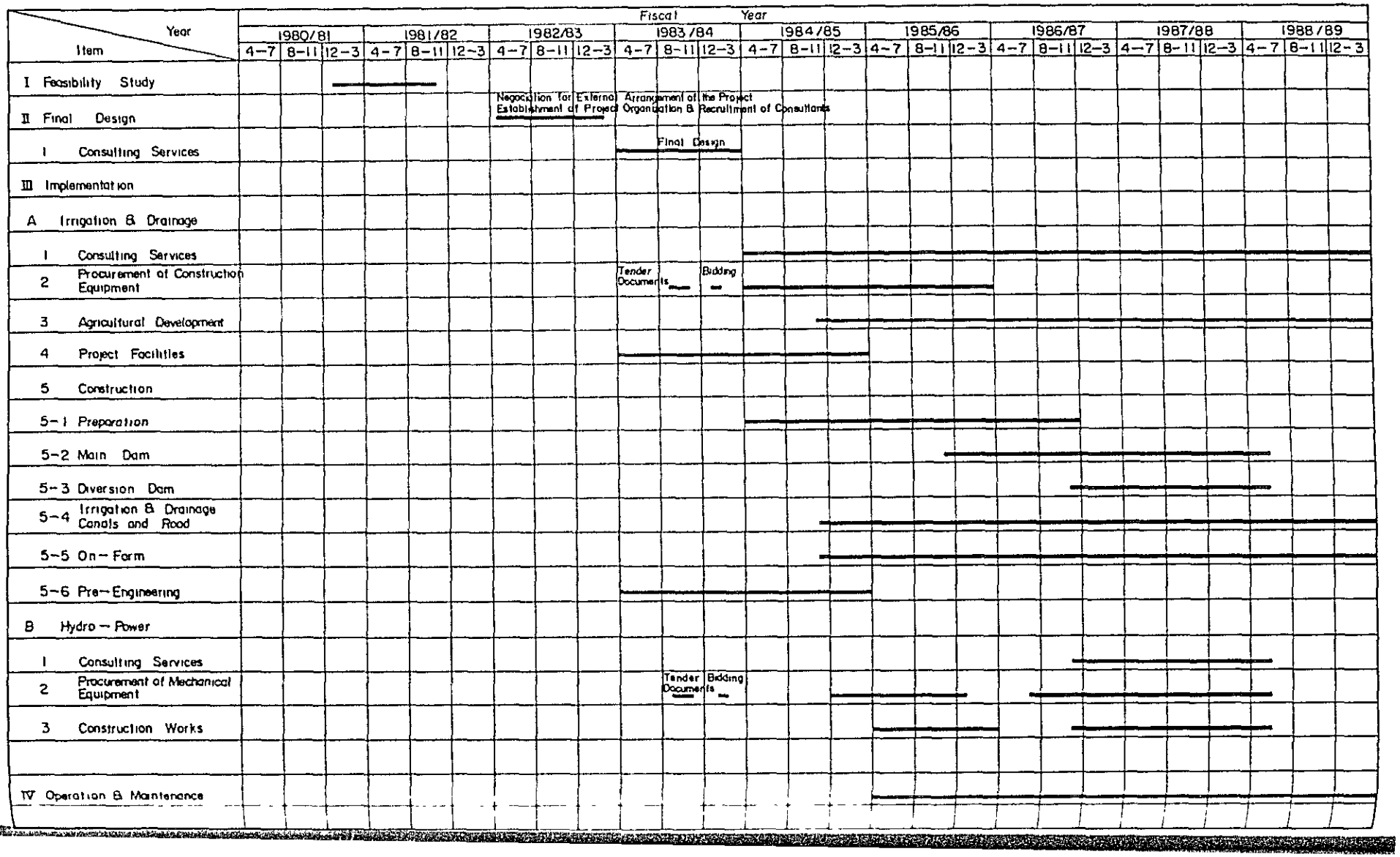


FIGURE 5-3 PROPOSED ORGANIZATION OF IRRIGATION SYSTEM OFFICE

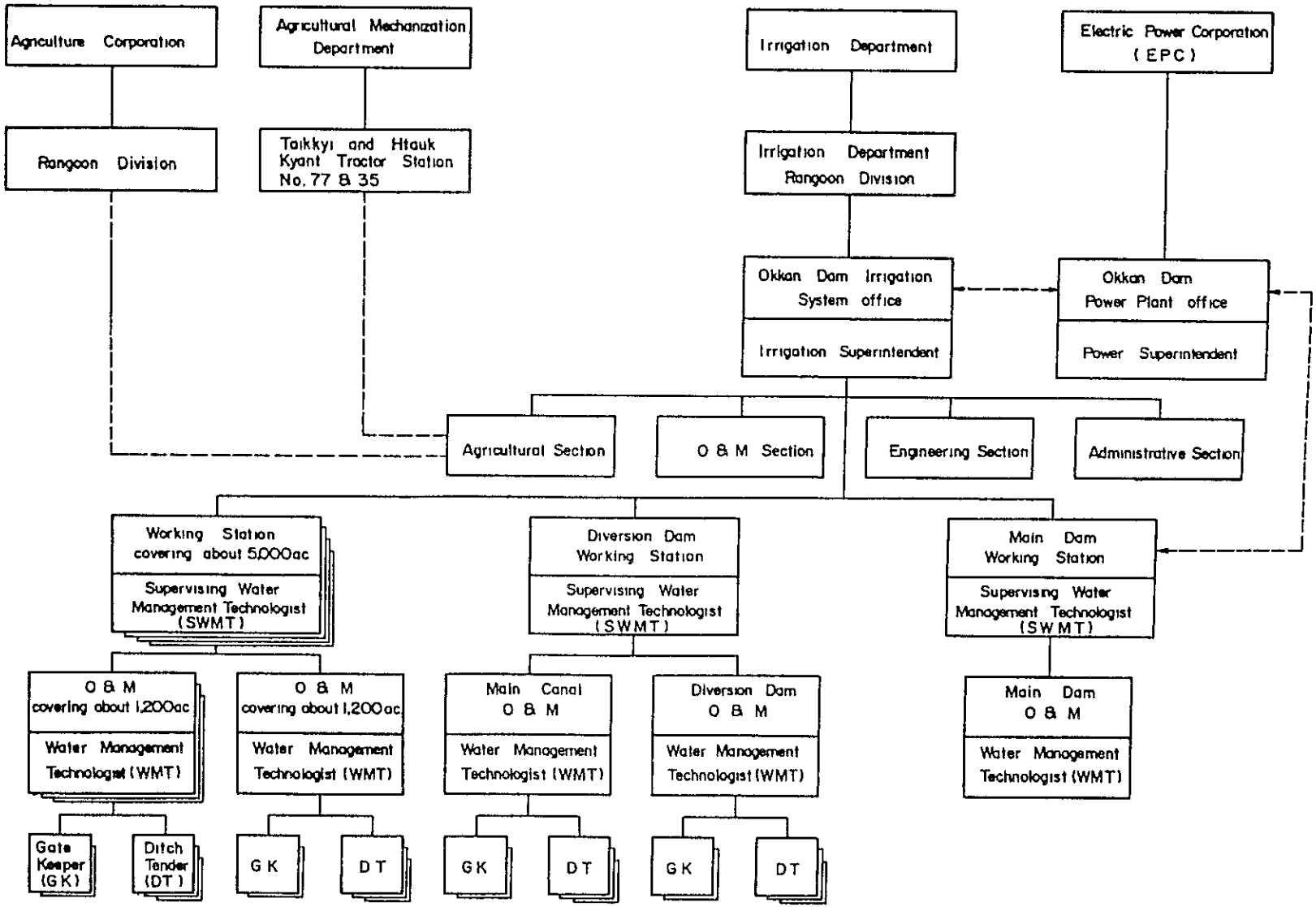
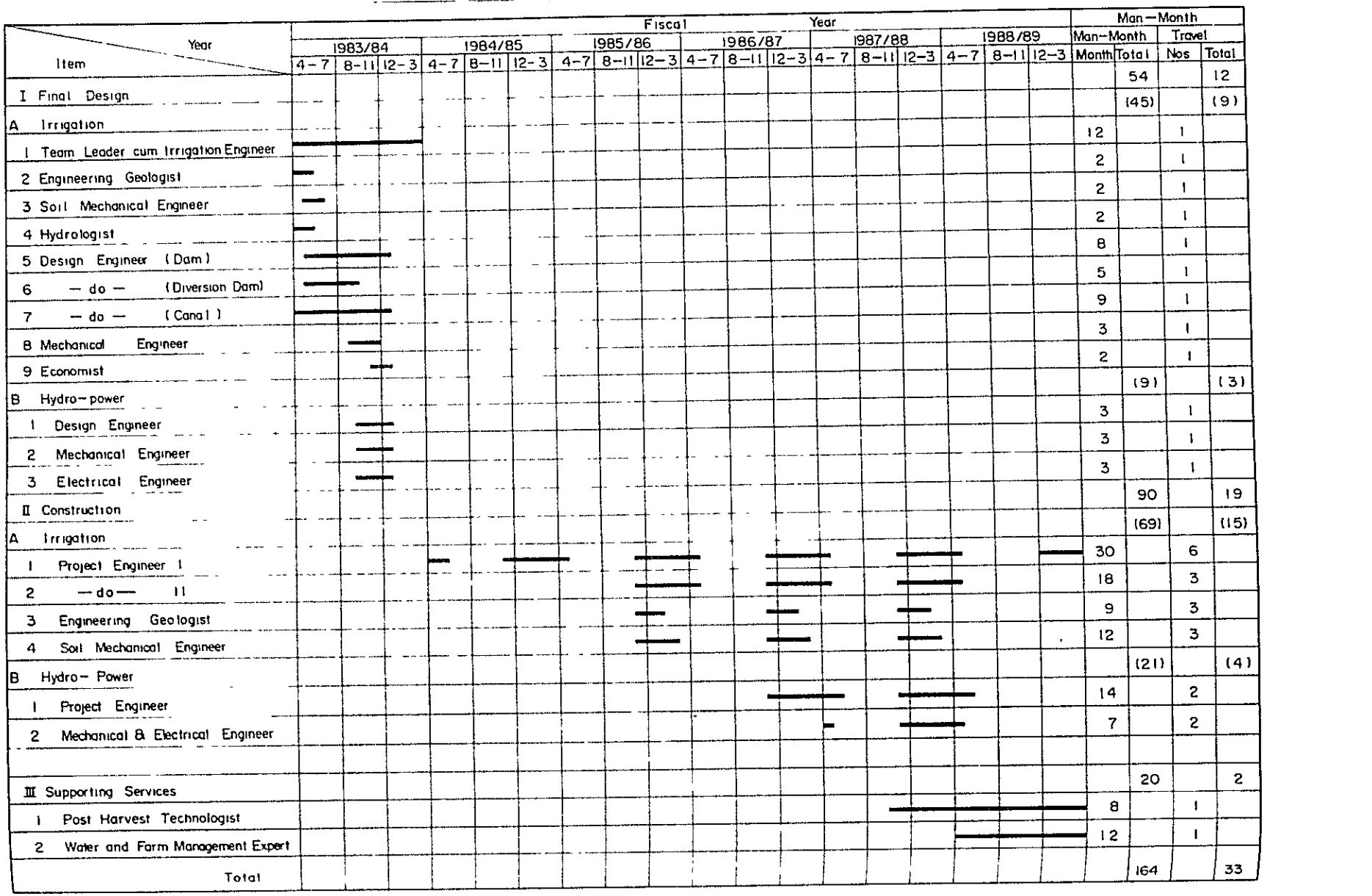


FIGURE 5-4 PROPOSED SCHEDULE OF CONSULTING SERVICES



Item \ Year	Fiscal Year 1983/84 4-7	8-11	12-3	1984/85 4-7	8-11	12-3	1985/86 4-7	8-11	12-3	1986/87 4-7	8-11	12-3	1987/88 4-7	8-11	12-3	1988/89 4-7	8-11	12-3	Man-Month Man-Month Month	Man-Month Total	Travel Nos	Travel Total
I Final Design																				54		12
A Irrigation																				(45)		(9)
1 Team Leader cum Irrigation Engineer																			12		1	
2 Engineering Geologist																			2		1	
3 Soil Mechanical Engineer																			2		1	
4 Hydrologist																			2		1	
5 Design Engineer (Dam)																			8		1	
6 — do — (Diversion Dam)																			5		1	
7 — do — (Canal)																			9		1	
8 Mechanical Engineer																			3		1	
9 Economist																			2		1	
B Hydro-power																				(9)		(3)
1 Design Engineer																			3		1	
2 Mechanical Engineer																			3		1	
3 Electrical Engineer																			3		1	
II Construction																				90		19
A Irrigation																				(69)		(15)
1 Project Engineer I																			30		6	
2 — do — II																			18		3	
3 Engineering Geologist																			9		3	
4 Soil Mechanical Engineer																			12		3	
B Hydro-Power																				(21)		(4)
1 Project Engineer																			14		2	
2 Mechanical & Electrical Engineer																			7		2	
III Supporting Services																				20		2
1 Post Harvest Technologist																			8		1	
2 Water and Farm Management Expert																			12		1	
Total																				164		33

CHAPTER VI. PROJECT JUSTIFICATION

CHAPTER VI PROJECT JUSTIFICATION

A. General

As well known, project justification is usually made from two points of view. One is from the view point of national economy, by which the project can be judged to be selected or not in comparison with other development project of the other resources. One more viewpoint is the individual economy of the project entity or beneficiaries of the project. And the former is studied through so-called economic analysis of the project, and the latter is studied through so-called financial analysis, although in case of irrigation project, it is through farm budget analysis.

This project includes not only irrigation project but also hydropower project. And the economic duration period of the both project facilities are different. Accordingly, economic analysis period is different between the respective project. Namely, it should be 50 years in the former case, whereas in case of the latter, it is assumed at 25 years after completion of construction (strictly speaking, 25 years after commencement of operation).

B. Price Analysis

All prices have been adjusted to the level of the beginning of 1981. All farm outputs and inputs were evaluated at the normal current farm gate prices. In this case, needless to say that regarding internationally traded commodies, their economic prices should be derived from the world market, although in case of non-internationally traded commodities, their economic prices will be derived from the local markets, and in both cases, financial prices will be derived from the local markets.

In this connection, the IBRD world market projection prices were referred for rice, jute, urea, T.S.P. and potassium chloride. But the IBRD projection price of mat'pe was not available, because

its trading amount is not so much in the world market, although this commodity is one of the exporting commodities in Burma. So, its economic price was derived from its actual f.o.b. price. As regards electric power, its economic benefit was derived from the cost of an alternative thermal power generation as in usual case.

As for agricultural chemicals, most of them are imported in this country, but the weight of agricultural chemicals in farm costs is not so high, and moreover, the government does not give any subsidy for distribution of them. Therefore, the present government controlled prices will be applied in both case of economic analysis we well as financial analysis.

Regarding farm labor wage rate, shadow pricing has been made based on the government minimum wage rate, which can be regarded as the opportunity cost of labor in this country. Farm machinery cost per acre was given by the Agronomist (See: "Farm Mechanization" in Appendix).

Shadow pricing for foreign exchange rate has been also made at 11 ks/US$ 1.00, taking into consideration the recent LBRD Appraisal Study in this country. And needless to say, this shadow foreign exchange rate will be employed to value the internationally traded commodities and the foreign component of farm costs as well as construction costs in the economic analysis, whereas for the purpose of financial analysis the current exchange rate which is ks 6.89/US$ 1.00 will be employed.

The detailed analysis can be seen together with the summarized table in Appendix 6A.

C. Analysis of Crop Economy

In order to make economic analysis, it is convenient to calculate economic net production value per acre per crop in both cases of without and with the project, and in order to make farm budget

analysis, it is also convenient to calculate financial farm income per acre per crop in both cases of without and with the Project.

In order to get the above, the following formulas will be applied.

E.NPV/ac = E.GPV/ac - E.FC/ac

Farm Income/ac = F.GPV/ac - F(cash)FC/ac

where,

E.NPV = economic net production value,

E.GPV = economic gross production value

E.FC = economic farm cost

F.GPV = financial gross production value

F.(cash)FC = financial (cash) farm cost

GPV (gross production value) can be gotten by multiplying farm gate price to the yield/ac which has been given by the Agronomist, and it has been worked out in Appendix 6C. And FC (farm cost) can be calculated by multiplying farm gate prices to inputs (labor and materials) requirements/ac. For this purpose, therefore, interview surveys were conducted with 30 farmers in 16 village tracts in the Project Area, the results of which will be shown in the Appendix 6B. As such, farm costs have been worked out in both cases of without and with the Project, as seen in Appendix 6C.

Consequently, crop economy of each crop concerned could be worked out as seen in Appendix 6C. The summarized results are as follows:

Crop Economy (Ks/ac)

	Economic NPV/ac					
	w/o case	1st yr.	2nd yr.	3rd yr.	4th yr.	5th yr.
Paddy HYV(s)	4,229	4,876	5,063	5,253	5,376	5,438
Paddy HYV(M)	3,917	4,252	4,439	4,626	4,751	4,804
Paddy LV	2,823	-	-	-	-	-
Groundnuts	1,615	1,971	2,041	2,111	2,251	2,321
Sesame	508	715	900	1,085	1,085	1,270
Sunflower	-	1,325	1,455	1,585	1,715	1,975
Mat'pe	546	843	992	1,161	1,479	1,956
Maize	-	1,158	1,446	1,733	2,021	2,309
Jute	1,195	2,333	2,492	2,631	2,790	2,940

	Financial Farm Income/ac					
	w/o case	1st yr.	2nd yr.	3rd yr.	4th yr.	5th yr.
Paddy HYV(s)	488	457	484	511	529	538
Paddy HYV(M)	443	366	393	420	438	448
Paddy LV	326	-	-	-	-	-
Groundnuts	1,837	2,242	2,312	2,382	2,522	2,592
Sesame	569	981	1,166	1,351	1,351	1,536
Sunflower	-	1,626	1,759	1,886	2,016	2,276
Mat'pe	113	176	226	275	374	522
Maize	-	367	465	562	660	760
Jute	338	673	730	779	835	888

D. Economic Project Benefits

Agricultural benefits can be obtained as the difference between the total NPV with the project and total NPV without the project. And NPV/ac has been given in the previous paragraph. So, agricultural benefits can be worked out by multiplying the above NPV/ac to the cropping acreage given by the Agronomist, as seen in Appendix 6D. As regards benefits from hydro-power generation, it has been derived from the alternative thermal power generation plant with the capacity to generate the power equivalent to the average firm peak by the proposed hydro-power project as in usual. (Details are shown in Appendix 6D).

As such, the over-all project benefits could be calculated as in Appendix 6D. And in order to compare this benefits with the economic project costs, this value should be converted to the present worth value by various discount factors. This conversion has been worked out in Appendix 6D. The results are as follows:

Present Worth Value of the Project Benefits
(by various discount factors)

Discount Factor	Overall Benefits ('000 Ks)
0.0%	7,543,093
10.0%	912,959
12.5%	635,688
15.0%	459,681
17.5%	342,340
20.0%	260,914
22.5%	202,973
25.0%	159,855
27.5%	127,405
30.0%	103,196

E. Economic Project Costs

Financial project costs have been given by the engineers concerned in Chapter IV. In order to make economic analysis, however, these costs should be adjusted to the economic project costs, in which taxes and duties should be excluded, subsidies should be included, price contingency (or price escalation) should be excluded, and interest during constructioin period also should be excluded. Moreover, unskilled labor should be re-evaluated by the opportunity cost of labor (i.e. 5.4 Ks/man.day) and foreign components should be re-evaluated by the shadow foreign exchange rate (i.e. 11 Ks/US$ 1.00).

On the other hand, financial costs cover the canal construction costs up to so-called water courses in this country. In order to make expected irrigation effects, however, farmers will be obliged

to arrange their own fields suitable for irrigation farming at their own expenses. For example, field ditches should be arranged by themselves, field levelling also should be made, if necessary. Although such costs are not included in financial costs, they should be included in the economic costs.

Regarding construction equipment, procurement cost should be included in the financial cost, but these equipment can be used for the other purposes even after completion of the project. In the economic cost, therefore, these residual value should not be included. In order to get this economic cost, there are two way. One is to deduct the residual value from the procurement cost, and the other is to calculate depreciation cost during the construction period. And the latter method has been employed in this study.

In treatment of farm mechanization cost also, there are two ways in economic analysis of the project; In case of the first way, the costs will be considered in the project costs, and in case of another way, the costs will be considered in farm costs. In any way, double accounting should be avoided in the economic analysis of the project. In this study, the latter way has been employed.

The above adjustments have been done in Appendix 6E. And in order to compare them with the economic project benefits, the present worth value of the economic project costs was worked out by using various discount factors as follows: (See Appendix 6E)

Present Worth Value of E. Project Costs

Discount Factor	E. Project Costs (' 000 Ks)
0.0%	603,242
10.0%	264,967
12.5%	235,037
15.0%	211,523
17.5%	191,722
20.0%	174,891
22.5%	160,341
25.0%	147,630
27.5%	136,457
30.0%	126,473

F. Economic Internal Rate of Return (EIRR)

As well known, the intersection point of the benefit curve and cost curve, which are drawn on the same section paper, shows the economic internal rate of return (EIRR) of the project. And according to Fig. 6-1, EIRR of this project is 26.15 percent, which well exceeds the opportunity cost of capital in this country, because it is understood that the opportunity cost of capital is around 11 percent in this country. Therefore, it can be said that this project is quite feasible from the viewpoint of national economy.

Of course, it may be pointed out that if the economic analysis is made only for hydro-power project, its EIRR will show 10.53 percent, as seen in Appendix 6F, which is slightly low compared with the opportunity cost of capital in this country. Never-the-less, the above analysis shows that the overall project (including hydro-power project) is quite feasible. Taking into consideration the electric power status in this country, therefore, it should be recommended that the proposed hydro-power project should be included in the proposed dam irrigation project from the viewpoint of national economy.

G. Sensitivity Analysis

As seen every where in the above analysis, this study has been made based on various assumptions. For example, economic prices, target yields, agricultural build-up period, estimation of project costs, construction schedule and so on - all of them can be called a kind of assumption. For such uncertain factors in economic analysis, sensitivity test have been made as follows:

	EIRR	Ref. Fig. No.
7.1 In case of decrease in target benefits		
10% decrease	24.1%	Fig. 6-2
20% decrease	22.8%	Fig. 6-3
30% decrease	20.6%	Fig. 6-4
7.2 In case of overrun in project costs		
10% overrun	24.9%	Fig. 6-5
20% overrun	23.4%	Fig. 6-6

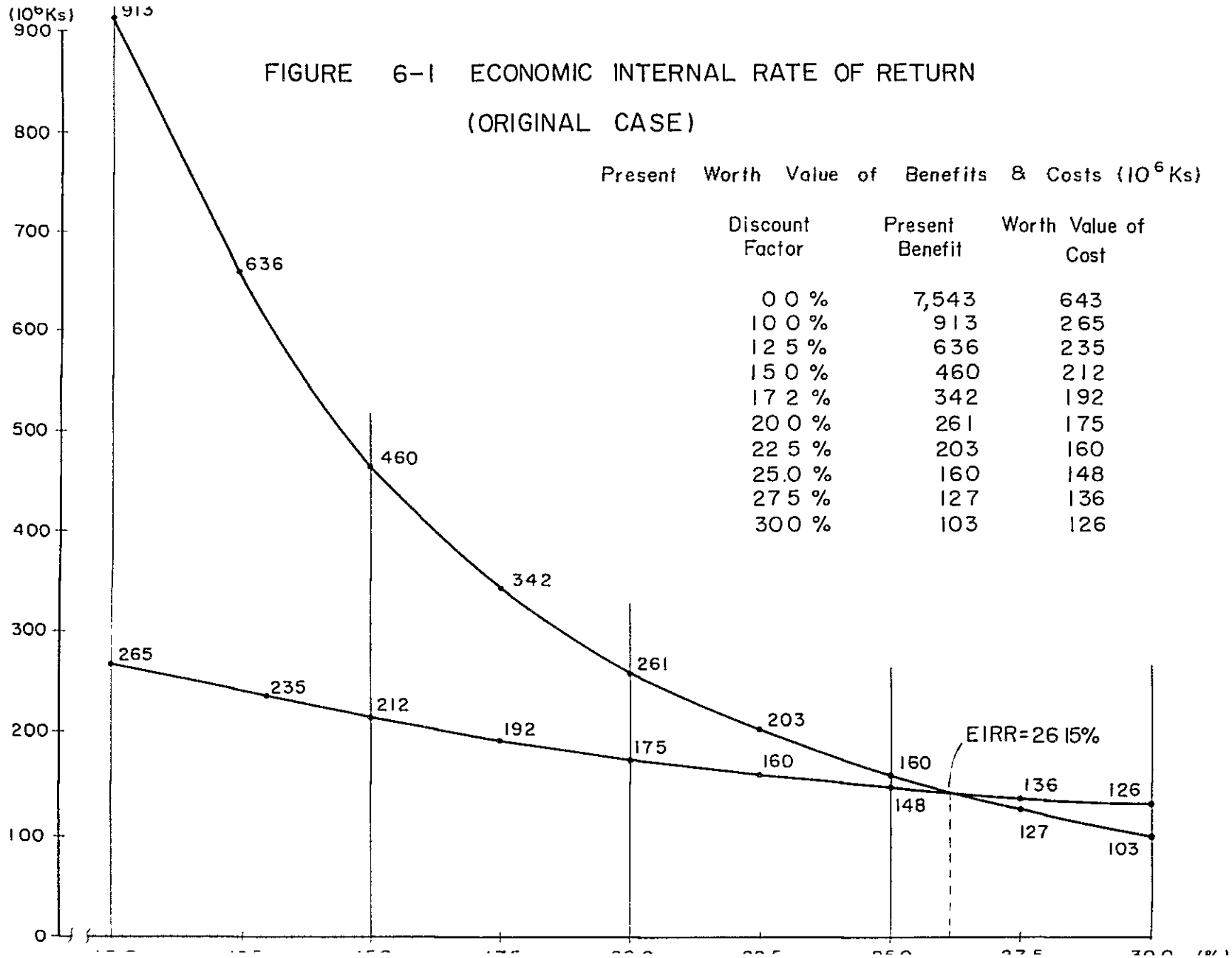


FIGURE 6-1 ECONOMIC INTERNAL RATE OF RETURN

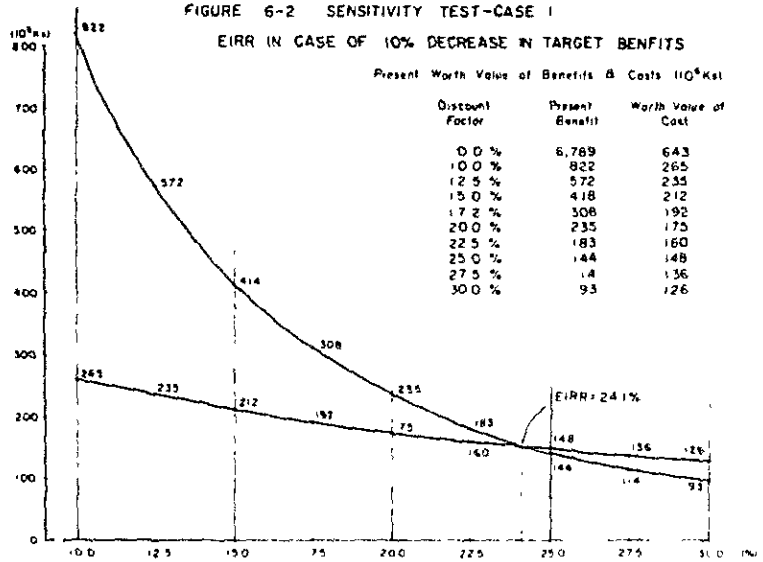
(ORIGINAL CASE)

Present Worth Value of Benefits & Costs (10^6 Ks)

Discount Factor	Present Worth Value of Benefit	Present Worth Value of Cost
0 0 %	7,543	643
10 0 %	913	265
12 5 %	636	235
15 0 %	460	212
17 2 %	342	192
20 0 %	261	175
22 5 %	203	160
25.0 %	160	148
27 5 %	127	136
30 0 %	103	126

FIGURE 6-2 SENSITIVITY TEST-CASE 1

EIRR IN CASE OF 10% DECREASE IN TARGET BENFITS

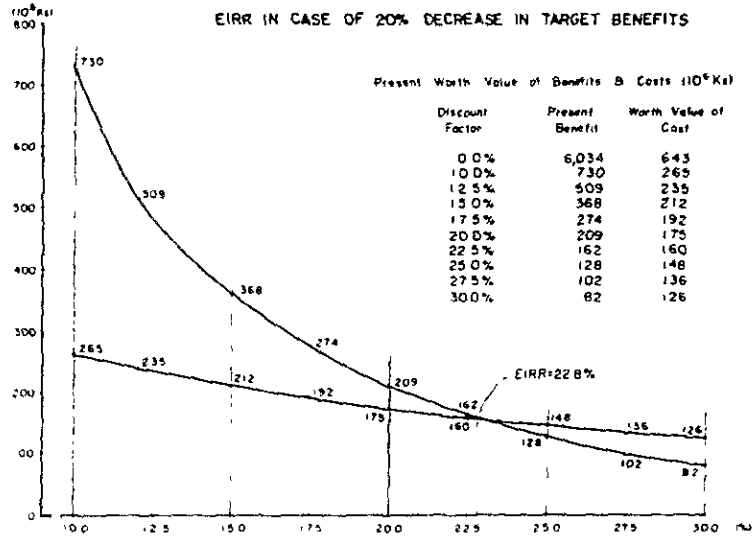


Present Worth Value of Benefits & Costs (10⁶Ksl)

Discount Factor	Present Benefit	Worth Value of Cost
0.0 %	6,789	643
10.0 %	822	265
12.5 %	572	235
15.0 %	418	212
17.2 %	308	192
20.0 %	235	175
22.5 %	183	160
25.0 %	144	148
27.5 %	114	136
30.0 %	93	126

FIGURE 6-3 SENSITIVITY TEST-CASE 2

EIRR IN CASE OF 20% DECREASE IN TARGET BENEFITS

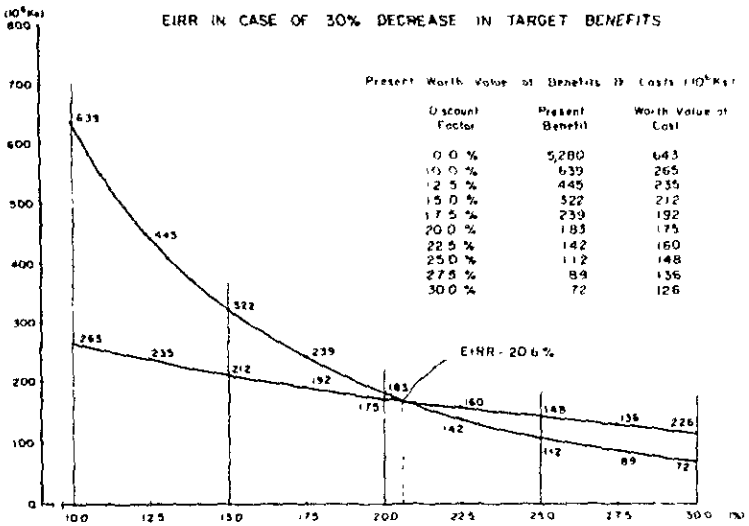


Present Worth Value of Benefits & Costs (10⁶Ksl)

Discount Factor	Present Benefit	Worth Value of Cost
0.0%	6,034	643
10.0%	730	265
12.5%	509	235
15.0%	368	212
17.5%	274	192
20.0%	209	175
22.5%	162	160
25.0%	128	148
27.5%	102	136
30.0%	82	126

FIGURE 6-4 SENSITIVTY TEST-CASE 3

EIRR IN CASE OF 30% DECREASE IN TARGET BENEFITS

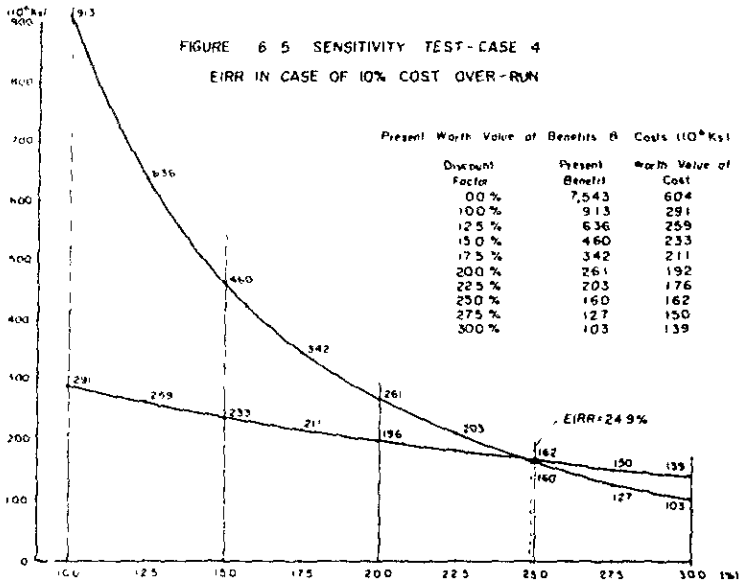


Present Worth Value of Benefits & Costs (10⁶Ksl)

Discount Factor	Present Benefit	Worth Value of Cost
0.0 %	5,280	643
10.0 %	639	265
12.5 %	445	235
15.0 %	322	212
17.5 %	239	192
20.0 %	183	175
22.5 %	142	160
25.0 %	112	148
27.5 %	89	136
30.0 %	72	126

FIGURE 6-5 SENSITIVITY TEST-CASE 4

EIRR IN CASE OF 10% COST OVER-RUN

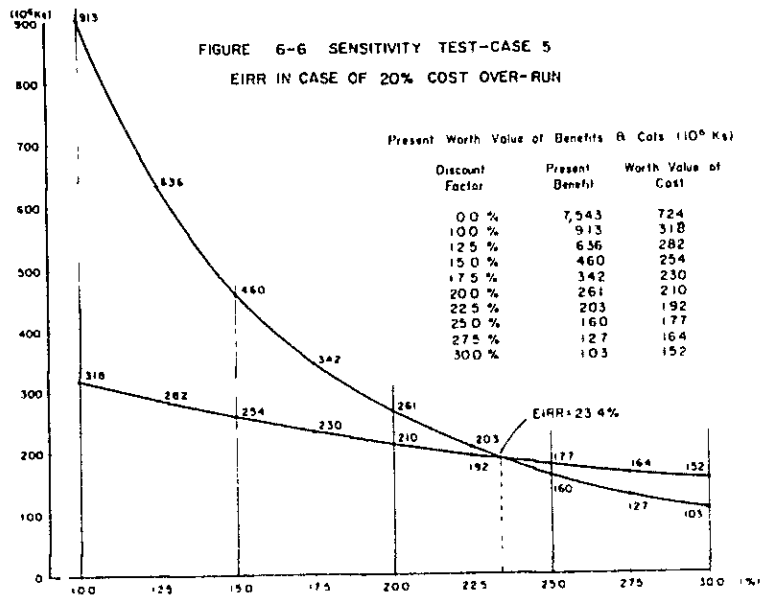


Present Worth Value of Benefits & Costs (10⁶Ksl)

Discount Factor	Present Benefit	Worth Value of Cost
0.0 %	7,543	604
10.0 %	913	291
12.5 %	636	259
15.0 %	460	233
17.5 %	342	211
20.0 %	261	192
22.5 %	203	176
25.0 %	160	162
27.5 %	127	150
30.0 %	103	139

FIGURE 6-6 SENSITIVITY TEST-CASE 5

EIRR IN CASE OF 20% COST OVER-RUN

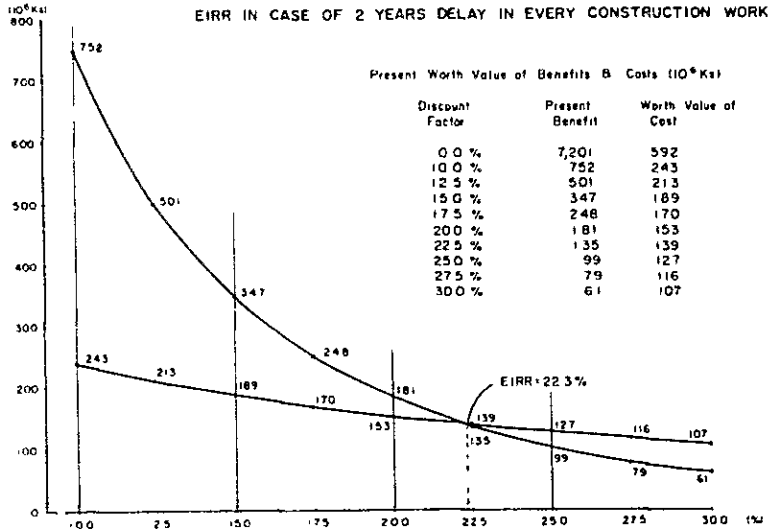


Present Worth Value of Benefits & Cots (10^6 Ks)

Discount Factor	Present Benefit	Worth Value of Cost
00 %	7,543	724
100 %	913	318
125 %	636	282
150 %	460	254
175 %	342	230
200 %	261	210
225 %	203	192
250 %	160	177
275 %	127	164
300 %	103	152

FIGURE 6-7 SENSITIVITY TEST-CASE 6

EIRR IN CASE OF 2 YEARS DELAY IN EVERY CONSTRUCTION WORK



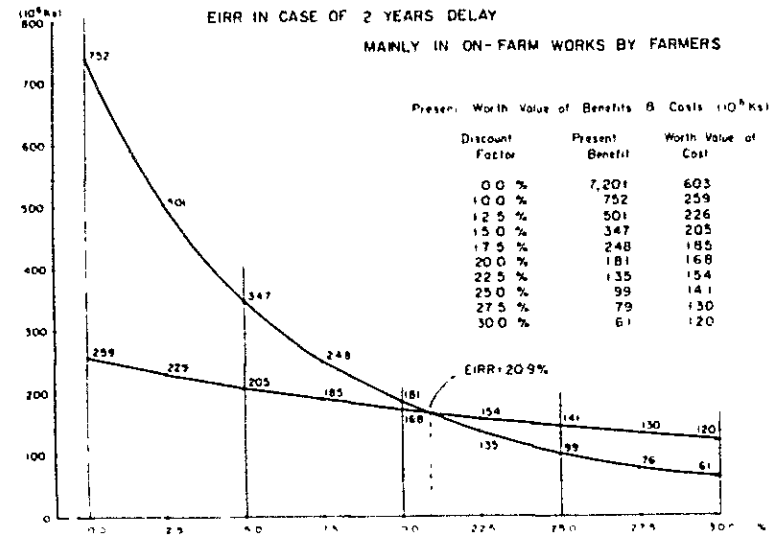
Present Worth Value of Benefits & Costs (10^6 Ks)

Discount Factor	Present Benefit	Worth Value of Cost
00 %	7,201	592
100 %	752	243
125 %	501	213
150 %	347	189
175 %	248	170
200 %	181	153
225 %	135	139
250 %	99	127
275 %	79	116
300 %	61	107

FIGURE 6-8 SENSITIVITY TEST-CASE 7

EIRR IN CASE OF 2 YEARS DELAY

MAINLY IN ON-FARM WORKS BY FARMERS



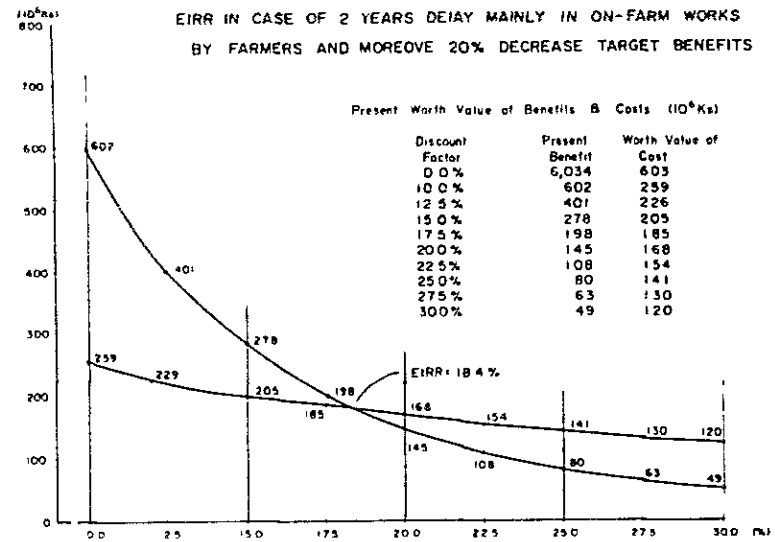
Present Worth Value of Benefits & Costs (10^6 Ks)

Discount Factor	Present Benefit	Worth Value of Cost
00 %	7,201	603
100 %	752	259
125 %	501	226
150 %	347	205
175 %	248	185
200 %	181	168
225 %	135	154
250 %	99	141
275 %	79	130
300 %	61	120

FIGURE 6-9 SENSITIVITY TEST-CASE 8

EIRR IN CASE OF 2 YEARS DELAY MAINLY IN ON-FARM WORKS

BY FARMERS AND MOREOVE 20% DECREASE TARGET BENEFITS



Present Worth Value of Benefits & Costs (10^6 Ks)

Discount Factor	Present Benefit	Worth Value of Cost
00 %	6,034	603
100 %	602	259
125 %	401	226
150 %	278	205
175 %	198	185
200 %	145	168
225 %	108	154
250 %	80	141
275 %	63	130
300 %	49	120

	EIRR	Ref. Fig. No.
7.3 In case of 2 years delay in construction works		
in every construction	22.3%	Fig. 6-7
in farmers' on-farm works	20.9%	Fig. 6-8
7.4 In case of 2 years delay in farmers' on-farm works and moreover 20% decrease		
in target benefits	18.4%	Fig. 6-9

The above analysis shows that this project is quite feasible in every case. At the same time, however, it seems that delay in, farmer's on-farm works and decrease of agricultural production target are most sensible for EIRR.

In this connection, it should be pointed out that farmers should construct their own farm ditches, etc. by their own expenses in time. Otherwise constructed dam and canals can not function effectively. As a matter of fact, it is found that in many developing countries, these on-farm works are not carried out properly and timely, and as the results, proposed agricultural benefits can not be accrued even after completion of government construction works. So, this point should be strongly educated to farmers in the course of implementation of the project.

And as regards agricultural development, it is needless to say that close cooperation between ID and AC should be requested.

H. Farm Budget Analysis

In case of irrigation project, financial analysis will be made in terms of farm budget analysis, which has been made in Appendix 6E. The results are as follows:

One representative farmer was taken up, whose family size is 6 members, farm size is 9.2 acres, and cropping intensity, cropping pattern, farming practices, yields, etc. are the same as those of the whole project area. Under such assumption, his farm income was

worked out at Ks.4,327/year in case of without the Project. This amount looks like relatively higher compared with the average income of the farmers in the whole Burma, but this class belongs to the IVth class of living standard in this area, although most landless laborer's families belong to the Vth class of living standard which is regarded as the lowest class in the Project Area.

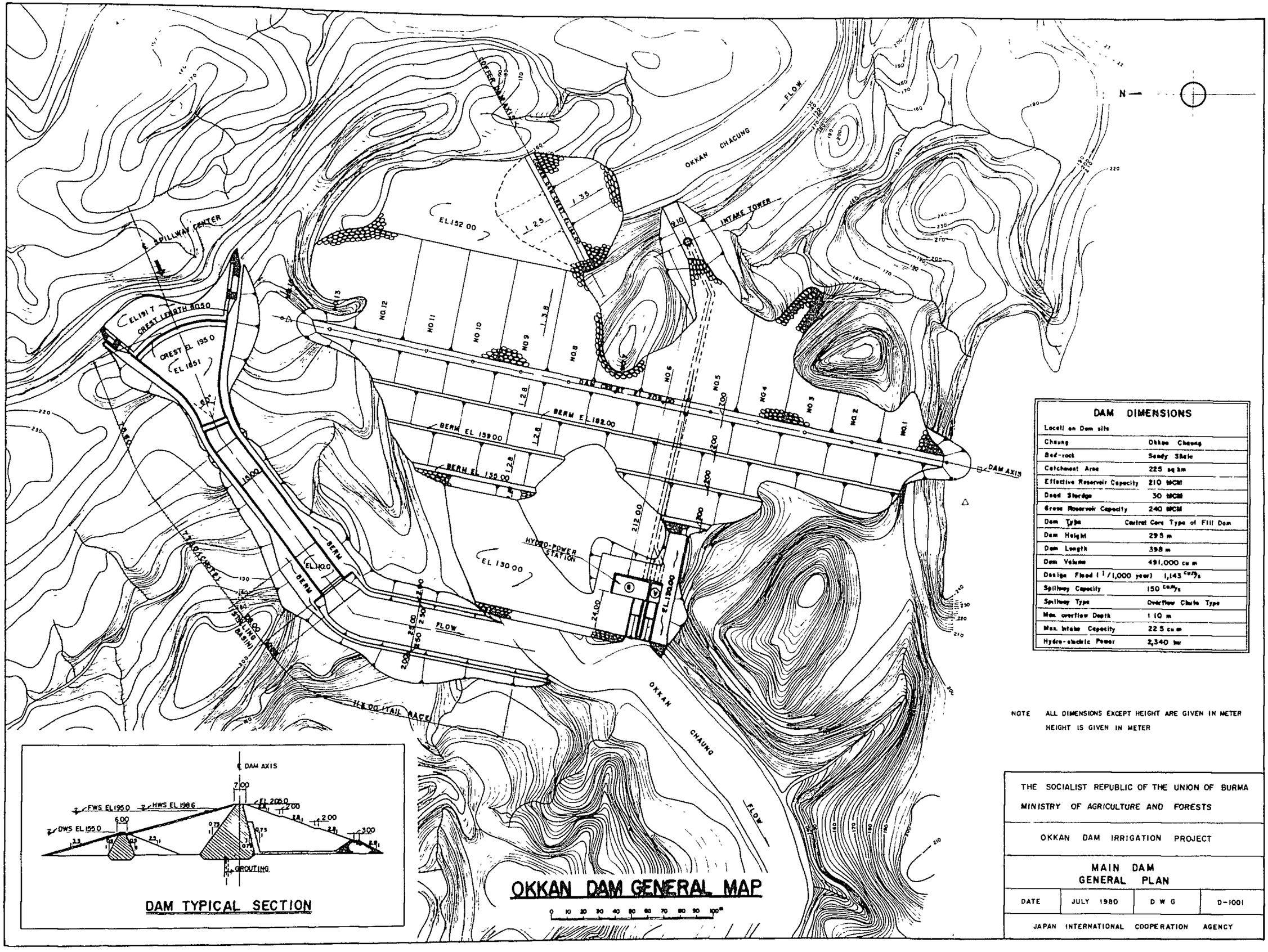
After completion of the Project, however, his farm income will increase to Ks. 11,025 even in the first year, and will reach to Ks. 15,480 in the full agricultural development stage (i.e. from the fifth year). In order words, he can enjoy the 1st class living standard even in the first year after completion of the Project, and in the full agricultural development stage, he can even save his surplus of Ks.4,480 per year from his farm income, even after enjoyed the highest living standard, which is estimated at Ks.11,000 per family per year in this area.

As such, it can be clearly concluded that this proposed dam irrigation project is quite feasibile from the viewpoint of individual beneficial farmer's economy.

I. Financial Analysis of Hydro-power Project

However, FIRR (Financial Internal Rate of Return) of the proposed hydro-power project shows only 4.44 percent, as seen in Appendix 6G. This rate means that if the selling price of electric power is 0.42 Ks/KWH, the Project entity (i.e. EPC) will suffer a great loss through this project. However, even the current selling price of electric power includes some government subsidies in this country. Therefore, it may be the point to study whether EPC can sell the electric power (generated by this project) at the rate of 0.42 Ks/KWH by giving its average subsidies or not. If it is possible, this project can be selected, and if it is not possible, this project may be pending in this selection.

LIST OF DRAWINGS



DAM DIMENSIONS

Locati on Dam site	
Chaung	Okkan Chaung
Bed-rock	Sandy Shale
Catchment Area	225 sq km
Effective Reservoir Capacity	210 MCM
Dead Storage	30 MCM
Gross Reservoir Capacity	240 MCM
Dam Type	Central Core Type of Fill Dam
Dam Height	29.5 m
Dam Length	398 m
Dam Volume	491,000 cu m
Design Flood (1/1,000 year)	1,143 cum/s
Spillway Capacity	150 cum/s
Spillway Type	Overflow Chute Type
Max. overflow Depth	1.10 m
Max. Intake Capacity	22.5 cu m
Hydro-electric Power	2,340 kw

NOTE ALL DIMENSIONS EXCEPT HEIGHT ARE GIVEN IN METER
HEIGHT IS GIVEN IN METER

DAM TYPICAL SECTION

OKKAN DAM GENERAL MAP

0 10 20 30 40 50 60 70 80 90 100m

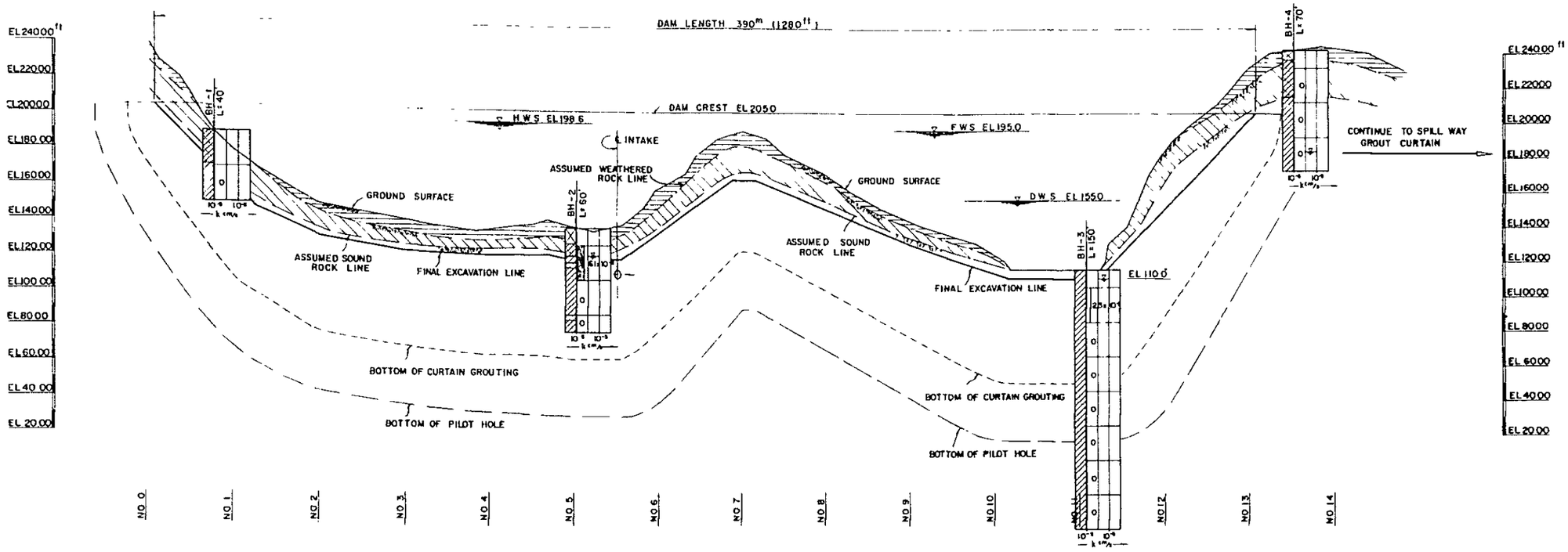
THE SOCIALIST REPUBLIC OF THE UNION OF BURMA
MINISTRY OF AGRICULTURE AND FORESTS

OKKAN DAM IRRIGATION PROJECT

MAIN DAM
GENERAL PLAN

DATE	JULY 1980	D W G	D-1001

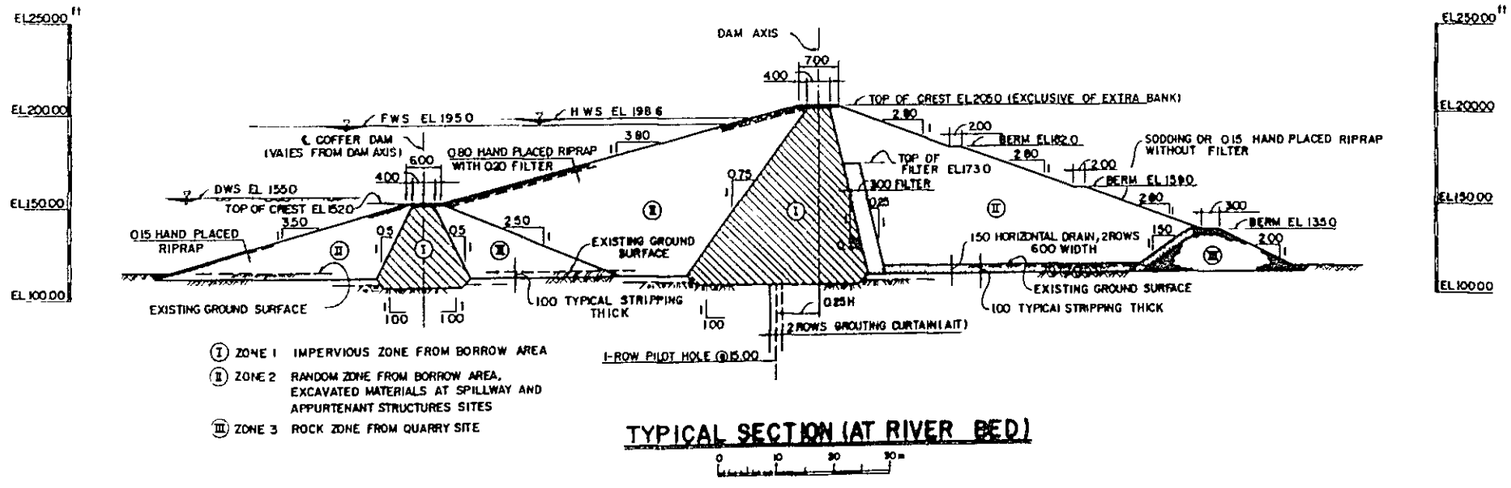
JAPAN INTERNATIONAL COOPERATION AGENCY



DEVELOPED LONGITUDINAL SECTION

0 5 10 20 30 40m VERTICAL

0 5 10 20 30 40 50 60 70 80 HORIZONTAL



TYPICAL SECTION (AT RIVER BED)

0 10 30 50m

NOTE ALL DIMENSIONS EXCEPT ELEVATION ARE GIVEN IN METER
ELEVATION IS GIVEN IN FEET

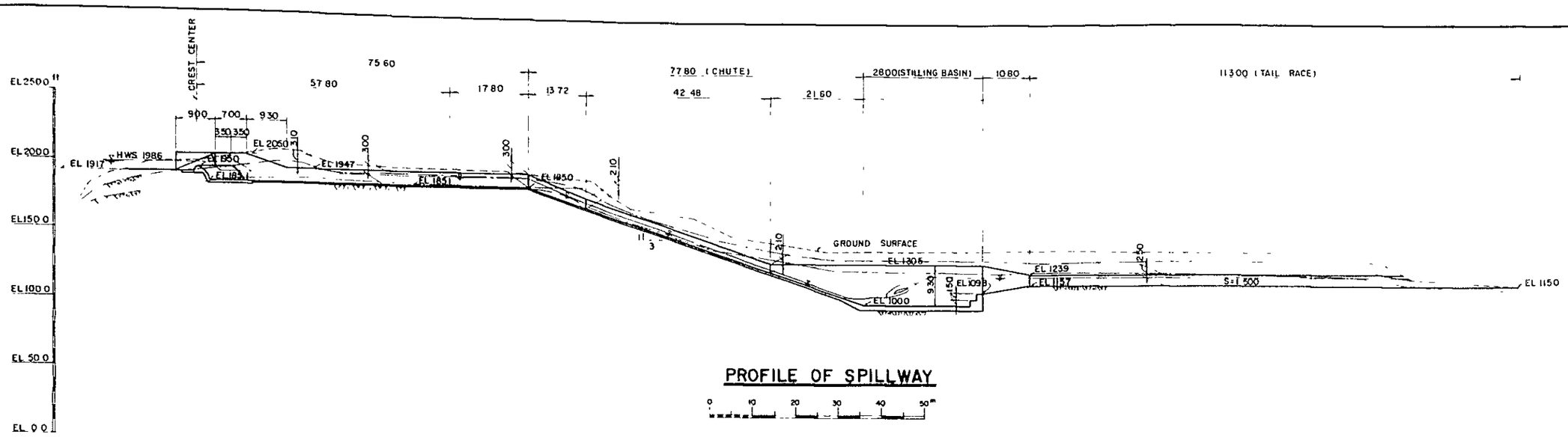
THE SOCIALIST REPUBLIC OF THE UNION OF BURMA
MINISTRY OF AGRICULTURE AND FORESTS

OKKAN DAM IRRIGATION PROJECT

MAIN DAM
DEVELOPED LONGITUDINAL SECTION & TYPICAL SECTION

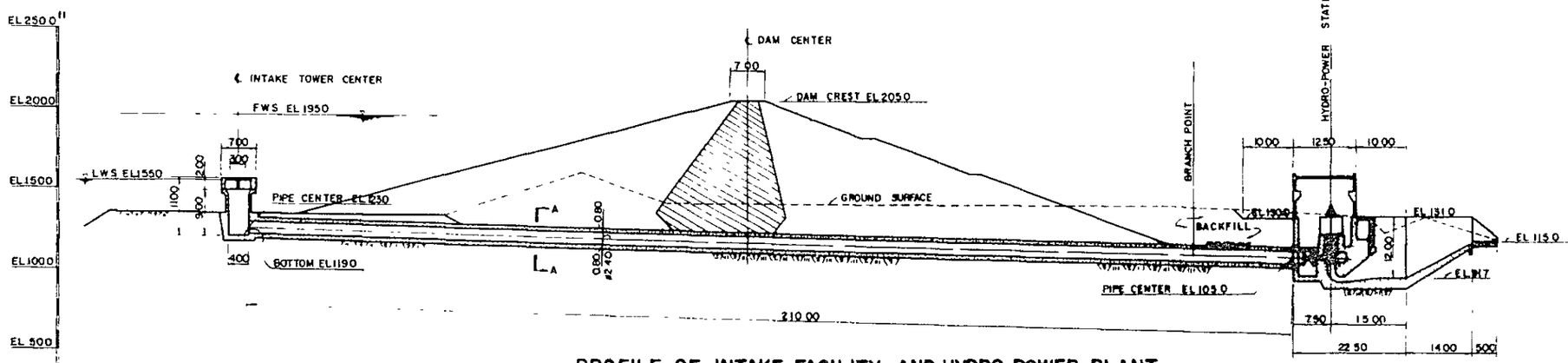
DATE	JULY 1980	D W G	D-1002

JAPAN INTERNATIONAL COOPERATION AGENCY



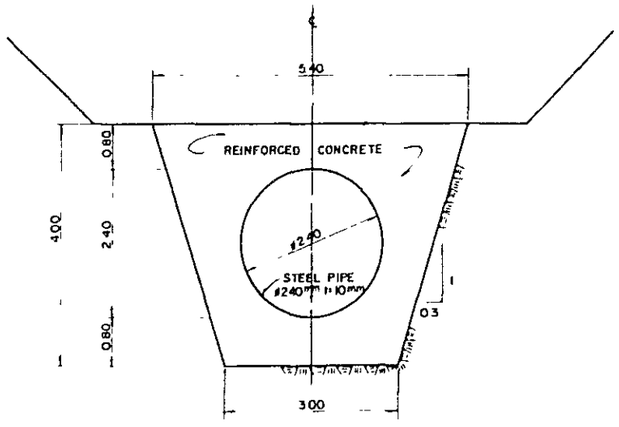
PROFILE OF SPILLWAY

0 10 20 30 40 50m

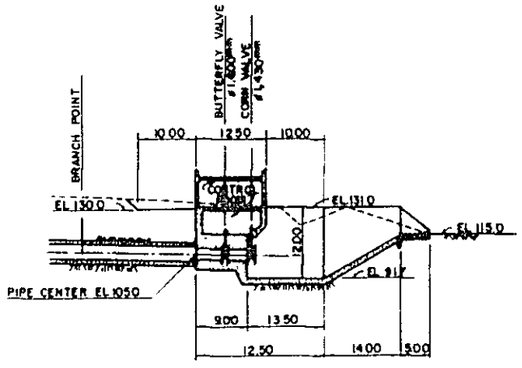


PROFILE OF INTAKE FACILITY AND HYDRO-POWER PLANT

0 10 20 30 40 50m



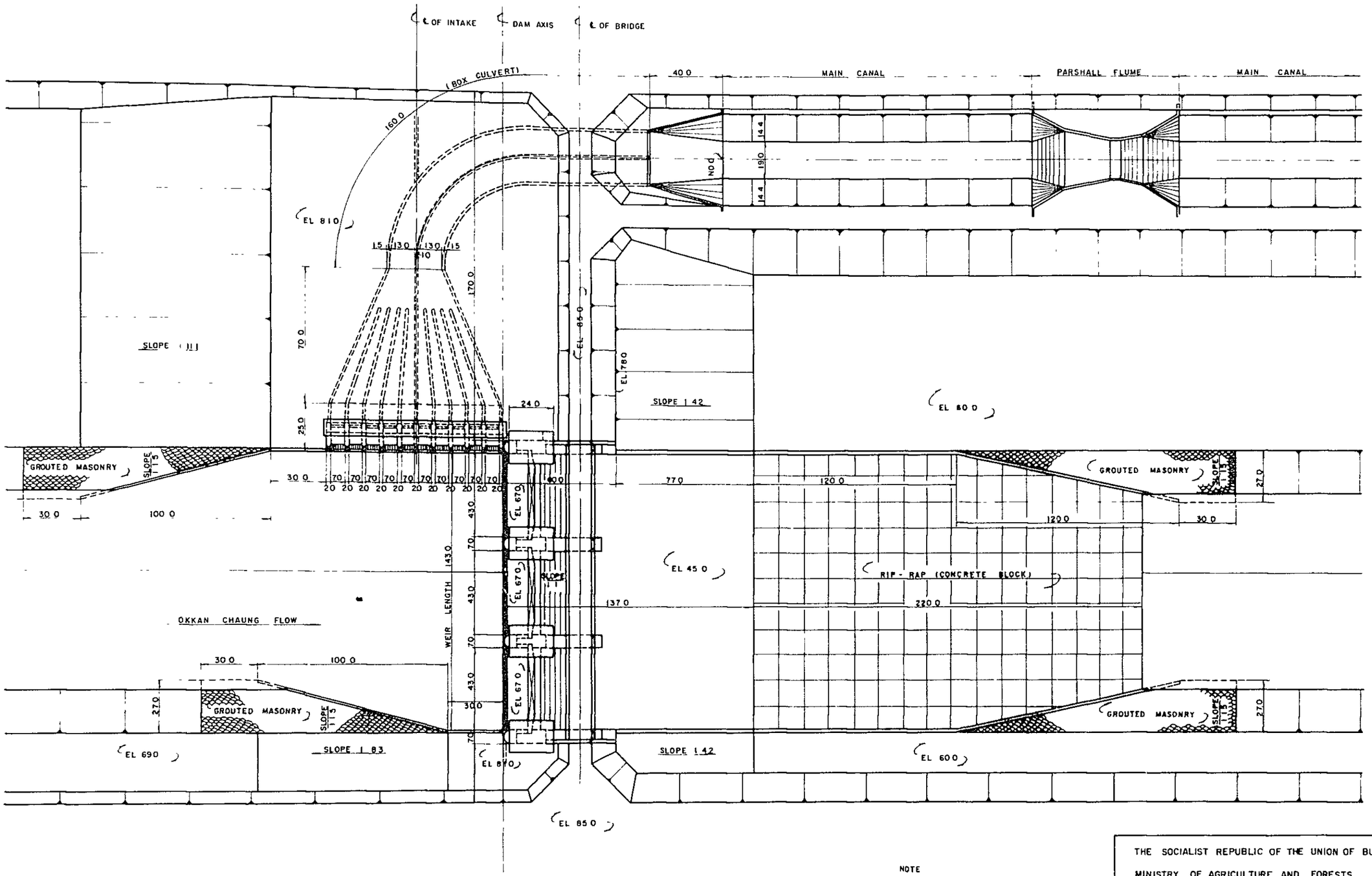
SECTION A-A



PROFILE OF HYDRO-POWER STATION

NOTE ALL DIMENSIONS EXCEPT ELEVATION ARE GIVEN IN METER
ELEVATION IS GIVEN IN FEET

THE SOCIALIST REPUBLIC OF THE UNION OF BURMA MINISTRY OF AGRICULTURE AND FORESTS			
OKKAN DAM IRRIGATION PROJECT			
MAIN DAM SPILLWAY & INTAKE			
DATE	JULY 1980	D W G	D-1003
JAPAN INTERNATIONAL COOPERATION AGENCY			



NOTE
ALL DIMENSIONS ARE GIVEN IN FEET

0 500 1000 1500

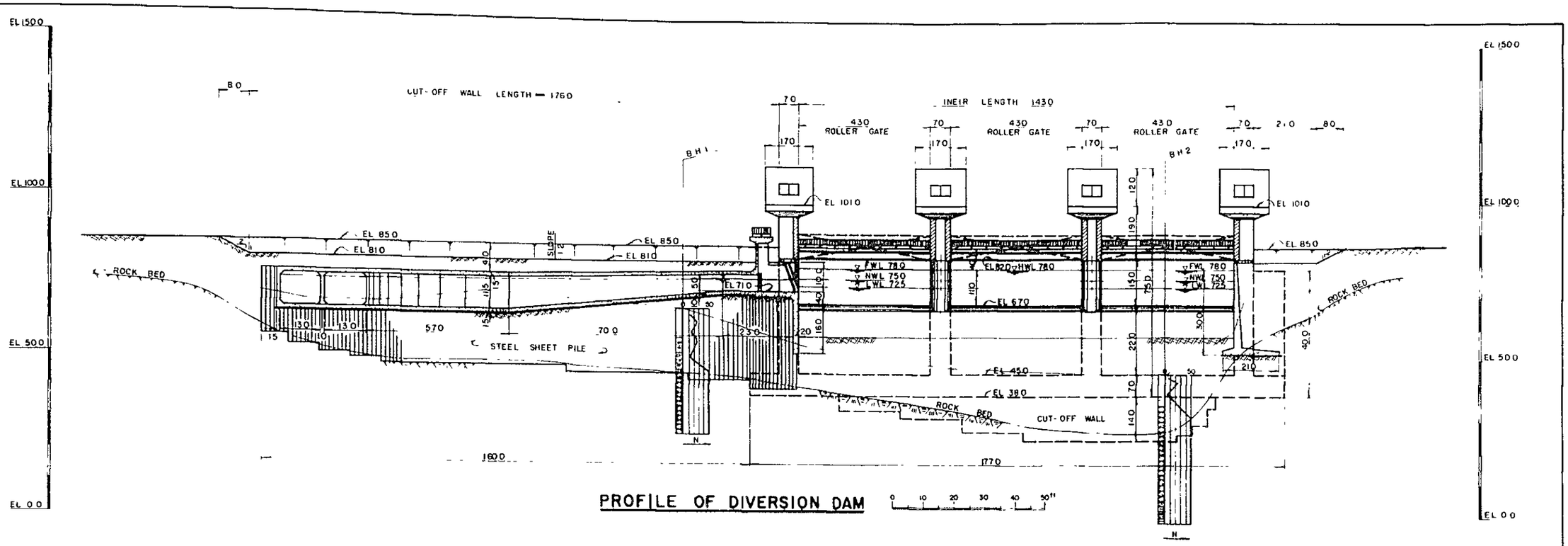
THE SOCIALIST REPUBLIC OF THE UNION OF BURMA
MINISTRY OF AGRICULTURE AND FORESTS

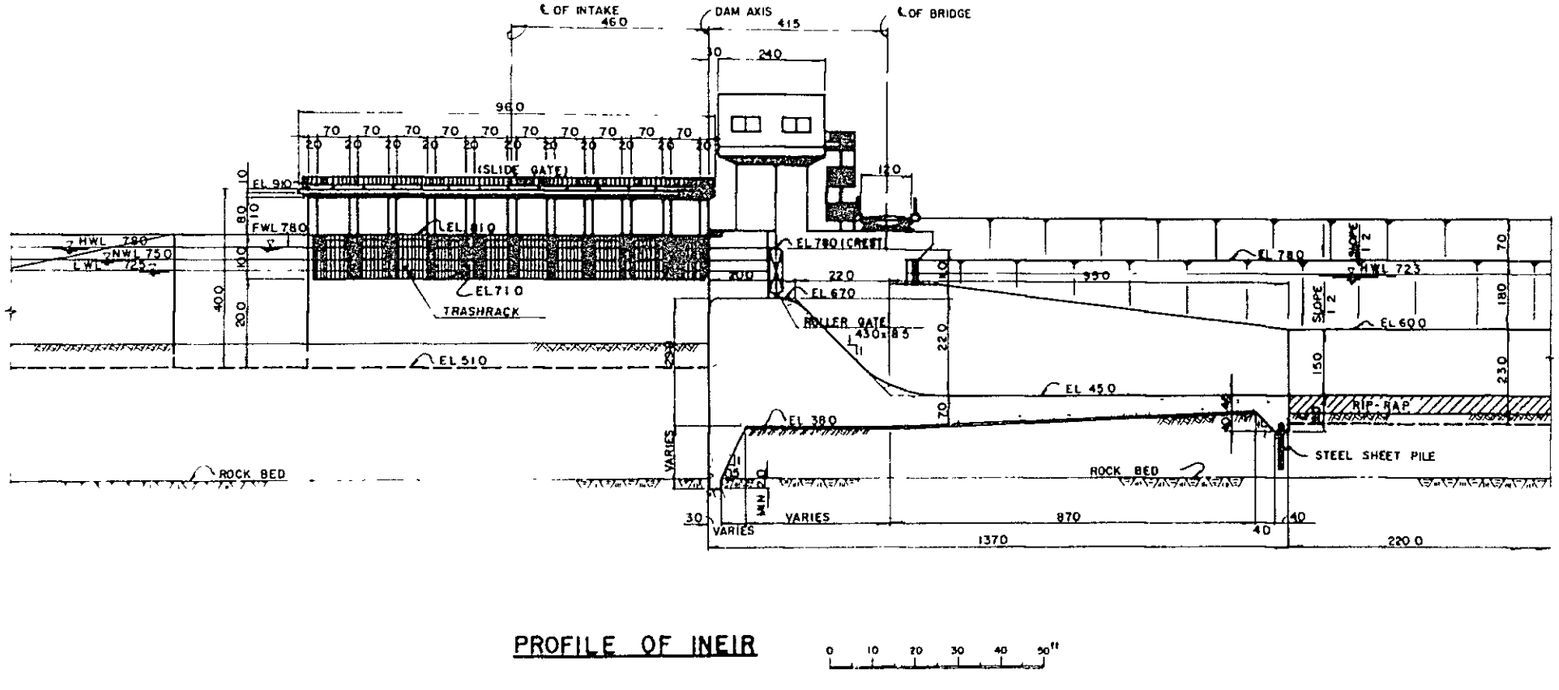
OKKAN DAM IRRIGATION PROJECT

DIVERSION DAM GENERAL PLAN

DATE JULY 1980 | D W G D-1004

JAPAN INTERNATIONAL COOPERATION AGENCY





NOTE ALL DIMENSIONS ARE GIVEN IN FEET

THE SOCIALIST REPUBLIC OF THE UNION OF BURMA MINISTRY OF AGRICULTURE AND FORESTS			
OKKAN DAM IRRIGATION PROJECT			
DIVERSION DAM PROFILE			
DATE	JULY 1980	D W G	D-1005
JAPAN INTERNATIONAL COOPERATION AGENCY			

DIVERSION DAM

LEGEND

- MAIN / LATERAL IRRIGATION CANAL
- SUBLATERAL IRRIGATION CANAL
- MAIN DRAINAGE CANAL
- LATERAL DRAINAGE CANAL
- PROJECT BOUNDARY
- RAIL WAY
- ROAD

MAIN IRRIGATION CANAL

OKKAN

TO PROME

TAIKKYI

TO RANGOON

HLAING RIVER

95°55'

17°30'

17°25'

17°20'

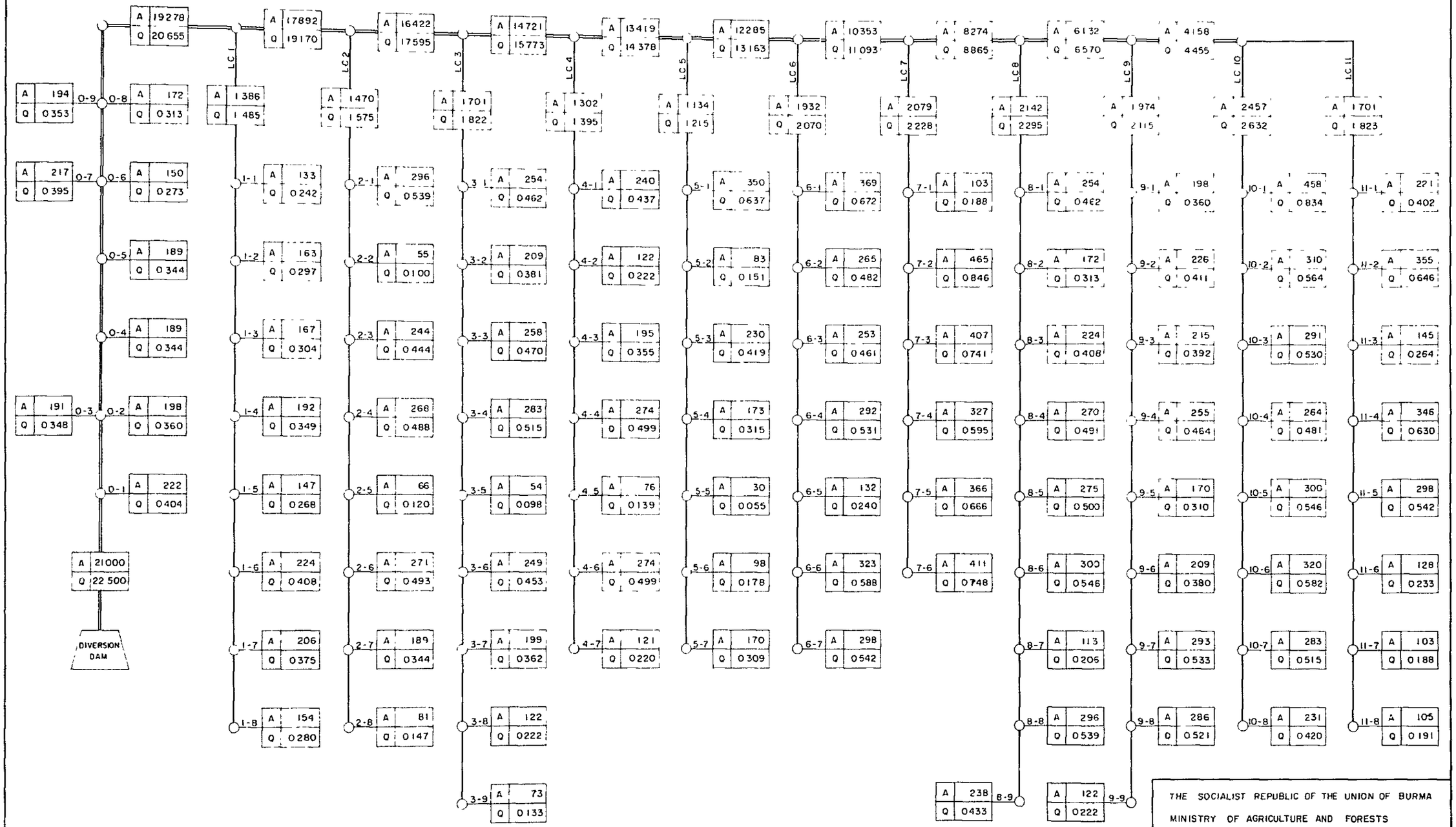
17°15'

NOTE
CONTOUR LINES ARE GIVEN IN FEET

GENERAL PLAN

0 1 2 3 4 5KM

THE SOCIALIST REPUBLIC OF THE UNION OF BURMA MINISTRY OF AGRICULTURE AND FORESTS			
OKKAN DAM IRRIGATION PROJECT			
GENERAL IRRIGATION SCHEME GENERAL PLAN			
DATE	JULY 1980	D W G	G-1001
JAPAN INTERNATIONAL COOPERATION AGENCY			



NOTES

A IRRIGATION AREA IN ha

Q WATER CAPACITY IN cum/S

THE SOCIALIST REPUBLIC OF THE UNION OF BURMA

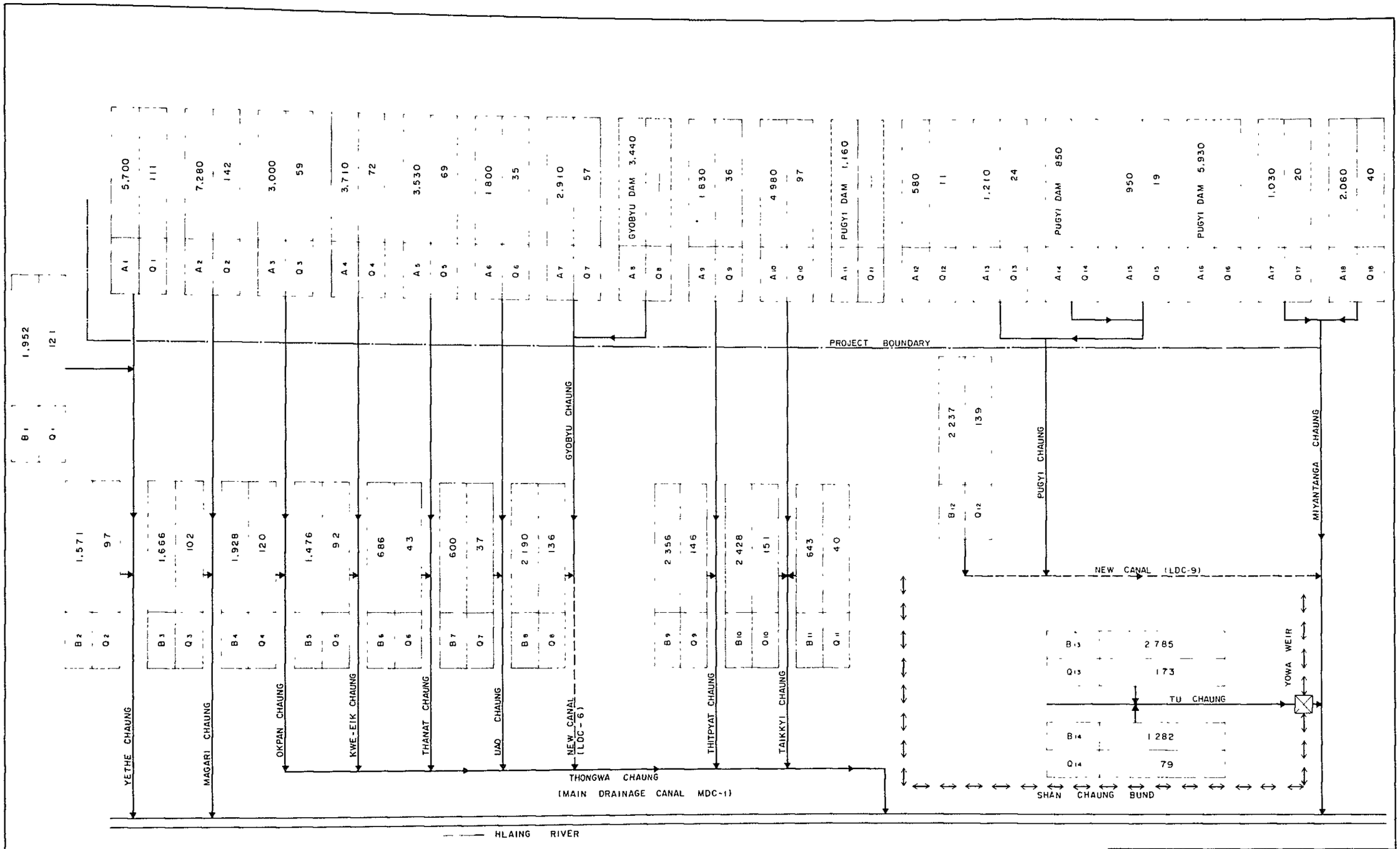
MINISTRY OF AGRICULTURE AND FORESTS

OKKAN DAM IRRIGATION PROJECT

GENERAL IRRIGATION SCHEME IRRIGATION NETWORK

DATE	JULY 1980	D W G	G-1002

JAPAN INTERNATIONAL COOPERATION AGENCY



NOTES
- A MOUNTANEOUS AREA IN HA
- B PROJECT AREA IN HA
- Q DAINAGE DISCHARGE IN CUM/SEC

THE SOCIALIST REPUBLIC OF THE UNION OF BURMA

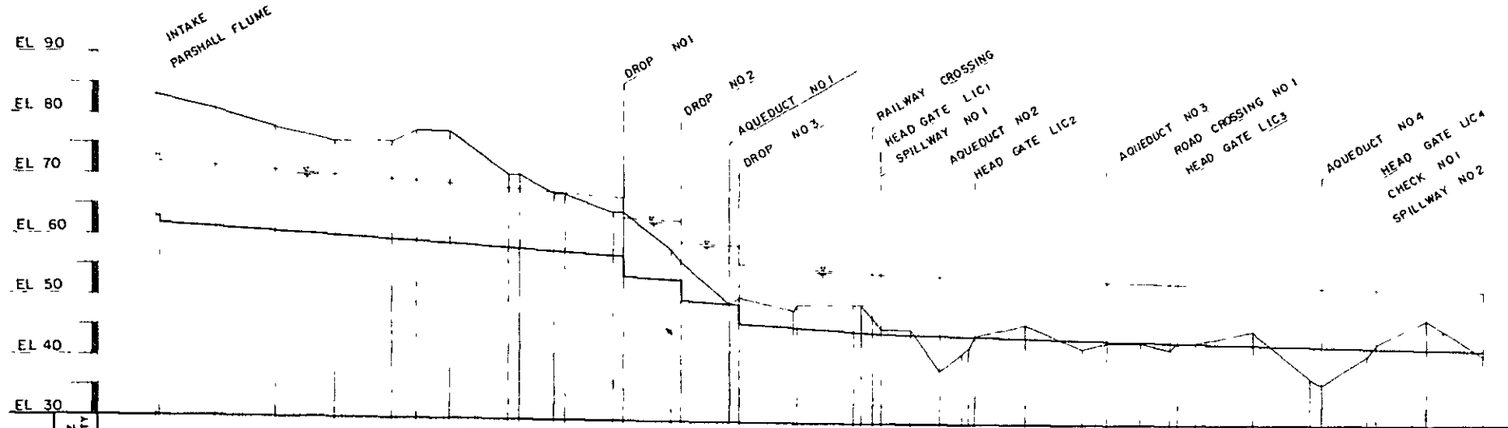
MINISTRY OF AGRICULTURE AND FORESTS

OKKAN DAM IRRIGATION PROJECT

GENERAL IRRIGATION SCHEME
DRAINAGE NETWORK

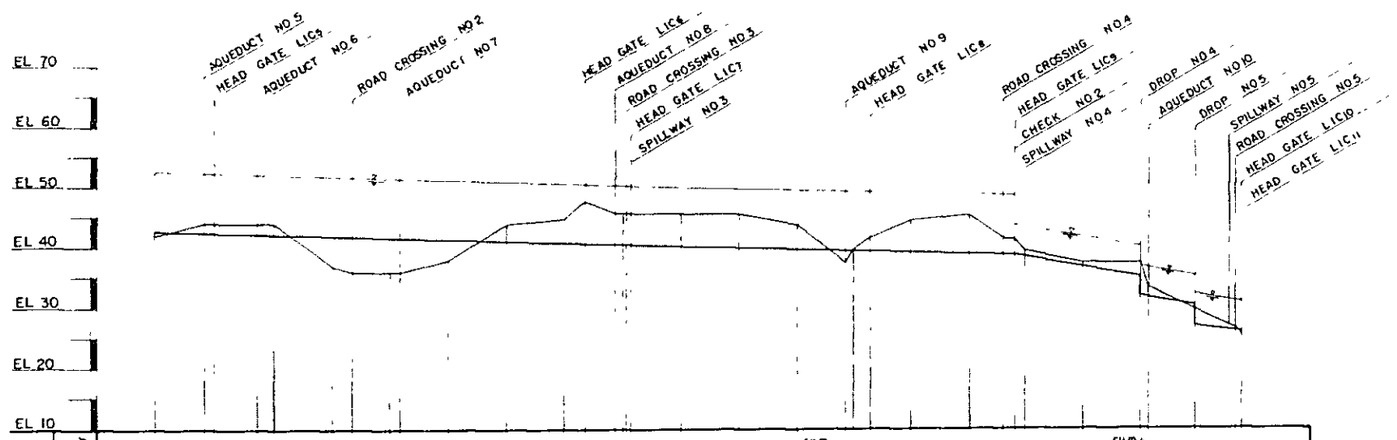
DATE	JULY 1980	D W G	G-1003

JAPAN INTERNATIONAL COOPERATION AGENCY



STATION	GROUND ELEV	INVERT ELEV	WATER LEVEL	BERM ELEV	SLOPE CAPACITY
NO 0	83 0	62 35	72 85	74 27	Q = 22,500 cum/s TYPE - A
+ 60		62 27	72 80	74 20	S = 1 / 6,000
+ 68		61 93	71 81	73 32	L = 12,500 m
NO 1	81 0	61 42	71 30	72 74	
NO 2	78 0	60 68	70 76	72 20	
NO 3	76 0	60 33	70 21	71 65	
NO 4	76 0	59 78	69 66	71 10	
+ 430	78 0	59 55	69 43	70 87	
NO 5	78 0	59 24	69 12	70 56	
NO 6	71 0	58 69	68 57	70 01	
+ 200	71 0	58 58	68 46	69 90	
+ 820	68 0	58 24	68 12	69 56	
NO 7	68 0	58 14	68 02	69 46	
+ 830	65 0	57 69	67 57	69 01	
NO 8	65 0	57 60	67 48	68 92	
+ 830	59 0	53 97	63 75	65 18	
NO 9	57 0	53 78	63 56	65 10	
+ 830	50 0	50 05	59 93	61 37	
NO 10	51 0	49 96	59 84	61 28	
+ 930	49 0	46 17	56 05	57 49	
NO 11	50 0	46 14	56 02	57 46	
NO 12	50 0	45 60	55 48	56 93	
+ 130	50 0	45 58	55 46	56 91	
+ 350	50 0	45 40	55 28	56 72	
+ 500	46 0	45 27	55 15	56 59	
NO 13	46 0	45 10	55 07	56 42	
+ 500	39 0	44 99	54 96	56 31	
+ 870	42 0	44 86	54 83	56 18	
NO 14	43 0	44 83	54 80	56 15	
+ 80	43 0	44 82	54 79	56 14	
NO 15	47 0	44 61	54 58	55 93	
NO 16	43 0	44 40	54 37	55 72	
+ 420	44 0	44 30	54 27	55 62	
NO 17	44 0	44 13	54 10	55 45	
+ 230	43 0	44 01	53 98	55 33	
+ 870	44 0	43 92	53 89	55 24	
NO 18	44 0	43 85	53 82	55 17	
NO 19	46 0	43 63	53 60	54 95	
NO 20	38 0	43 41	53 38	54 73	
+ 200	37 0	43 37	53 34	54 67	
NO 21	42 0	43 15	53 12	54 47	
+ 150	44 0	43 11	53 08	54 43	
NO 22	48 0	42 96	52 90	54 28	
NO 23	42 0	42 74	52 68	54 06	

Q = 19,170 cum/s TYPE - B S = 1 / 15,000 L = 8,650 m



STATION	GROUND ELEV	INVERT ELEV	WATER LEVEL	BERM ELEV	SLOPE CAPACITY
NO 23	42 0	42 74	32 68	34 06	Q = 14,378 cum/s TYPE-C S = 1 / 15,000 L = 9,980 m
+850	44 0	42 35	32 49	33 87	
NO 24	44 0	42 27	32 41	33 78	
+ 720	44 0	42 31	32 25	33 63	
NO 25	44 0	42 20	32 14	33 52	
NO 26	37 0	41 98	31 92	33 30	
+ 350	36 0	41 91	31 85	33 23	
NO 27	36 0	41 71	31 65	33 03	
+ 170	36 0	41 68	31 62	33 00	
NO 28	38 0	41 45	31 39	32 77	
NO 29	44 0	41 23	31 17	32 55	
NO 30	45 0	41 01	30 95	32 33	
+ 380	48 0	40 93	30 87	32 25	
+ 860	46 0	40 78	30 72	32 10	
NO 31	46 0	40 73	30 67	32 05	
+ 130	46 0	40 68	30 62	32 00	
NO 32	46 0	40 73	30 41	31 88	
NO 33	46 0	40 51	30 19	31 66	
NO 34	44 0	40 29	29 97	31 44	
+860	38 0	40 11	29 79	31 26	
NO 35	40 0	40 05	29 71	31 18	
+ 300	42 0	39 97	29 65	31 12	
NO 36	45 0	39 81	29 49	30 96	
NO 37	46 0	39 59	29 27	30 74	
+ 600	42 0	39 46	29 14	30 61	
+ 800	42 0	39 36	29 04	30 51	
NO 38	40 0	39 05	28 73	30 20	
NO 39	38 0	37 41	42 36	43 64	Q = 8,865 cum/s TYPE - D S = 1 / 15,000 L = 6,670 m
NO 40	38 0	33 77	39 72	42 00	Q = 4,455 cum/s TYPE- E S = 1 / 2,000 L = 4,000 m
+ 150	34 0	33 25	37 20	38 48	
NO 41	30 0	30 89	35 84	37 12	
+ 680	27 0	26 50	31 45	32 73	
+ 800	26 0	26 28	31 23	32 51	

SCALE - HORIZONTAL - 0 1 2 3 4 5 Km / 0 1 2 3 MILE

SCALE - VERTICAL - 0 10 20 30 40 50 FEET / 0 5 10 15 m

NOTES ELEVATION IS GIVEN IN FEET
EACH STATION INTERVAL IS 1 KM

THE SOCIALIST REPUBLIC OF THE UNION OF BURMA

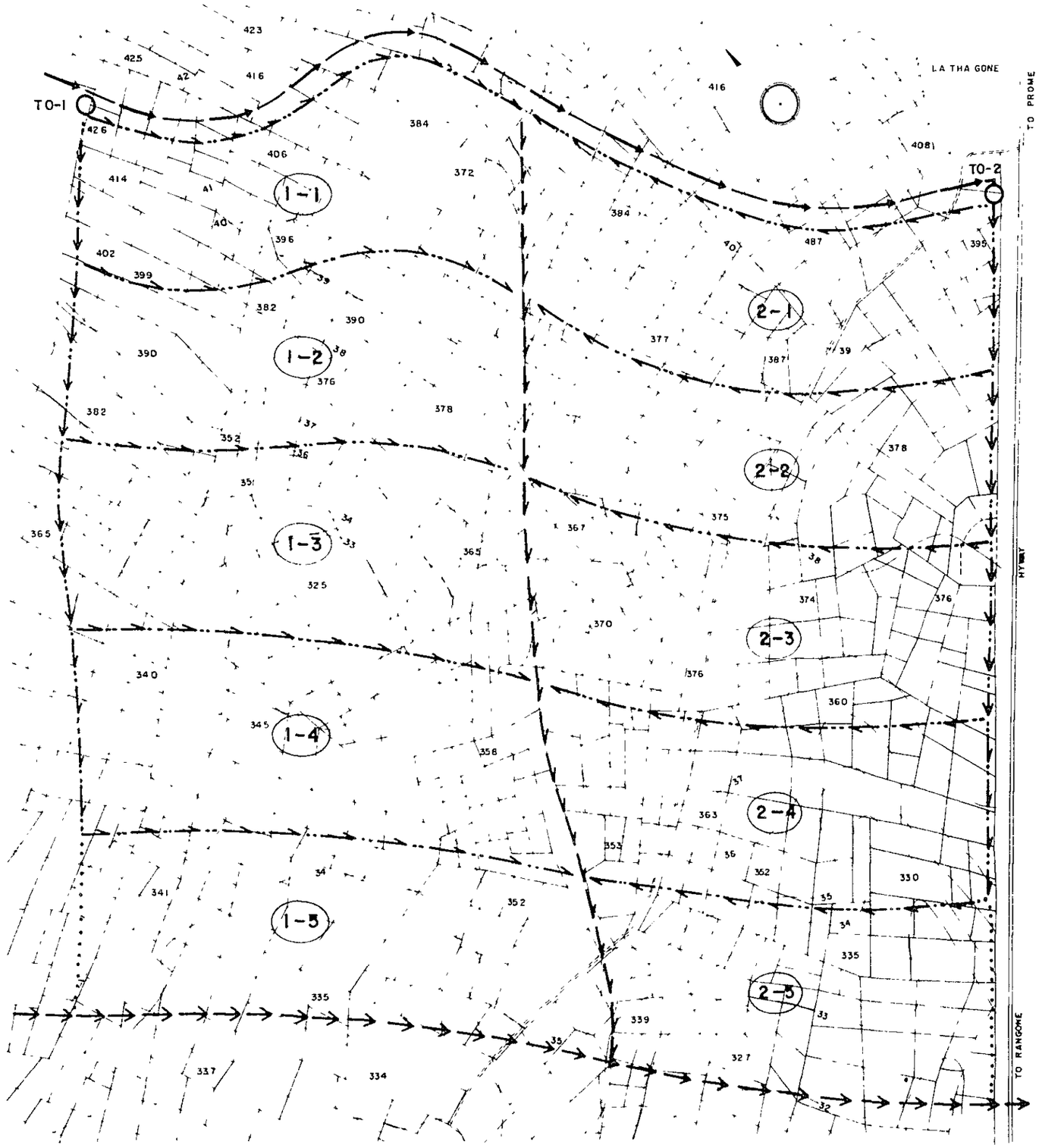
MINISTRY OF AGRICULTURE AND FORESTS

OKKAN DAM IRRIGATION PROJECT

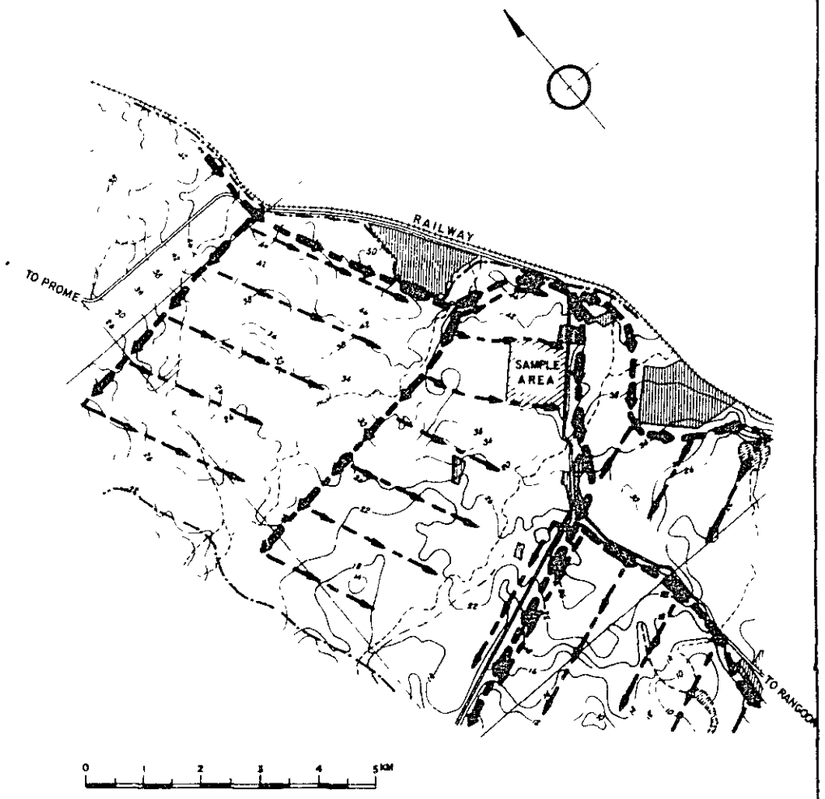
GENERAL IRRIGATION SCHEME LONGITUDINAL SECTION (MAIN IRRIGATION CANAL)

DATE JULY 1980 D W G G-1004

JAPAN INTERNATIONAL COOPERATION AGENCY



LOCATION OF SAMPLE AREA



KEY MAP OF SAMPLE AREA

LEGEND

- MAIN / LATERAL IRRIGATION CANAL
- SUB LATERAL IRRIGATION CANAL
- MAIN WATER COURSE
- SUPPLEMENTAL WATER COURSE
- SUB LATERAL DRAINAGE CANAL
- DRAINAGE CANAL
- TURN OUT
- IRRIGATION UNIT NUMBER

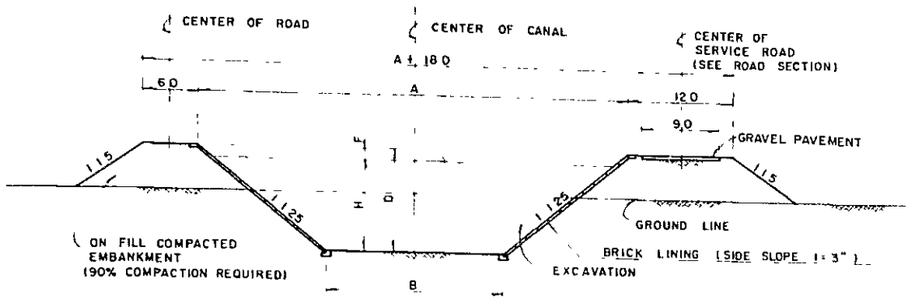
THE SOCIALIST REPUBLIC OF THE UNION OF BURMA
MINISTRY OF AGRICULTURE AND FORESTS

OKKAN DAM IRRIGATION PROJECT

GENERAL IRRIGATION SCHEME
SAMPLE AREA

DATE JULY 1980 D W G G-1005

JAPAN INTERNATIONAL COOPERATION AGENCY



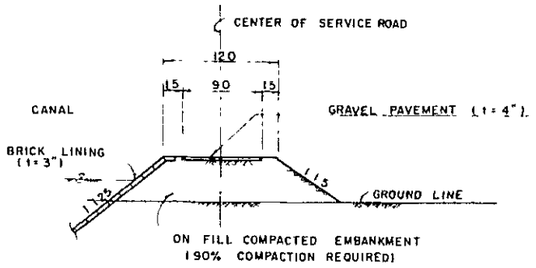
MAIN CANAL

TYPE	A	B	D	H	F
A	47.3	19.0	11.3	9.9	1.4
B	55.3	27.0	11.3	9.9	1.4
C	55.3	19.0	11.3	9.9	1.4
D	37.9	10.0	11.1	9.7	1.4
E	21.6	6.0	6.2	5.0	1.2

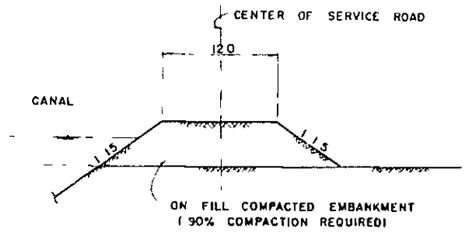
LATERAL CANAL

TYPE	A	B	D	H	F
F	18.3	6.0	4.9	3.8	1.1
G	16.5	5.0	4.6	3.5	1.1
H	14.7	4.0	4.3	3.3	1.0

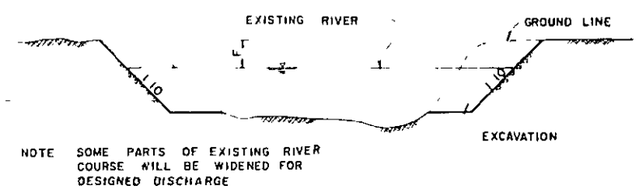
MAIN AND LATERAL IRRIGATION CANALS



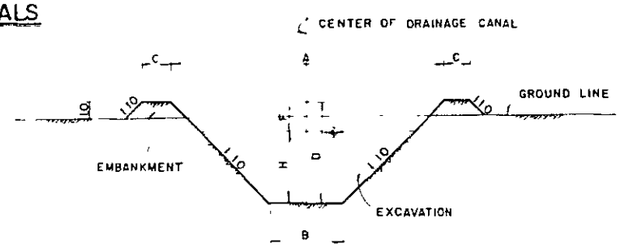
SERVICE ROAD ALONG MAIN AND LATERAL CANALS



SERVICE ROAD ALONG SUBLATERAL CANAL



MAIN AND LATERAL DRAINAGE CANALS

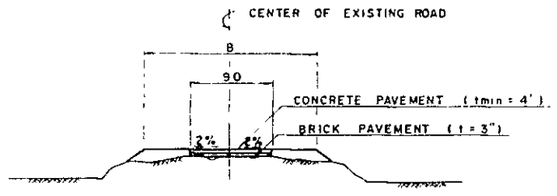


ROUTE	A	B	C	D	H	F
LDC6	16.3	3.5	3.0	6.4	4.4	2.0
LDC9-1	33.2	10.0	3.0	11.6	9.6	2.0
LDC9.2	39.4	16.0	3.0	11.7	9.7	2.0

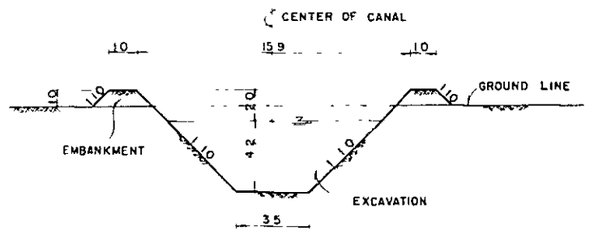
LATERAL DRAINAGE CANAL

TYPE	A	B	D	H	F
I	14.3	3.0	3.8	2.7	1.1
J	11.8	2.5	3.1	2.1	1.0

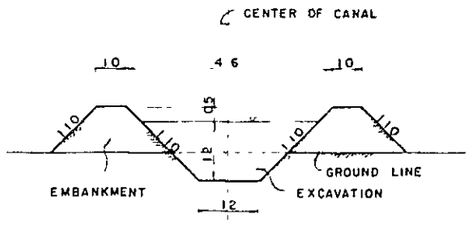
SUB LATERAL IRRIGATION CANAL



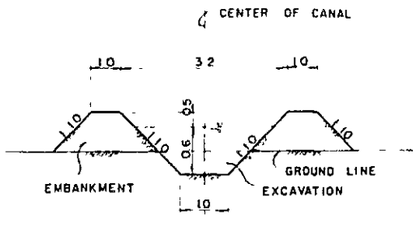
IMPROVEMENT OF EXISTING ROAD



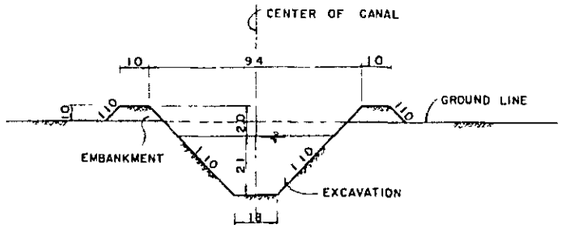
SUBLATERAL DRAINAGE CANAL



MAIN WATER COURSE



SUPPLEMENTAL WATER COURSE



DRAINAGE CANAL

NOTE ALL DIMENSIONS ARE GIVEN IN FEET

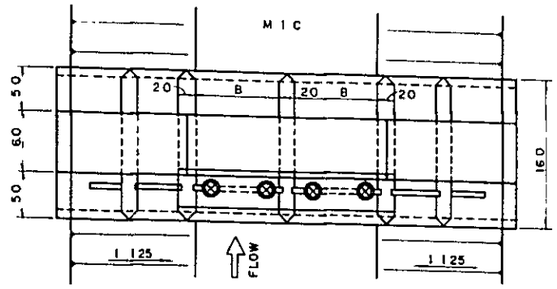
THE SOCIALIST REPUBLIC OF THE UNION OF BURMA
MINISTRY OF AGRICULTURE AND FORESTS

OKKAN DAM IRRIGATION PROJECT

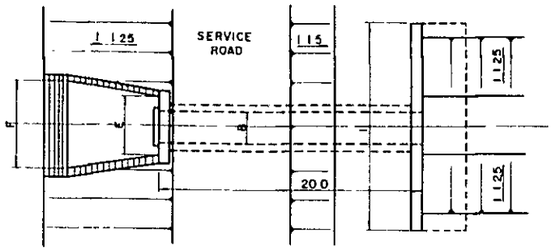
GENERAL IRRIGATION SCHEME
TYPICAL CANAL SECTION

DATE	JULY 1980	D W G	G-1006

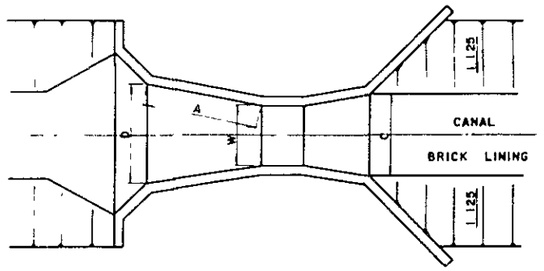
JAPAN INTERNATIONAL COOPERATION AGENCY



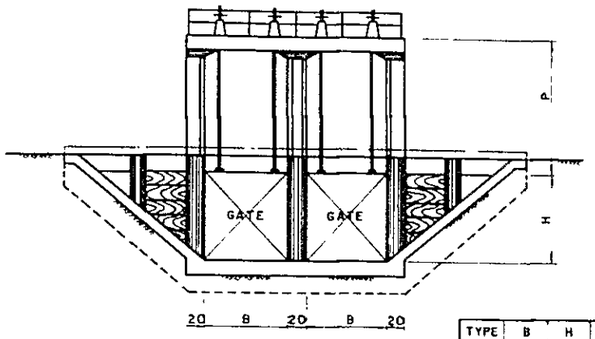
PLAN



PLAN



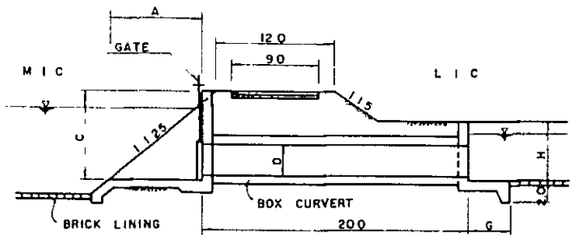
PLAN



ELEVATION

CHECK GATE

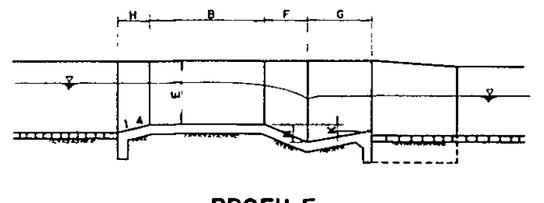
TYPE	B	H	P
A	85	99	129
B	40	97	127



PROFILE

HEAD REGULATOR

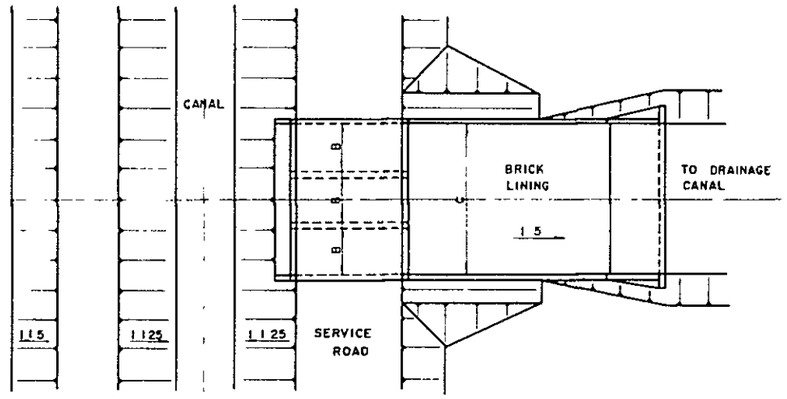
TYPE	B	D	A	C	E	F	G	H	I
A	60	40	75	60	70	80	40	50	200
B	50	35	75	60	60	70	40	46	170
C	40	30	75	60	50	60	40	43	150



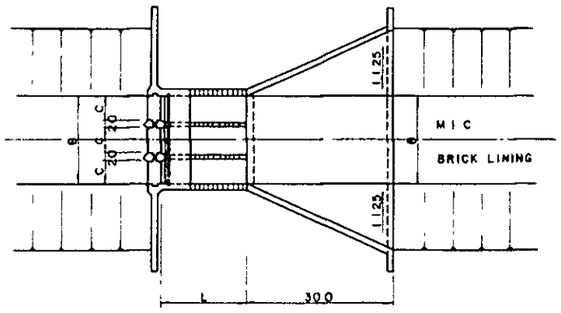
PROFILE

PARSHALL FLUME

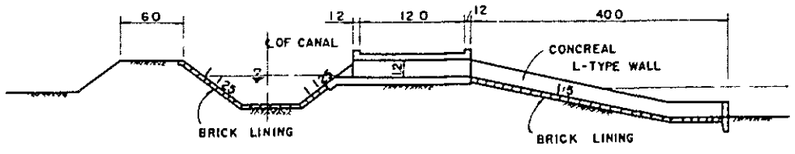
TYPE	W	A	B	C	D	E	F	G	K	N	H
A	200	255	250	240	300	70	60	120	100	225	170
B	60	70	68	70	88	30	20	30	025	075	80



PLAN



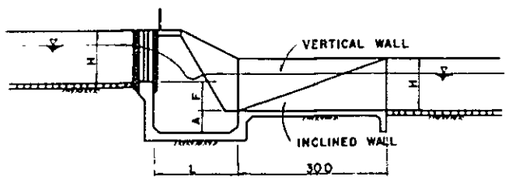
PLAN



PROFILE

SPILLWAY

TYPE	B	C
A	569	183
B	100	100



PROFILE

DROP

TYPE	B	H	C	F	A	L
A	190	113	50	32	22	220
B	60	62	60	32	14	130

NOTE ALL DIMENSIONS ARE GIVEN IN FEET

THE SOCIALIST REPUBLIC OF THE UNION OF BURMA

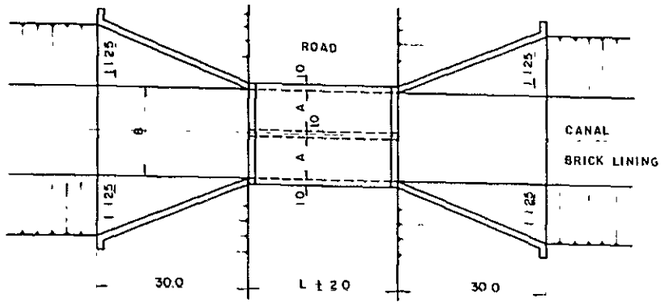
MINISTRY OF AGRICULTURE AND FORESTS

OKKAN DAM IRRIGATION PROJECT

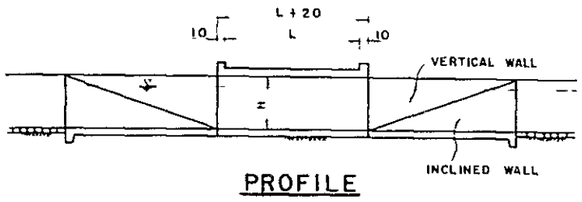
GENERAL IRRIGATION SCHEME
FACILITIES NO 1

DATE	JULY 1980	D W G	G-1007

JAPAN INTERNATIONAL COOPERATION AGENCY



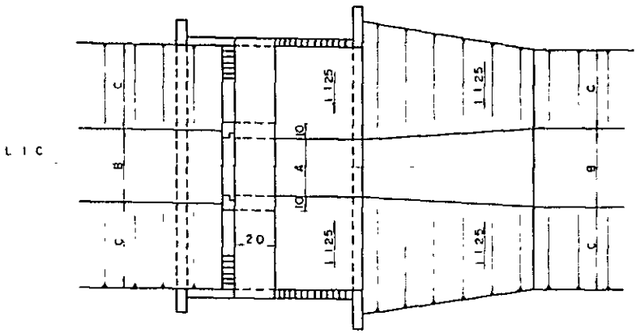
PLAN



PROFILE

TYPE	A	B	H	L
A	90	190	11 3	200
B	50	50	46	200
C	30	30	42	200

ROAD CROSSING



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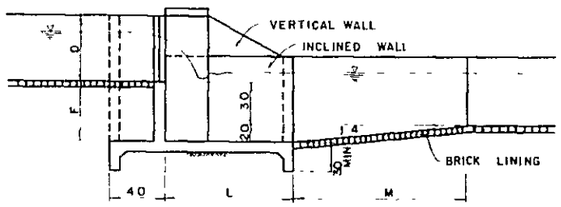
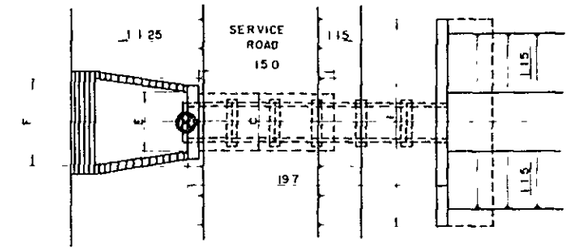


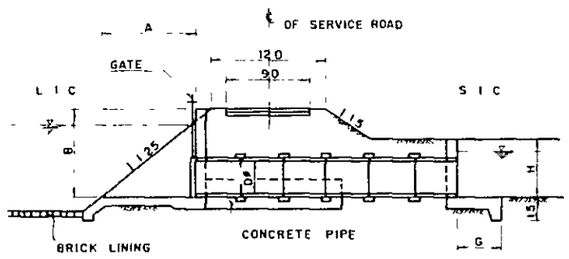
PROFILE

TYPE	A	B	C	D	F	L	M
C	40	60	62	49	50	110	70
D	35	50	57	46	50	100	70
E	30	40	54	43	50	90	70

DROP



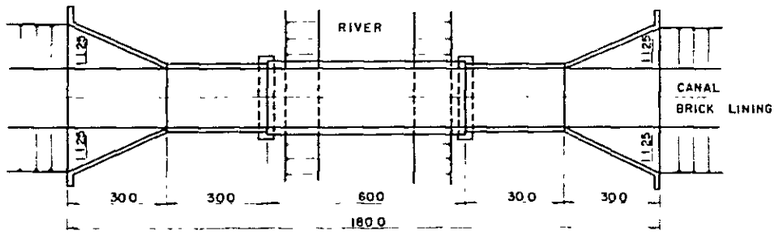
PLAN



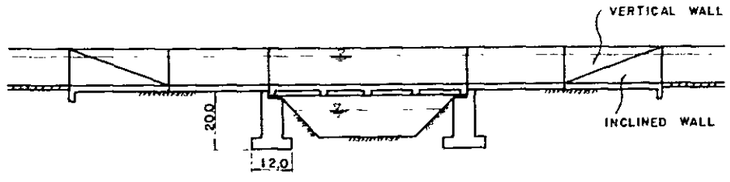
PROFILE

TYPE	D"	A	B	E	F	G	H	I	C	Q (m³/s)
D	36"	50	40	40	50	40	38	150	44	0 80
E	30"	50	40	35	45	40	31	120	38	0 40
F	24"	50	40	30	40	40	26	100	32	0 20

HEAD REGULATOR

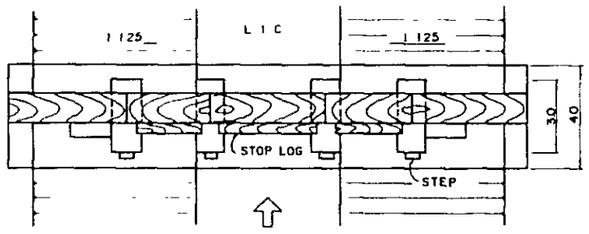


PLAN

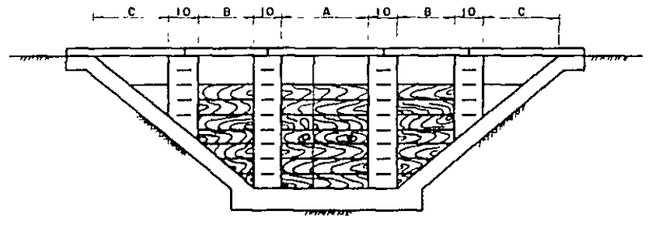


PROFILE

AQUEDUCT



PLAN



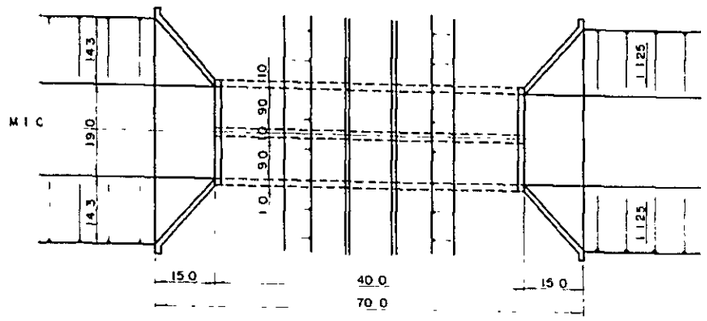
ELEVATION

TYPE	A	B	C	D
C	30	30	18	46
D	30	20	17	36

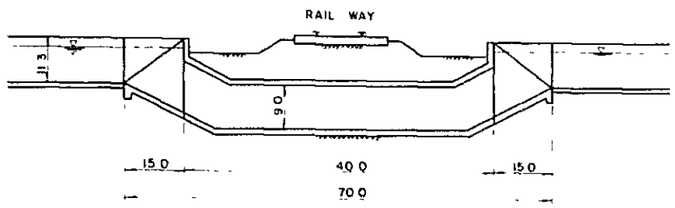
CHECK

NOTE ALL DIMENSIONS ARE GIVEN IN FEET

THE SOCIALIST REPUBLIC OF THE UNION OF BURMA MINISTRY OF AGRICULTURE AND FORESTS			
OKKAN DAM IRRIGATION PROJECT			
GENERAL IRRIGATION SCHEME FACILITIES NO 2			
DATE	JULY 1980	D W G	G-1008
JAPAN INTERNATIONAL COOPERATION AGENCY			

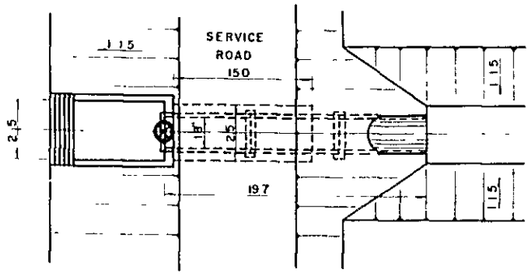


PLAN

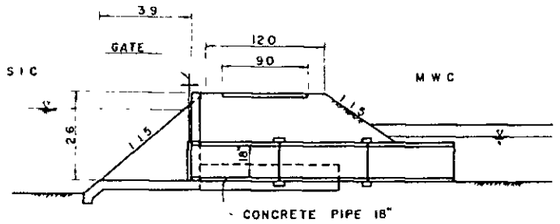


PROFILE

RAILWAY CROSSING WORK

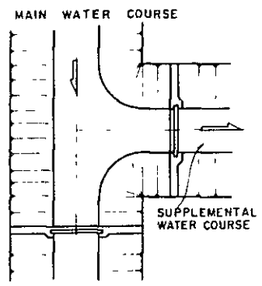


PLAN

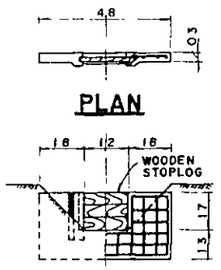


PROFILE

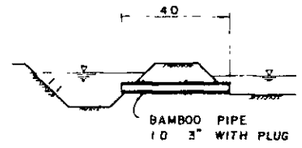
TURN OUT



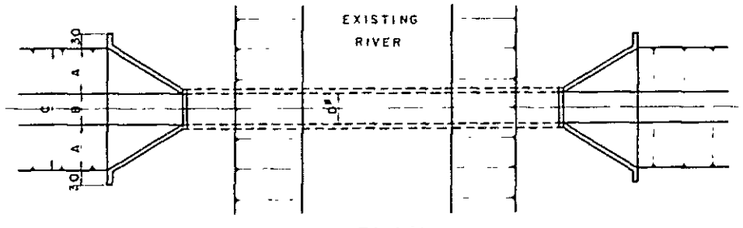
LOCATION



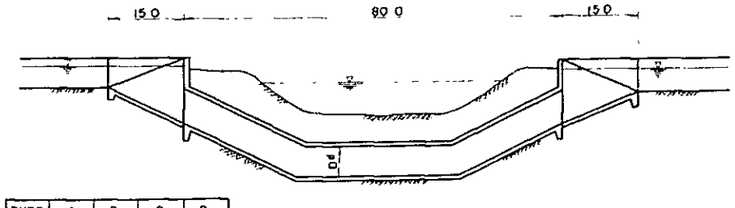
DIVISION BOX & END CHECK



OFF - TAKE



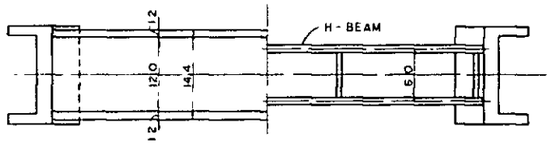
PLAN



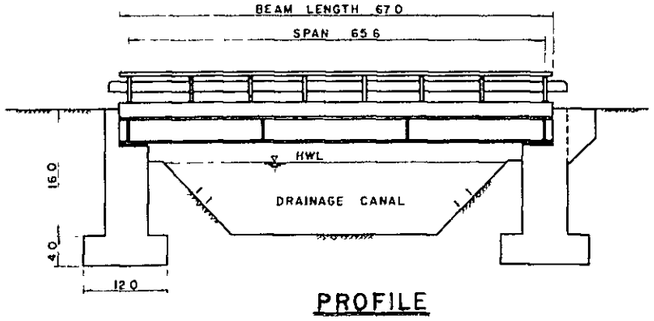
TYPE	A	B	C	D
A	5.4	4.0	14.8	4.0
B	4.7	2.5	11.9	3.0

PROFILE

DRAINAGE CROSSING WORK



PLAN

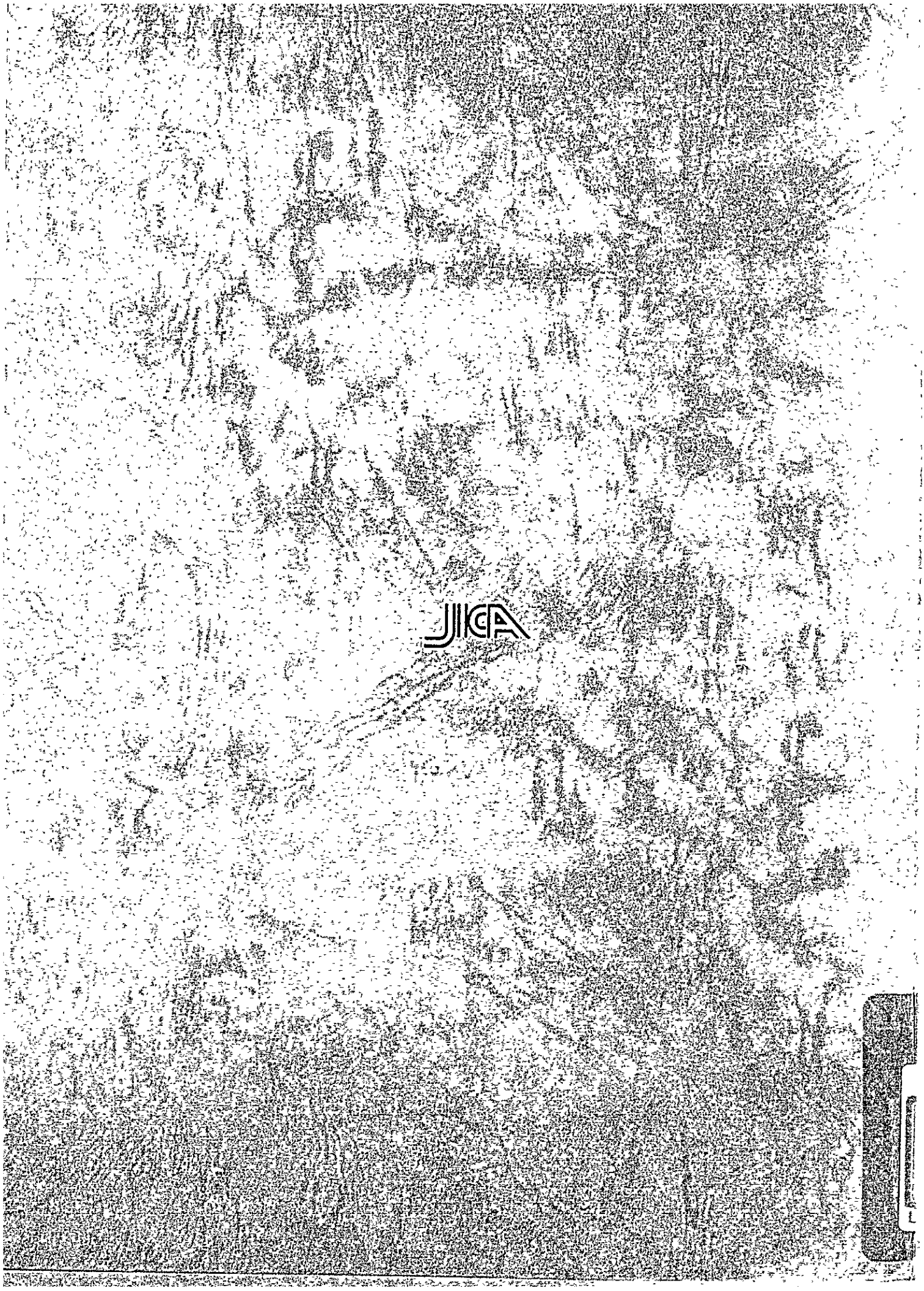


PROFILE

BRIDGE

NOTE ALL DIMENSIONS ARE GIVEN IN FEET

THE SOCIALIST REPUBLIC OF THE UNION OF BURMA MINISTRY OF AGRICULTURE AND FORESTS			
OKKAN DAM IRRIGATION PROJECT			
GENERAL IRRIGATION SCHEME FACILITIES NO 3			
DATE	JULY 1980	D W G	G-1009
JAPAN INTERNATIONAL COOPERATION AGENCY			


JICA