GOVERNMENT OF TAMILNADU
PUBLIC WORKS DEPARTMENT

WATER RESOURCES ORGANISATION

HISTORY
OF
UPPAR DAM

Compiled By

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FOREWARD

The Dam Safety Project externally aided by World Bank contemplates many activities for safety of Dams and updating the Records relating to the various irrigation projects in the Tamilnadu State.

One of the aims is to write and preserve the History of Dams. As the writing of history of project involves expertise knowledge of the various aspects of execution of dam, the task of writing history was entrusted to the Retired Engineers of Public Works Department and the Government of Tamilnadu have also approved the proposals to utilise the services of the Retired Engineers for compiling the History of Dams.

The Uppar Dam is one among and the task of writing History was assigned to **Er.K.Muthusamy, Retired Superintending Engineer,** P.W.D.

Er.K.Muthusamy, with his experience in the field of irrigation project and knowledge in the irrigation system has brought out this volume of **"HISTORY OF UPPAR DAM".**

This publication contains the General History from the formulation to completion, earth dam, masonry dam and appurtenant works, history of dam since commissioning etc.

I acknowledge the efforts putforth by **Er.K.Muthusamy,** in bringing out the **"HISTORY OF UPPAR DAM"** in a comprehensive manner, making it a valuable contribution to the Engineering field.

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HISTORY OF UPPAR DAM

LOCATION:

Taluk	Dharapuram
District	Erode Periyar

GEOGRAPHICAL LOCATION:

Latitude	10° 47'0" N
Longitude	77° 25'20" E

PREAMBLE AND OBJECTIVE OF THE PROJECT

Irrigation in Tamilnadu is as old as the existence of the world. Tamil civilisation namely worship of God in "Linga" form is spread all over the world. At Colorado in America, there is an age old "SIVA" temple on the top of the hill.

There is a reference in old Testament of Bible that EKOVA, one of the 12 disciples of Jesus Christ published the Ten commandments of Christ from the top of Sinoi Hill on the 6th day of "SIVA" month. From this we learn that there was a month in the year by name "Sivan". There are all the few examples to prove that the culture of Tamilians is as old as the existence of the world.

Irrigation by constructing Dams for storage of water to utilise them in the needy period is a well versed art of Tamilians. "Kallanai" near Trichirappalli is a monument to the construction of dams, built by Karikal Cholan 2000 years ago. One of the Epics in Sangam age "PURANANOORU" clearly insist the importance of construction of dams. The 18th song in the epic describes that those who are responsible for the storage of water will ever live in the world. Their fame and name will be remembered for several thousand crores of years.

"ஒன்று பத்து அடுக்கிய கோடி கடை இர் இய'
பெருமைத்தாக நின் ஆயுள்தானே"

It defines the term "food" as follows

"உணவெனப்படுவது நிலத்தொடு நீரே"

The author of this poem insists the king pandian Nedunchezhian to construct dams without anymore loss of time.

The poet also mentions the type of place for the construction of dams.

"நிலம் நெளி மருங்கில் நீர் நிலை பெருகத்
தட்டோரம்ம இவண் தட்டோரே!"

Apart from this, we learn from the History of the nation the long process of storing water across rivers by Anicuts and utilising the same for irrigation, is going on till date.

PARAMBIKLULAM ALIYAR PROJECT:

In the age old process after independence of the country in 1947, much importance was attached to the Irrigation facilities in Tamilnadu. In this process several dams came up like Lower Bhavani, Manimuthar, Vaigai, Amaravathy and so on.

Among the multipurpose projects in the world, Parambikulam, Aliyar project is an unique irrigation projects of the world. It envisages the diversion of west flowing rivers to east in the Western Ghat region. This is also a best example for the Inter-state co-operation between Tamilnadu and Kerala in constructing dams and connecting them through tunnels from one valley to another valley and finally bringing them to the eastern slope of Palani hills area of Thirumoothy dam and Aliyar dam.

The venture of this project was taken up as early as in 1958 and completed in 1968. The total cost of the PAP project was Rs.80 crores only. The whole credit goes to the persons apart from the Government of Tamilnadu, one well known public Thiru V.K. PALNISAMY GOUNDER of Vettaikaran-pudur village of Pollachi Taluk and the vetvan Chief Engineer, PWD U.ANANDARAO.)

During the formation of this Inter-state multipurpose project there was a mention in the project reports that the major drains in the command area of Parambikulam Aliyar project are to be inter-linked for the construction of small dams so that the regenerating flows of Parmbikulam Aliyar project during irrigation seasons can be stored along with rain water realised during heavy rains in the monsoon seasons.

Executive Engineer, Pongalur division in his reference to Superintending Engineer in his letter no.605 SE/dt.14.05.64 writes as follows.

"The feasibility of utilising the flow from Parambikulam Aliyar project by impounding the same in small reservoirs and utilising to the additional ayacuts under these reservoirs has been thought over and included in the preliminary reports of the Parambikulam Aliyar project". One such small reservoir is UPPAR DAM in Dharapuram Taluk of Erode Periyar district.

PRELIMINARY INVESTIGATIONS & PROPOSALS

In Parambikulam Aliyar project a major portion of the ayacut out of 2.40 lakhs acres are coming under Parambikulam main canal and Udumalpet Canals in various Taluks such as Udumalpet, Palladam, Dharapuram and Tiruppur etc.

As per the guide lines indicated above, the existing major drains under the canals were considered for preliminary investigations to construct small reservoirs. Among them there are three major drains traversing the ayacut of PAP. They are,

1. UPPAR ODAI, 2. SENJERIKARAI ODAI, 3. NELALIKARAI ODAI

Assessment Of Regenerated Flow Of PAP:

These drains will collect major portions of the regenerated flow of PAP ayacut and water will flow through out the irrigation seasons. From the experience of the other projects like Amaravathy & Lower Bhavani, the regenerated flow is estimated roughly as

20%. But the condition of PAP is little different. The channels upto 50 Acres limit are lined and this will naturally reduce the regeneration. More over the ayacuts localised under Parambikulam Aliyar project are 80% dry and 20% wet in the lower down portion of each irrigation source. The irrigation sluices are provided for 25 acres limit in Parambikulam - Aliyar project. The regeneration depends on the following important conditions.

1. Location of wet ayacut with reference to the drain localisation
2. The slope of the terrain
3. Percentage of porosity in the subsoil
4. The length of the drain which collects the regenerated flow.

There is one small private anicut near Poolavadi constructed before the formation of Parambikulam - Aliyar project. The Parambikulam - Aliyar project was completed in 1968 (commenced in the year 1958) including all investigation proposals.

ALTERNATE SITES FOR THE FORMATION OF RESERVOIR

Just on the border of Dharapuram Taluk, and Udumalpet Taluk, a reservoir was proposed across Uppar odai as early as in 1958. The proposal was dropped due to its heavy cost. Again it was reconsidered at the time of formation of Parambikulam - Aliyar project. A reservoir of capacity 196 mcft was proposed with F.R.L. at 997.00 and to feed an ayacut of 2500 acres dry. The rough cost of the scheme was worked out as Rs.30.45 lakhs with a return of 0.95%

Palladam division under Parambikulam - Aliyar project was formed and a detailed investigation was conducted by Palladam division. Vide E.E./Palladam letter No.645 SE/dt.23.06.62.

The Special Chief Engineer, PAP inspected the site on 12.07.62 and decided to locate the dam at damaged weir at 16/2 of Dharapuram - Poolavadi road. The capacity of the proposed dam was fixed at 144.5 mcft. with FRL + 990.00. The cost worked out was 36.00 lakhs.

The yield from the catchment returns flows of Parambikulam Aliyar project at Poolavadi site of the same odai near Dasampatty were worked out in detail and approved in Special Chief Engineer Lr. number 773^{m}/62-5-1/dt.19.03.63.

An ayacut of 1500 acres wet were proposed in the above mentioned proposals. It was also suggested to take up the work under special minor irrigation scheme, so that the Central Government aid also can be obtained for the same.

By deeper study of yield calculations, it is proposed to have an anicut at Poolavadi site and connecting it to a small tank of 10 mcft. capacity by a supply channel to serve as a balancing and buffer storage. Proposals for formation of another reservoir at Dassampatty site, lower down of Uppar Odai were made by Superintending Engineer in his Lr. number 2738 CE/dt.28.11.62. Two sites for dam line were examined and comparative cost worked out. Other important aspects like valuable land submersion and villages were also con-

sidered. The site below Lakkambady village and one at mile 7/2 (11.4 km) of Dharapuram - Poolavadi road was selected and two other alternatives were examined as per the instructions of the Chief Engineer, PAP on 15.04.64

Accordingly Assistant Engineer investigation has submitted a report in his letter numbers 597 E/dt.21.05.64 and 608 E/dt.27.05.64. In the reference first mentioned above one alignment was suggested just above Lakkambady village keeping FRL at level + 906.00. The capacity worked out was 203 mcft. To increase the capacity to atleast 300 mcft. the FRL level is to be kept at the level of + 910.00. This will submerge part of Kallivalasu village. Hence this proposal was abandoned.

The second alternate site, two furlongs above Kallivalasu village along the boundary of Bellampatty village was examined. This alignment will also involve submersion of a part of Maravapalayam village. Assistant Engineer had suggested to keep the capacity of the dam as 500 mcft. With three fillings, storage available will be 1500 mcft. Assuming the entire ayacut as wet, at 5 acres/mcft. the total ayacut will be 7500 acres. Hence the site to be selected will be such that the storage capacity will be not less than 500 mcft.

Assistant Engineer in his letter number 608 EE/dt.27.05.64 reports that levels were taken at 4 furlongs interval to calculate the capacity keeping FRL at +935.00 and sill level at +915.00. The capacity was workedout as 432.00 mcft. The area of submersion is 832 acres. (700 acres patta and 132 acres purampoke). Assuming 3 fillings, the quantum of water available is 1215 mcft. This will cater an ayacut of 6075 acres at 5 acres/mcft.

Chief Engineer, Parambikulum Aliyar project had inspected the various proposals on 24.06.64. Based on his suggestions and considering the various aspects, Executive Engineer, Pongalur division reported in his letter number 846 SE/dt.27.06.64, that the site selected was below the Lakkambady village, where the Uppar odai and Varatukarai odai join. This is the final alignment, where the dam was constructed. Here also two alignments were examined. Finally one was selected excluding the valuable lands and few tiled houses. The capacity of the reservoir at the finalised site is 600 mcft. with FRL at +906.00. The net capacity was assumed as 500 mcft. and fixing the sill levels of the irrigation sluices were decided. Assuming 3 fillings a net command of 7500 acres wet ayacut was envisaged by this scheme.

RENAMING OF THE SCHEME: Uppar Reservoir Scheme

Executive Engineer, Pongalur division in his letter number 1001 SE/dt.17.07.64 writes as follows. In as much as the only one reservoir across the Uppar odai is finalised, one final nomenclature is to be adopted. Hitherto the scheme was called Dasarypatty scheme instead of Dasampatty scheme. The name of the village in the TALUK MAP is also mentioned as Dasarypatty, which is not correct. A similar village is existing in Ponnapuram village, just 5 kms south of Poolavadi. This village has got nothing to do with the proposed scheme. It is also a custom to name the scheme by the name of the stream across which the dam is constructed. For example Aliyar dam is constructed across the river Aliyar. Following the same pattern, the Dasarpatty scheme may be hereafter called as Uppar reservoir scheme. Executive Engineer, Pongalur division adopts the name in anticipation of the approval of the Chief Engineer in his further proposals.

HYDROLOGY

The Catchment:

The total catchment for the Uppar odai at the selected site is 349 square miles spread over in four taluks, Pollachi, Udumalpet, Palladam and Dharapurum. The breakup details are as follows.

Pollachi	6 square miles
Udumalpet	163 sq. miles
Palladam	89 "
Darapuram	91 "
Total	**349 square miles**

The catchment may generally be assumed as an average, though the rainfall may not be heavy. The nature of the soil and topography is such that contribution to run off will be substantial.

THE YIELD: (BASED ON SPECIAL CHIEF ENGINEER MEMO S-1, DT.19.03.62)

The average distribution of rainfall in the four different periods of the year is given below.

Taluk	Dry Weather January To March	Hot Weather April To May	South West Monsoon June to September	North East Monsoon Oct. to December	Annual Total	April To September
Pollachi	1.81	4.58	17.41	11.85	36.05	22.39
Udumalpet	2.16	4.56	4.00	16.18	26.92	8.56
Palladam	1.55	5.68	2.80	11.62	21.85	8.48
Dharapuram	1.48	4.32	3.84	14.28	23.20	8.16

Considering the run off from the monsoon periods only and from stange's tables, the taluk wise contribution towards yield is as below:

Pollachi	6x6.917+6x1.890	=	52.84
Udumalpet	163x0.479+4.226	=	766.96
Palladam	89x0.466+89x1.776	=	199.56
Dharapuram	91x0.416+91x2.817	=	294.20
Total annual yield probable			=1273.58 Mcft.

Capacity of the reservoir proposed +576 m.cft. Since the rainfall is spread over both the monsoons two fillings from its own catchment can be assumed which contributes only 2x576 M.cft. or 1152 mcft. against the total yield required of 1273.58 mcft.

Dead storage in the proposed reservoir		+44 m.cft.
Useful storage in one filling 576-44 or		532 m.cft.
Useful storage in two fillings	532×2 =	1064 m.cft.
Supplement from P.A.P. flow water about 1/2 filling		266 m.cft.
Total annual availability		1330 m.cft.

Assuming the requirements as 0.2 m.cft/acre

Ayacut that may be localised 6650 acre

Ayacut actually localised

left flank	4023 acres ✓
right flank	2771 acres ✓
Total	6794 acres ✓

THE MAXIMUM FLOOD DISCHARGE:

There are no gauging stations or other devices available along this odai to allow computation of annual yield or maximum run off with better accuracy.

The Rhyves formula is proposed to be used, using a value of 500 for the coefficient. This value is the one recognised for the plain areas of Dharapuram and Udumalpet taluk of poor rainfall.

Maximum Flood Discharge	=	$C.M^{2/3}$
	=	$500 \times 349^{2/3}$
	=	24,800 c/s
or say		25,000 c/s.

There is a bridge on the Uppar odai along Palladam - Dharmapuram road about 3 miles below the dam site. The M.F.L. mark in the bridge as observed in some peak years were traced out. Cross-section of the odai have been taken to determine the average bed slope. Calculations of the probable maximum flood discharge that might have passed through the bridge gives a figure of 34,960 c/s. This may be well taken as corroborating the value obtained by formula for the dam site satisfactorily.

SPILLWAY:

Vent	:	3 Nos. 30'-0"x18'-0" (3 Nos. 9.14m x 5.49 m)
Sill	:	+888.00 (270.66 m)
Discharge capacity	:	25,000 c/s. (730 cumecs)

CANAL SLUICE: LEFT SIDE:

Vents	:	1 No.3'-0"x4'-0" (1 No. 0.91m x 1.22m)
Sill	:	+882.00 (268.83m)
Discharge	:	105.62 c/s (3.03 cumecs)

CANAL SLUICE : RIGHT SIDE:

Vents	:	1 No. 3'-0"x4'-0" (1 No.0.91 m x 1.22m)
Sill	:	+882.00 (268.83m)
Discharge	:	72 c/s (2.04 cumecs)

CANAL: LEFT SIDE:

Length	:	10.85 km
F.S. Discharge	:	105.6 c/s (3.00 cumecs)
Ayacut	:	2510 acres

CANAL: RIGHT SIDE:

Length	:	12.74 km
F.S.Discharge	:	72.00 c/s (2.07 cumecs)
Ayacut	:	3550 acres (2453 Ha)

HYDRAULIC PARTICULARS:

Location:

Latitudes	:	10° 49'N
Longitude	:	77° 25'E

GENERAL:

River	:	Uppar
Basin	:	Cauvery
Nearest Town	:	Dharapuram
District	:	Periyar
Construction period	:	1965-68

RESERVOIR:

Catchment area	:	938.80 sq.km
Design flood	:	708 cumecs
F.R.L.	:	+276.15M
M.W.L.	:	+276.76M
Area at F.R.L.	:	4.53 sq.km
Capacity at FRL gross	:	16.31 M.cum

DAM:

Type	:	Earth dam
Top of Roadway	:	278.89 M
Max. height	:	16.76 M
Length: Earth dam	:	2362.2 M

UDUMALPET DIVISION: PWD
DETAILS OF DEVELOPMENT OF AYACUT/IRRIGATION
UPPAR DAM

Sl.No.	Year	Uppar dam section Uppar dam	Udumalpet Canal sub Division	Udumalpet Division
		Period of Irrigation	Ayacut developed total in acres	Percentage of development
1.	1971-72	07.10.71 to 31.03.72	3829.00	63.29%
2.	1972-73	07.10.72 to 01.03.73	4215.00	69.70%
3.	1973-74	15.10.73 to 21.03.74	4600.00	76.03%
4.	1974-75	01.09.74 to 19.10.74	-	-
5.	1974-75	01.12.74 to 27.03.75	-	-
6.	1975-76	16.09.75 to 01.03.76	5300.00	87.60%
7.	1976-77	16.10.76 to 13.03.77	4740.62	78.63%
8.	1977-78	21.10.77 to 31.03.78	5391.29	89.11%
9.	1978-79	01.11.78 to 31.03.79	5312.92	87.82%
10.	1979-80	01.10.79 to 31.03.80	5217.93	87.13%
11.	1980-81	15.09.80 to 16.03.81	5471.54	90.44%
12.	1981-82	15.09.81 to 16.03.82	5231.00	86.46%
13.	1982-82	05.11.82 to 28.02.83	3475.64	57.45%
14.	1983-84	- -	-	-
15.	1984-85	02.12.84 to 05.04.85	4968.00	82.12%
16.	1985-86	05.03.86 to 15.03.86	-	-
17.	1986-87	24.12.86 to 09.02.87	-	-
18.	1987-88	01.01.88 to 10.03.88	5450.00	90.10%
19.	1988-89	09.09.89 to 14.01.89	-	-
20.	1989-90	04.12.89 to 04.05.90	5513.00	91.12%
21.	1990-91	24.12.90 to 02.04.91	4467.25	73.83%
22.	1991-92	- -	-	-
23.	1992-93	04.12.92 to 03.04.93	5950 AC	98.18%

THE VILLAGES COMING UNDER UPPAR DAM AYACUTS

1.	Velayuthampalayam	21 acre
2.	Kethalrev	896 acre
3.	Thoppampatty	4334 acre
4.	Puthur	89 acre
5.	Nanjiampalayam	76 acre
6.	Sooriyanalloor	24 acre
7.	Kannankovil	220 acre
8.	Sangarandampalayam	400 acre
		6060 acre

GEOLOGICAL INVESTIGATIONS CARRIED OUT TO SELECT THE SITES

Modern concepts are evolved in the dam constructions. The locations of spillway and formation of earth dam above 20 meter height are all possible and adopted in all the irrigation dams of Tamilnadu after Independence, right from the lower Bhavani Dam. Moreover the construction activities of the Uppar dam is a part and partial of the Parambikulam Aliyar project. In the project, major dams in hill areas like Sholaiyar dam, Parambikulam Dam were tackled easily with the available resources and technical personnel. When compared to the above dams, the Uppar dam is a tiny one and based on the experiences gained in the PAP dams, the readily available experiences and technical expertise were utilised fully and quick decisions were arrived at in finalising the proposals of Uppar dam construction.

Executive Engineer, Pongalur division on 10.06.64. had given an inspection notes on various activities to be carried out for the commencement of the dam construction. It was on two headings namely,

1) Field work

2) Office work and gathering of records

INSTRUCTION NO.1:

Central line of the bund to be demarked on ground fixing stones at every furlong and at kinks with dead mark built at the ends and the kinks to offer easy identifications. Chainages are to be painted on those central line stones starting from left flank at level + 920.00. The above instructions were carried out by the Assistant Engineer and central line fixed.

INSTRUCTION NO.2:

A Benchmark is to be fixed at a safer location preferably by the side of the proposed office buildings. The value of the benchmark is to be painted on the stone. Accordingly the benchmark was installed.

INSTRUCTION NO.3:

A fresh condensed L.S. along the alignment now fixed may be taken and quantity of works assessed for the estimate purpose.

INSTRUCTION NO.4: CANALS

The alignment on the ground as per the preliminary investigation proposals may be traced out and the central line stones fixed at every furlong.

INSTRUCTION NO.5:

Suitable localisation map along with the proposed branch canals, distributaries and field bothies may be prepared. The ayacut localisation pattern may be adopted like the localisation of PAP ayacuts. Grouping of ayacuts may be done upto 50 acres limit. The pipe outlets are located for every 25 acres limit.

The above instructions were carried out in the field and trial pit particulars were made out.

OFFICE WORK AND GATHERING RECORDS:

Instructions:

6 (a): Draw the L.S. of the bund along the central line and give trial pit particulars in the same sheet. The plans were prepared on the line instructed above.

6 (b): Draw in one sheet, the front elevation, rear elevation and the plan.

6 (c): Prepare a layout for the construction of camp colony buildings. The total cost of the buildings may be restricted to Rs.50,000. The estimates may be prepared by adopting the accepted designs and rates for the buildings as in other places of PAP.

6 (d): A rest shed: A small rest shed preferably placed on high ground overlooking the water spread would be fitting for the inspection of officers. A site plan may be prepared for the above proposal on the right flank end at the location indicated, and suitable designs may be evolved. Location may be near the juncture of the Dharapuram - Poolavadi and Dharapuram - Kundadam road. Accordingly the camp site were selected and proposals of buildings were submitted to the division.

INSTRUCTION NO.7:

This instruction deals with the preparation of canal sections, distributaries and field bothies.

INSTRUCTION NO.8:

Preparation of the water spread map and capacity curve may be drawn and capacity calculated at level +906.00. Shifting proposal of Poolavadi-Dharapuram road may be shown in the same map.

In the same reference, lead particulars of the construction materials are given. Based

on the above instructions, detailed estimates were prepared to a value of Rs.55.00 lakhs as detailed below.

DETAILS OF ESTIMATES:

1.	Head works	Rs.42.50 lakhs
2.	Main & branch canal	Rs.4.77 lakhs
3.	Distributaries and water courses	Rs.1.85 lakhs
4.	Special tools and plants	Rs.1.00 lakhs
5.	Direct and indirect charges at 10%	Rs.4.88 lakhs
	Total	**Rs.55.00 lakhs**

Trial pit particulars were sent to soil mechanics laboratory, design circle PWD Madras - 5 in the month of November 1964. The trial pit index plan was also enclosed for reference.

During the investigation period of 1963, the trial pit samples were sent to Parambikulum dam soil test laboratory. The Executive Engineer, Parambikulum division refers in a D.O. letter 536 m/ dt.10.03.65. as D.O. 173/dt.29.12.63. of Executive Engineer, Pongalur division. So the samples for the test were sent to Parambikulum in 12/63 and the results were obtained in the month of March 1965. Soil tests show that the sand content varies from 61% to 85% and clay content varies from 5% to 17%. The samples were classified under various categories as follows:

SFM = Sand with excess of silt fine

SC = Well graded sand with excellent clay binder

SP = Poorly graded sand

SW = Well graded sand

H = Hearting soil

C = Casing soil

The soil samples results furnished by the soil mechanics lab, Madras-5 gives the following results.

The sand content varies from	34% to 87%
Clay content varies from	14% to 57%

Most of the samples show that the sand with excess silt fines are predominating (SFM).

BORE HOLE DETAILS:

Bore hole details for the investigations of hard strata in the masonry dam portion was carried out during the period of 1964.

As per the drawing drawn in May'70, Six bore holes were drilled in the river bed and details are furnished.

Borehole No.	Chainage	Ground level	H.R.level	Level to which drilled
1.	0.7.616	+869.00	858.75	826.50
2.	1.0.33	+874.00	863.53	836.25
3.	0.7.570	+861.50	854.40	835.50
4.	0.7.460	+865.00	841.00	835.00
5.	0.7.400	+871.00	750.00	835.50
6.	0.7.356	+874.00	761.25	844.50

BORE HOLE NO.1:

This strip of soft disintegrated rock is met with at 864.00 to 862.00 and from level 860.00 to 858.00. From level +858.00 onwards upto +826.50, the hard strata core is exhibited.

BORE HOLE NO.2:

From level +865.00 to 863.42 soft disintegrated rock is met with and also at level from 844.00 to 843.50. After this level upto 836.35, the strata is a hard rock.

BORE HOLE NO.3:

The bore hole was drilled in the deep river bed, where the ground level is +861.50. Upto the level of 854.50 change of strata such as hard earth and soft disintegrated rock are met with. Then hard rock cores are available upto the level of +837.00 and 0.5' in between the level 837.00 and 836.50 is soft disintegrated rock and then the rock strata continues. The bore hole was drilled upto the level of 835.50.

BORE HOLE NO.4:

Hard earth is met with in between the rock strata at various levels +859.75, 856.00, 842.50. The average thickness of the strata is about 0.5' to 1.0'. The hole was drilled upto a level of +835.00.

BORE HOLE NO.5:

In this hole also loose strata are met with intermittently. The bore hole was drilled to a level of +835.00.

BORE HOLE NO.6:

Between the level +861.25, 844.50 the uniform hard rock is founded. Based on the bore hole details found above, the average foundation level of the surplus regulator was fixed at the level of 850.00 average.

TRIAL PIT PARTICULARS OF THE EARTH DAM:

In the same map, the samples in various survey field numbers in water spread area are marked for the test of suitability of earth dam and sent to soil mechanics laboratory of Design circle, PWD, Madras. The tests are carried out in the period of 03.04.66 to 15.09.66 and the results are communicated to the Executive Engineer, Pongalur division. The soil samples were sent to the soil mechanics lab during the period of 11/64 as per the plan showing the trial pit locations. They are located in water spread area. Eventhough there are 32 places numbered, the following numbers are selected for the borrow area both for hearting and casing soils.

LOCATION	HEARTING	CASING
SF No.263		Pit No.1
SF No.215	Pit No.2 & Pit No.4	Pit No.3
SF No.267		Pit No.8
SF No.194		Pit No.9
SF.No.225 & 230	Pit No.12	Pit No.17
SF No.227	Pit No.21	Pit No.20
SF No.228		Pit No.22
SF No.259 & 262		Pit No.22
SF No.97 & 100	Pit Nos.27,28,29	
SF No.189 & 190		Pit No.30

The other pits like 6,7,8,10,11,13,14,15,16,17,18,24,25,26,31 and 32 are not noted in the map whether they are suitable for either casing or hearting.

SANCTION OF THE PROJECT

Based on the above test results the estimate was submitted along with the project report and was sanctioned in G.O.Ms.No.2977 PWD/dt.17.11.64. for Rs.50.00 lakhs (Coimbatore Dt.) PAP. Following the administrative sanction mentioned above, Chief Engineer, PAP has technically sanctioned the project in his letter No.6788/64-P1014/ dt.15.12.64.

One thing is to be mentioned at this juncture. A scheme is sanctioned by the Government within three months of submission. The whole scheme of PAP was completed in eight years from 1960 - 1968, involving an estimated cost of nearly 80 crores. There were close watch over the field works progress and administrative side. No project in India is completed in such a short interval of eight years. Moreover the unique scheme of PAP is diverting the west flowing rivers to east, is purely designed and executed by the eminent Tamilnadu Engineers. Foremost among them were Chief Engineer Mr. U. Ananda Rao, Superintending Engineers Mr.C.R. Ramamoorthy, Mr. Hedge and Executive Engineers Mr. T.S. Kannan, Mr. R. Kuppusamy, Mr. Natarajan, Mr. Mohana Krishnan. Because of their frequent inspection of sites and decision taken on the spot and giving site orders to carry on with the works without any lapse. This enabled the Engineers to complete the projects in a stipulated time.

STAFF EMPLOYED:

As discussed in preliminary report, where the drains in the PAP ayacuts are to be tackled for development of ayacuts, one of the major drain is Uppar odai and the investigation works were taken up as early as in 1962. The Executive Engineer, Pongalur division under the PAP canals circle was incharge of this work and four sub division were formed and engaged in the project construction works as follows:

1. One sub division at Kundadam Head quarters in charge of right flank Earth dam, spill way portion and camp colony.

2. One subdivision for the right flank of Earth dam.

3. One subdivision for canals, both right and left Flank.

4. One subdivision of machinery for maintenance of Earth moving Machineries and Automobiles.

The first subdivision was formed originally at Kundadam and preliminary works such as taking water spread area levels, preparing condensed L.S. for Earth dam and spill way portions and preparing estimates in addition to construction of camp colony for staff and office buildings for subdivision and section.

A small rest house for the inspecting officers was also designed and constructed. Each subdivision was having three to four sections for which Assistant Engineer or Junior Engineer was in charge of works.

THE SURPLUS REGULATOR DESIGNS AND PLANS:

The design and drawings were prepared by the planning and design division, Madras - 5 and finalised. According to the plan, the following specifications were adopted in the drawing.

LOCATION:

The Uppar dam location is just 11.2 kms north west of Dharapuram on the road Dharapuram - Poolavadi. The alignment of the dam lies north were just below the confluence point of Uppar odai and Varattu karai odai.

CATCHMENT AREA:

The catchment area taken for the calculations purposes is 36.9 sq.miles. They line in the taluks namely Udumalpet, Pollachi and Dharapuram. The details are furnished in the Hydrology.

SOURCE OF WATER:

Estimated to have 2.5 fillings. Two fillings from its own catchment and half filling from the seepage of Parambikulum main canal irrigation. The detailed calculations are furnished in the Hydrology.

WATER SPREAD AREA:

The estimated area marked in the plan corresponding to the level +906.00 is 1120 acres.

LENGTH OF THE DAM:

It is 7400' (2255 m) including 118' length of masonry surplus regulator. Maximum calculated flood discharge - 25,800 cusecs.

The details of calculation are furnished in Hydrology.

CAPACITY OF THE DAM:

The gross storage is calculated as 572m.cft.

Dead storage - 45 m.cft.

Utilised storage - 527 m.cft.

2.5 fillings will result in total quantity of 11317 m.cft.

SILL LEVEL OF IRRIGATION SLUICES:

There are two nos. of sluices one at L.s.3190' in left Flank and another at L.S.5610' in the right Flank provided at a sill level of +882.00 (268.83). The details of the sluices will be discussed later. Full reservoir level - +906.00 (276.15 m)

The FRL was fixed based on the quantity of the storage and submersion of valuable lands, buildings and of course one village namely Lakkambody was submerged for which compensation were paid and the inhabitants have vacated willingly on the reason that the irrigation sources will provide them better status in future. There were about 32 families including harijans. With available compensation they have constructed houses and purchased lands in ayacut areas.

TOP OF BUND LEVEL:

With a free board of 9'-0" the top level of the dam was fixed at +915.00 (278.98 m). The norms of the free board is maintained.

SURPLUS REGULATOR PORTION: (SPILLWAY PORTION)

The length of the masonry spillway is 118' - 0" (36.00 m) commencing from the chainage 1582 m to 1618 m from left flank end (ch 5192'-0" to 5310'-0"). The location is just below the confluence point of the major odais namely Uppar odai and Varattu karai odai. The average foundation level in the masonry portion is +850.00. The crest level of the surplus weir is +880.00 (270.66 m).

DECK BRIDGE TOP LEVEL:

The deck level is kept at +935.00 and roadway provided is 16'-0".

VENTS:

There are 3 nos. of spillway vents of size 30'x18' each. Three gates are located in between two abutments and two piers.

ENERGY DISSIPATING ARRANGEMENTS:

The length of the stilling basin is 60'-00". The width of the stilling basin is 110'-0" and depth is 6'-0"

ESTIMATED QUANTITY OF MASONRY:

Based on the average foundation level as 850.00 the estimated quantity is 4900 units. Each unit consists of 100 cft.

EARTH DAM:

The left flank length is 5192'-0" (1580.56 m) and the right flank is of 2090'-0" (637.45 m). The proposed earth dam has got a maximum height of 55'-0" at the chainage 5110'. Total quantity of soil from borrow area conveyed is 1,37,000 units of each unit consisting 1000 cft.

PARTICULARS OF IRRIGATION SLUICES:

There are two sluices at chainage 3190'-0" left flank and at 5610'-0" in the right flank. The operating platform is provided at +916.00 level i.e. 1'-0" above the top of earth dam. Ayacut at 50 duty for left flank is 3550 acres and 2510 acres for right flank canal (total 6060 acres). The size of the vent provided for both these sluices are 3'x4' discharging a quantity of 105.62 c/s and 72 c/s respectively. The shutters provided are of size 4'x5'. There is a provision of groove for the insertion of emergency gate when the regular gate is under repair. The length of the barrel across the earth dam is 84'-3"

CANAL-LEFT FLANK:

The initial reach has got a bed width of 13'-0" and side slopes 1:1. The supply depth of canal flow is 4"-0" with the free board of 1"-6" . The length of the main canal is 17.29 kms. The initial bed level of the canal is +882.00 with a bed fall of 1'/mile. Number of irrigation outlets proposed are 35 nos.

CANAL-RIGHT FLANK:

The length of the right main canal is 12.47 kms. Bed width at the starting point is 9'-0" with a bed fall of 1'-0" per mile. The side slopes are of 1:1 and the total depth of the canal is 5'-6" with a full supply depth of 4"-0". There are about 23 nos. direct sluices in the command.

MASONRY ABUTMENTS:

There are two abutments one at the chainage 1582.00 m in the left flank and another at 1618.00 m in the right flank. The top level of the upstream varies from level +906.00 to level +865.00 while the top level in the down stream varies from the level +910.00 to level +870.00. Width of the abutments at bottom varies from 34"-0" to 6"-10" in the upstream and 33'-0" to 12'-0" in the down stream side. The top width of the upstream wing is 3'-0" and the down stream is 4'-0".

SPILLWAY:

The width of the spillway at the bottom at foundation level +850.00 is 59.83'. The ogee curve starts at the same level. The crest level of the spillway is +882.00. The top level of the operating platform of vertical gates is +938.88. The width of the pier is 10.00'. The crest level of ogee is +880.00. The equation of the parabolic curve of ogee is $y = 0.156 \times 2 + 0.27432 X - 0.4518$.

BUCKET CURVE AT TOE:

The tangent point is at the level of +859.35. The radius of the curve is 20'-0". The nose curve starting point is at the level of +885.872. The radius is 3'-6". The second curve radius is 9'-0". The length of the curve is 3.15' on either side from the axis of the dam.

VERTICAL LIFT GATES:

There are three nos of vertical lift gates of size 30'x18'. They are also designed, manufactured and erected by the PWD workshop, Aliar, Necessary detailed drawings for groove frames etc. are enclosed.

UTILITY TOWERS:

There are two nos. utility towers, one on the left wing of the masonry dam and another at the right wing of the masonry dam to reach the operating platform of shutters. There are spiral staircases provided from the top of the bund level to the operating platform.

LAND ACQUISITION

The Parambikulam Aliar project is a major scheme involving thousands and thousands of acres of land acquisition. A separate Revenue wing was formed under the control of Special Deputy Collector with Head quarters at Pollachi, PAP Makkinampatty colony with necessary staff. The PWD authorities will mark the approximate requirements of the land acquisition in the village map survey number wise and rough land plan and schedule will be sent to the deputy collector. He will then process the land acquisi-

tion proceedings. While the land acquisition process is going on the Revenue staff will get the consent statement from the concerned land owners and hand over the lands to the PWD authorities to proceed with the execution of the project. The farmers in the Coimbatore DT. and Pariyar Dt. are very reasonable, cordial and accommodative. They have readily signed the concerned statements to part with the lands pending the finalisation of the compensation. There were few cases of objections to enter upon the lands before paying compensation. Such farmers were negotiated by the PWD officials amicably.

The inspection notes of Superintending Engineer PAP canal circle dt.10.06.66. regarding the borrow area is dealing with such objections. The borrow area was inspected. There is a difficulty in obtaining the consent for entering upon the lands from some land holders. Everytime the local officers are contacting them and convincing them of the urgent need for entry upon the lands and arranging for watering the borrow area. A few land holders belonging to Kallivalasu village are not yielding easily and are questioning the rate of compensation that are being proposed for the land acquisition. One of the riots who was available at the borrow area was contacted by the Superintending Engineer. On hearing his grievances he has been convinced that the pending award enquiry for the fixing up of the cost of land acquisition, they may allow the department to enter into the lands and borrow the earth. However this seems to be a difficult task. Even though there were such few cases, the majority of the riots have handed over the lands as and when the officers requested them. This is the first and foremost factor of the easy execution of the project. First we require the land to start any work. Unless the lands are available for the execution of the project, the project execution will be naturally delayed. The project was completed in September 1968 commencing in the month of March 1965. Thanks to the land owners who have readily handed over their lands on demand by the department even before knowing the rate of compensation.

SITE CLEARING AND EARTH WORK EXCAVATION WORKS FOR FOUNDATION

After preliminary works are almost over the site clearing and excavation of foundation work were commenced in the first week of January 1965. All the works including surplus regulator were started foundation earth work simultaneously under job work system. Several job workers were engaged in the excavations of cutoff trenches for each dam and foundation for the surplus regulator. The average ground level in the river bed is +866.00. The foundation excavated for the surplus regulator is upto the level of 850.00 with an average depth of 17'-0". There is no problem in foundation works with the interruption of weak zones, pegmatite zones etc. Leveling course of cement concrete 1:3:6 using 3/4" hard broken granite metal over which a foundation concrete 1:4½:8 using 1 ½" hard broken metal was laid.

TREATMENT OF FOUNDATION AND PROBLEMS MET WITH:

Before laying levelling course a thorough check-up of loose materials, fissures and cleavages were examined by benching operations. Grout hole locations were also decided and 3" dia pipes were positioned in order to drill the holes after building some masonry to act as a counter weight against the uplift of grout pressure. Random rubble masonry in cement motor at various proportions were done with extending the provision of grout hole pipes for gouting. The foundation rock was a homogeneous gneiss variety of hard blue granite sheet rock. Hence no foundation problem is met with in the Uppar dam during execution.

GROUTING:

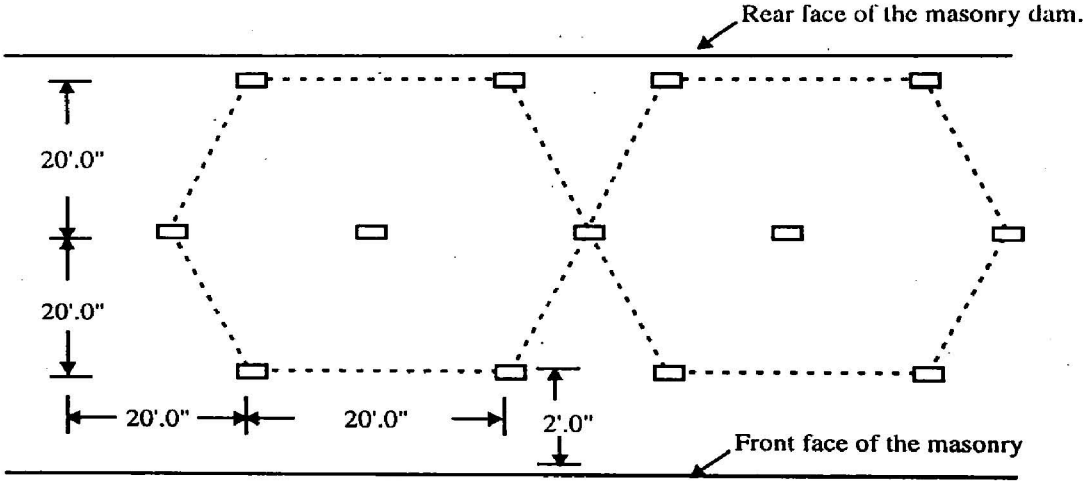
Grouting is the process by which joints or seams in foundation rock are filled with a suitable impervious material cementing the huge masses of rock separated by the joints. Generally cement in water is used for the purpose. The suspended cement particles in the water go on settling in the joints excluding the water until the cement settles in the joints expelling the water out. This layer of cement forms the joining media of the spiltrock joints and makes a pervious zone. Grouting of foundation has got three advantages.

1. Consolidates the rock base of the Dam
2. Forms a barrier arresting the seepage through the fissures.
3. Grouting reduces the uplift pressure on the base of the dam

It will be better to select the grout holes after the foundation excavation is over. So that we can clearly select the vulnerable points. It is preferable at the benching of the rock faces of foundation. These holes were generally taken to depths as fixed by the pattern plan or till 6' to 8' below last joint as seen from the cores which ever was deeper.

PATTERN OF GROUT HOLES:

The ground holes consists of 3 rows and each hole is at 20'-0" interval in both the directions as shown in the sketch. The first line will be 2'-0" inside the front face of the masonry dam.



The holes at forty feet interval are first drilled and grouted and then the intermediate holes at 20'-0" interval are drilled and grounted. The dia of holes is 3".

METHODS OF GROUTING:

Generally holes drilled with 2.5" drills were of 3" dia. A pipe 3" dia and 3'long is threaded one side upto 12' length and the other end chambered to 3" outer dia and inserted into the grout hole to 12" depth. The annular space around pipe is caulked with cement mortar tightly and then cement concrete 1:3:6 to a thickness of 9" is laid around the pipe and allowed to settle for 21 days. Then the holes are washed by air and water

alternately connecting to the air compressor and water jet. The purity of water shows the clearing of the bore hole.

WATER TEST:

The bore is tested with water pressure and sudden loss of water head will prove that there are large joints. If the water head disappears, slowly the hole is tight.

GROUTING:

The grouting drum is filled with 1 ½ times capacity of grout hole and started grouting. The cement slurry 1:5 density is slowly pumped in and agitation of the hoses are continued till the hole refuses to take the grout. The grouting operation is to be continued till the holes refuses grout.

There were 36 grout holes grouted in the Uppar Dam including 2 nos in old dam for trial bores. They were grouted in the period 13.10.65 to 29.11.65 that is after completing the masonry dam in full. The masonry is built up to certain height after fixing pipes in the grout hole position. The pipes will be extended up as the masonry comes up. Then the holes are drilled upto the required depth. The dia of the hole is 3" and depth varies from 42' to 21'. There is no special feature in the grouting since sheet rock is available in the foundation.

Meanwhile earth dam on both the flanks were going on with cutoff trench excavations. The machinery subdivision, Aliyar brought the machineries including rollers to fill up the cutoff trench. Thus the work both in the earth dam and in the masonry dam went off well.

DIVERSION WORKS OF RIVER COURSE AND COFFER DAM WORKS:

The river is dry in most of the months of the year except the northeast monsoon period from October to December. A six inches diameter R.C. hume pipe was placed in the centre of the river portion and flow was allowed through this pipe. Practically there is no problem in the diversion works. Temporary coffer dams with sand bags were made to divert the flash flood, whenever they occur.

CONSTRUCTION OF MASONRY DAM

The masonry portion is only 118' in length to serve as a surplus regulator in the deepest river bed. This regulator is with three vents of 30'x18' having a vertical lift gates with hoisting arrangements. The sill level of crest is at +888.00. The ogee portion in the down stream face starts at the level +850. The foundation is taken up to 847.00 and levelling course were done with cement concrete 1:3:6. The front portion upto axis of the dam is built by cement mortar 1:2 ¾ as usually done in all masonry dams upto +860.00 level and then in flyash cement mortor 1:4. The front face of the regulator above G.L. is built with hammer dressed stones to a thickness of 1'-6" in cement mortor 1:2 ¾ upto +860.00 level and onwards the flyash c.m. 1:4.

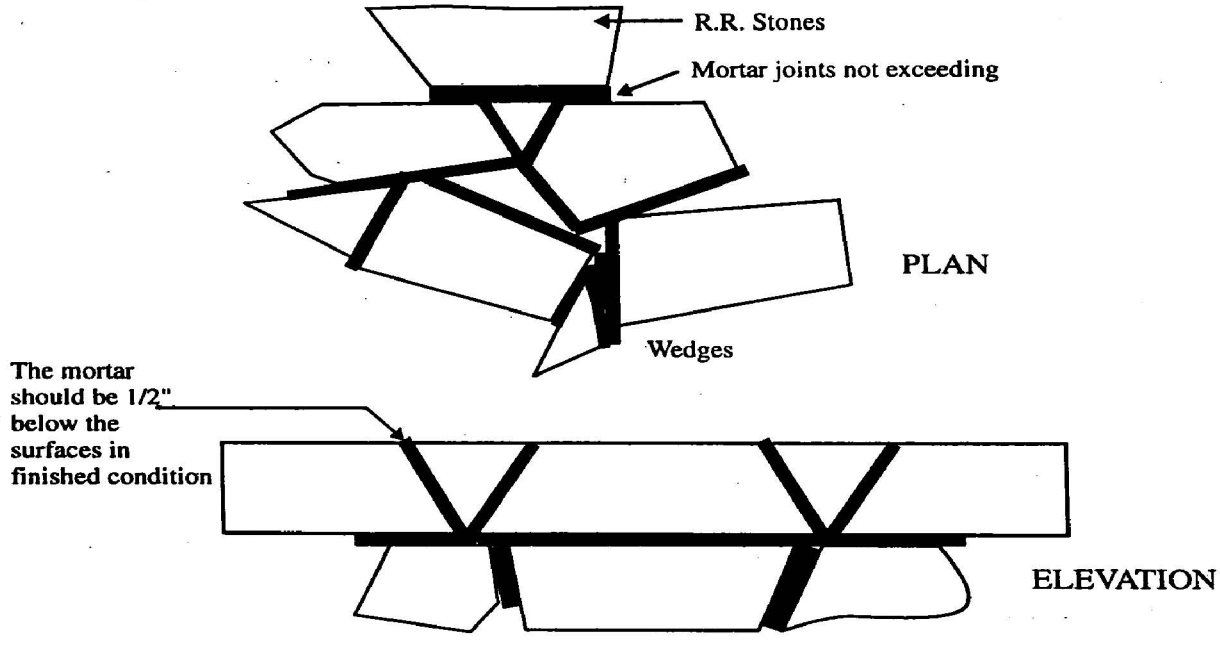
WING WALLS:

The wing walls are of 87'-0" length (horizontal) with 25° splay. Down stream wings are of 89'-0" length. The bottom width of the wing wall along with the body wall is

59.85' and 33'-0" in the end. The wing wall are also raised simultaneously along with body wall of the regulator the wing wall in front face has got a construction joint. Similarly the body wall is divided into 3 blocks. Each block has a construction joint.

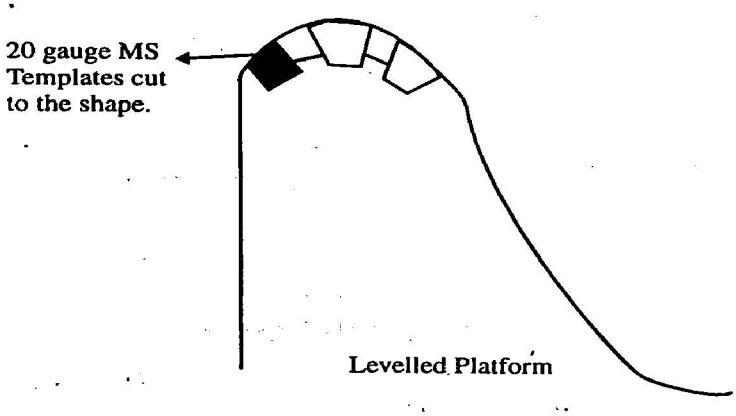
METHOD OF BUILDING R.R. MASONRY:

The stones are of staggered sizes. All stones should be good shaped without angular faces. The tail length should be 1 ½ times the width of the stone. The broad face is to be laid as bed. The old surface is well wire brushed early in the morning and the face of the mortar is to be made clean by removing the cement slurry. There should not be any mortar sticking on the finished surface except joints. The mortar in the joint should be ½" below the surface of the stone in all joints. The stones are to be washed to remove dirt, mud and vegetation with wire brushes before carrying it to the built up site. After spreading mortar at the bottom with relevant consistency built up site. After spreading mortar at the bottom with relevant consistency and applying mortar in the sides of the built up stone, the stone is placed in such a position such that the joints in all sides are minimum. The top surface should be almost level. The large pockets are plugged with spalls after packing with mortar. The stone after placing it in position is to be hammered well so that it can sit tightly over the mortar without any voids in the mortar. The finished surface is to be cleaned with soft brooms and extra mortar sticking over the surface are to be removed. After laying 100 sft. or masonry, when the top surface is dry, due to sun the loose morter are to be removed in full and cleaned with wet cloth over the surface of the stone. Care should be taken that the water should not squeeze into the mortar joints, when the stone surfaces are cleaned. The packing labour should pack the joint carefully and with a rod he should give a jerk to the stone so that the air particles if any in the joints will escape. The wedges in the big joints are to be placed in conical shape, the broad face in the top. The same process should be repeated for the further courses.



CONSTRUCTION OF OGEE CURVE:

Based on the parabolic curve equation furnished by the Poondi Research station Y = $0.1576 X^2 + 0.27432 x - 0.4518$, the ogee curve is buildup. The coordinates are calculated and a platform is prepared with the level surface and the ogee curve to the true scale is marked and painted. The following sketch explains the method of preparing each stone.



The double line C.R. stones prepared in the above manner is usued to build first model section with templates made of M.S. angles. The space inbetween models are filled with the prepared chisel dressed stones. The mortar used is C.M. 1:4 upto +860.00 level and above flyash mortar 1:4 is used. Flyash used is 20% by weight.

CONSTRUCTION JOINTS:

There are several construction joints in the masonry portions as detailed below. There are two numbers in wing wall at the junction of the dam bucket portion and stilling basin, and two nos between main body wall and upstream wing wall. The other joints are in the main body wall dividing the 110'-0" masonry dam into three equal parts. During construction, the body wall will be provided with keys at 10' interval at the face. Usually alternate blocks will be atleast 3' higher than the adjacent block. The wing wall will be built flush after plastering the body wall with lime cement mortar 1:4, ¾" thick. In construction joints of body wall necessary copper plates made in U shape with anchoring arrangements will be provided stage by stage and will be filled with suitable grade of max phalt.

DECK BRIDGE:

There are three spans of 30'-0" clear span. The thickness of piers are 10' each. There are two nos of piers. The deck bridge is designed as T - beam bridge and designs were evolved by the Pollachi division, drawing branch, Pollachi as per the page 365 of Highways manuals, Volume III.

The size of T beam is 1'-3"x3'-3" including the slab thickness of 0'-6". There are two nos of kerbs of size 1"-0"x1"-0". Over the deck slab a wearing coat of 3" thick with cement concrete 1:1¾:3 using ¾" metal is provided.

HOISTING ARRANGEMENTS AND UTILITY TOWERS:

The two piers to a width of 12'-0" and 12'x12' in two wings are raised with R.R. masonry to 937.88 level providing necessary anchor bolts for assembling the girder deck bridge. The two towers on the wings are provided with the staircases to climb to the deck bridge. The deck bridge is made up of steel girders and chequerred plates of ¾' thick. Three motors for three gates, necessary switch boards, hand operating devices in the case of failure of power are all provided. The counter weights are of R.C.C. beam with necessary hook to connect the vertical gate with the chain for the operating purposes. The head room of the utility tower is 10'-0" above deck bridge and dome shape roof slab is provided for the utility tower, on both the sides to improve the architectural view of the dam with Shutters and hoisting arrangements.

The shutter 30'-0" x 18'-0" size made of steel plates and angles, manufactured at Aliar, PAP workshop. The entire fabricated parts are, carried to the site and erection of the shutters are all done by the workshop and machinery division, Aliar. The details of groove frames and shutters are furnished in the workshop drawing attached to the report.

ENERGY DISSIPATING ARRANGEMENTS:

The energy dissipating arrangement is a pool of size 110'-0" with Baffle blocks. The average foundation level excavated is +845.00. After removing loose materials of rock in foundation by chipping and Chisseling, foundation concrete 1:4½:8 to a thickness of 4'-0" from level 845.50 to 849.5 was done in a block system of 10'x10'. The alternate blocks are completed and the gap in between the blocks were filled in afterwards. A wearing coat of 6" thick from +849.50 to +850.00 was done with plain cement concrete 1:1½:3 using ¾" metal with necessary construction joints.

BAFFLE BLOCKS:

Two rows of baffle blocks of size 3'x4'x3' are provided at a distance of 18'-0" from the toe of the masonry and 35'-0" from the toe of the bucket was provided with R.C.C. 1:½:3 using 3/4" metal. The height of the blocks if 3'-0". A baffle wall 60'-0" away from the toe of the dam, 3' wide R.C.C. 1:½:3 is built upto a level of +855.00. A wearing coat 1'-0" thick to a length of 20' over built up with R.R. masonry in CM 1:5. over the concrete of 1:3:6 using 66⅔% 1½ metal and 33⅓% 3/4" metal.

RIVER TRAINING WORKS IN THE D/S

The distance between the road bridge and the dam is about 250'-0" away from the stilling basin. The two sides of the river banks are naturally left without any protection upto the Highways bridge since the river bed and sides are of rocky outcrop nature.

DEVIATIONS AFFECTED DURING EXECUTION WITH REFERENCES

Generally there is no deviation in the proposed construction of both earth dam and masonry dam. This happens in the projects like PAP that the proposals, designs and executions go ahead simultaneously. But it is not the case the regular process of sanction and construction. So the deviations are not generally necessary in the project works. The same condition was existing in the construction of Uppar dam also. So there is no deviation generally noticed.

EARTH DAM

The earth dam concept and soil mechanism has not grown up as today in the post independence period. In olden days earth dam concept was with a hearting of a core of puddle clay. The clay content in the soil of hearting should not be less than 20%.

Nowadays it is possible to have earth dam to a height of 300' to 400'. In America, the Ganison dam, Davis dam and Andersonranchi dam are few high earth dams.

BHAVANISAGAR DAM

After independence the first irrigation dam taken up in Tamilnadu was Lower Bhavani dam and it has got its longest earth dam of 5½ miles length. The experience gained in Lower Bhavani, Amaravathy etc. the design of earth dam has become very common to the Tamilnadu Engineers and the same design methods were adopted for Uppar Dam also. Earth sections are evolved by slip circle method and rear and front slopes are decided accordingly. The Uppar Dam is nothing but an earth dam except a masonry dam of 118' length. Out of 7392'-0" length of the dam, only 118'-0" is masonry and remaining length consists of earth sections. The length of left flank is 5192'-0" while the right flank is 2090'-0". The maximum height of the earth dam at the junction of masonry dam is 55'-0" at L.S. 5110'-0".

SOIL SURVEYS:

A systematic survey of soil available in water spread was taken up. Soils from different trial pits (nearly 32 nos.) were got analysed in the soil mechanics laboratory at Chepauk and at the laboratory at Parambikulam in January 1965. The soil available in the borrow area were certified as suitable. The quantity of required soils both for hearting and casing were arrived at, based on the cross sections prepared according to the height of the earth dam at different longitudinal sections. Borrow areas were located within 1 to 2 kms lead and care was taken not to have borrow area within 3 h + 120' from the central line of the dam where `h' is the height of the earth dam at this section. The borrow area was mapped.

In suitable survey nos. the depth of soil was assessed by trial pits and quantity of earth available calculated. The requirements of impervious zone earth is 4500 units where the semipervious zone earth is 9875 units, the unit being 1000 cft. The entire quantity of 14,375 units are available in the borrow area of 1120 acres of water spread as furnished below.

Village	Area in acres (pattas)	Area in acres (poramboke)	Total (acres)
Gattalrevu	60.28	3.00	63.28
Velayuthampalayam	393.51	100.34	493.85
Molarpatty	199.95	41.70	241.65
Bellampatty	103.86	0.50	104.36
Sadayapalayam	174.71	38.89	213.60
Total	932.31	184.43	1116.74 or 1120

As per the history of the Lower Bhavani project manual volume I head works page 318, One cubic yard barrow pit when excavated becomes 1.25 cubic yard white it is compacted in earth becomes 0.80 cubic yard. The loose nature is called SWELL and the compact nature is called SHRINKAGE. The test conduct by soil mechanics laboratory, Chepauk, Madras reveals that this samples are having clay content 19% to 34% when tested from 4.4.62 to 14.9.66.

DESIGN BY SLIP CIRCLE METHOD:

The cross section were tested for stability by slip circle method of analysis of slopes. The final designed sections will have the factor of safety 1.5 in all sections for both the conditions of the reservoir either empty or full.

TYPICAL SECTION:

The front and rear slope are varied according to the height of the earth dam.

UPTO HEIGHT	FRONT SLOPE	REAR SLOPE
18' height	2:1	1 ½:1
25' height	first 20'2:1	1 ½:1
	beyond 20'2 ½:1	1½:1 with 4' berm
upto 40' height	first 20'2:1	1 ½:1 with 4' berm
	second 20'2 ½:1	2:1 with 4' beam
from 40'-55'	first 20' 2:1	1 ½:1 with 4' berm
	second 20'2 ½:1	2:1 with 4' berm
	third 20'3:1	2 ½:1 with 4' berm

Upto 18' height the earth dam is upto 2640'. No hearting section is provided upto 18'-0" height. Upto 25' height hearting, zoned filter, cut off trench and rock toe filters are provided. The hearting section will be 5'-0" below the top of the bund and top width will be 6'-0" with side slopes 1:1. In the front toe of the hearting cut off trench will be provided to the half of the height or upto hard lock level which ever is less. If the cut off trench is met with rock in shallow depth, cut off walls in R.R. masonry will be provided. The road way on the top of the sam is 15'-0" wide with parapet on both ends in random rubble masonry in clay pointed with the cement mortar 1:5. The height of the parapet is 2'-6" above the road level on both the sides.

KEY TRENCHES INFRONT OF SEMIPERVIOUS ZONE:

The first and foremost importance in earth dam formation is the treatment of the junction between original ground and the made up bund. In the front semi pervious portion a key trench of 5'-0" x 1'-0" with side slope of 1:1 is excavated at the interval of

15'-0" C/C upto cut off trench. This provides a good bonding between the original ground and newly formed earth dam in addition to increasing the creeping length of the seepage water.

CUT OFF TRENCH:

Cut off trench is excavated when the height of the earth dam is 25' and above. The cut off trench commences at the toe of front hearting slope. The bottom width of the cut off trench is 8'-0". They were filled up with the puddle clay in layers not exceeding to the thickness of 0'-8" and rolled well at the optimum moisture content. Grout curtain concrete cut off walls in cement concrete 1:2 ½:5 where necessary in Lower Bhavani dam above the height of 60'-0" earth dam. In Uppar dam the maximum height to a small length is about 55'-0". Hence no grouting and cut off wall is necessary.

SEEPAGE PAST CUT OFF TO BE TAKEN CARE OFF:

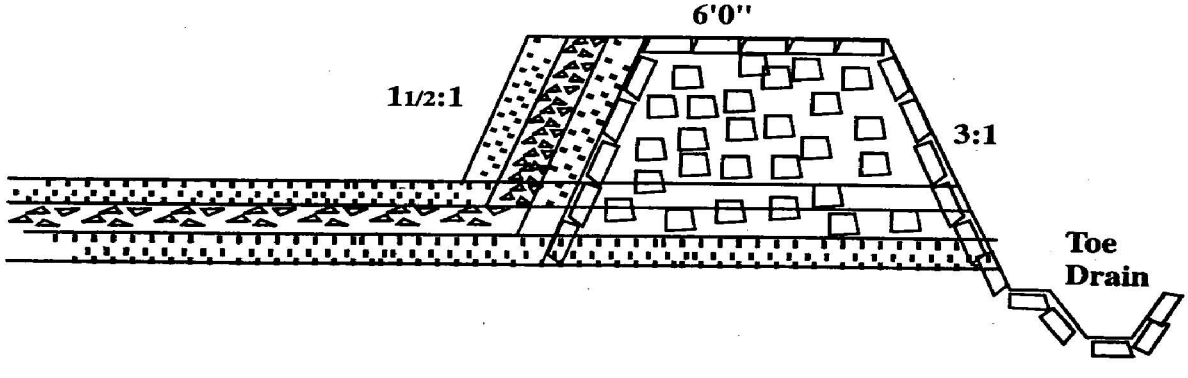
Inspite of all precaution such as cut of trench, impervious zone etc. There will be yet some seepage through the porosity of the earth particles. This seepage water will diminish the stability of the earth dam if allowed to build up pressure under the base of the earth dam. This seepage upto the optimum moisture content will increase the cohesion between the earth particles, and at saturated condition, the cohesion power will be reduced. Hence any seepage inside the bund is to be freely drained without building pressure on the earth dam and without carrying the particles of earth.

REAR FILTER:

This is formed by providing a graded filter at the rear base of the earth dam commencing from the rear toe of the impervious zone. The grading will be finer to coarser in the direction of flow. The zonal filter area of three layers bottom and top layer 1'-0" each sand layer and the central layer is hard broken stone 1'-6" thick with graded metal from ¾" to 3". The rear end ends with rock toe filters.

ROCK TOE FILTERS:

The rock toe is made up of hard broken stones for 3" to ¾" graded metal and enclosed with the pitching of R.R. stones in the profile. The size of the stones are not less than 6"x6"x9" over the zonal filter. The top width is 6'-0" and the rear slope is the same as earth dam. Inner slope is 1½:1 with the finish of graded filters.



TOE DRAINS:

A toe drain was formed to the entire length of the dam and drained into the river. At the end of the both flanks "V" notches are provided to measure the seepage. The toe drain is 4'-0" width at the bottom with 1½:1 side slopes. The pitching of the toe drain was done by 9" thick rough stones.

After the rear filter was formed, pervious zone earth in 8" layer are spread in uniform layers with the aid of the graders or manual labour and consolidated by power rollers. Forming of first layer will be a bit difficult and then it is a routine work. The excavated rock spalls of foundation of masonry dam were fully utilised for rock toe fillings, and quarry rubbish in the front slope below rivetment.

TOTAL QUANTITY OF FILLING MATERIALS USED:

1)	Zonal filter 3'-0" depth	2600 units (of 100 cft)
2)	Zonal filter 2'-0" depth	1400 units
3)	Forming rock toe with rubble stones	1600 units
4)	Quarry rubbish for baking the rivetment	2600 units

OPTIMUM MOISTURE CONTENT:

Optimum moisture content is a term which contains water sufficient so that at proper consolidation, it should have maximum density. In general optimum moisture content is 17 to 19% by weight of dry soil for impervious zone, and 11 to 13% for the semipervious zone. To obtain this, the practical solution is to wet the borrow area 24 hours before removing the soil to 2" to 3" depth. In addition to this, watering on the bund to get the optimum moisture content was sprinkled by lorries.

MACHINERIES EMPLOYED:

The inspection notes of SE/PAP/Canals circle dt.10.06.66 gives the details of machineries available at Uppar dam.

L.C. scrapper	-	3 nos.
D.W.10 scrapper	-	1 no. (11 cu.yd capacity)
D 8 Dozer N:6	-	1 no.
TD18 grader	-	1 no.
Rollers	-	2 nos.
Water lorries	-	2 nos.,

With these machineries, the earth dam works have progressed satisfactorily. The above inspection reports mention that the earth dam has reached to the level of +874.00 near masonry dam. The toe drains were formed upto river margin in the left flank.

IMPERVIOUS ZONE:

The earth dam was designed with two zones. The centre core of the dam is done with impervious soils. That is to be water tight after formation. Soil containing 10 to 15% clay is suitable for this zone. Its wet density is 128 to 135-lbs. Optimum moisture content is 17 to 19%. Dry density is 110 lbs per cft. The percolation rate through this materials per year is 0.3 feet.

SEMIPERVIOUS ZONE:

Enveloping the impervious zone is semipervious zone. The type of soil used will contain 8 to 15% clay. This will have high shear strength and stability in the alternate conditions of wet and dry. The wet density will be 135 to 142 lbs/cft. Moisture content is 11 to 13%. Dry density will be 120 to 125 lbs/cft. Cobbles upto 4" size were allowed in this zone.

PROCEDURE OUTLINED:

The cut off trench earth work taken up and competent impervious soil placed in the cut off trench to a thickness of 8" and spread uniformly and rolled with power roller to get the maximum density in optimum moisture content. After filling upto the cut off trench entire width of the earth dam at this section are marked with reference to centre line including marks of pervious and semipervious zones on both the sides of cut off trench. The vegetation and top soils are removed upto 6" and key trenches are formed according to the specification. They are filled with the respective soils of pervious as well as impervious zones. Spreading to a layer of 8" thick is carefully watched and water is sprinkled if necessary. Then the layer is consolidated. 2' extra on either side are formed since consolidation in the end will not be possible with the rollers. The extra earth placed will be cut to the required slope and utilised for the formation then the there. In order to exercise economy in rehandling the excessively formed earth dam, the cutting is to be done within 10/-0" height, so that lead involved will be less. Semipervious zone will be rolled with a pass of 16 to 18 times while the impervious zone 12 to 16 times.

The rolled surface was scarified before putting a next layer of earth and watered to have proper binding. The front slope is subjected to alternate conditions of dry and wet during filling and emptying. It is likely to loose down the earth particles when there is sudden draw down. there is also wave action when the reservoir is full. To overcome this difficulties 18" thick quarry rubbish was spread over the trimmed surface to the required slope. Over the quarry rubbish of 18" thick,. jetty stone revetments are provided with proper wedging.

The rear slope is trimmed and turf with root and clay support of placed and watered for 45 days. Drainage chuts at 100' interval is provided with R.R. masonry 1'-0"x0'-9" in cm 1:5 with excavated stones.

The revetment is build up on the foundation of rock toe wall taken at level 3'-0" below ground level.

FIELD TESTS:

Soil mechanics laboratory were maintained and consolidated tests are performed then and there and rerolling was done as and when required.

EARTH DAM DESIGN AND DRAWINGS:

The earth dam was designed in slip circle method at planning and designs division, Madras and suitable cross sections are evolved. Drawings prepared in May 1970 at Pollachi division numbered nil gives the clear and final cross section of the dam.

CROSS SECTION AT L.S. 660'-0":

The average ground level is +908.00. Key trenches of size 5'x1' with side slope of 1:1 at 15'C/C interval was proposed after removing the top soil to a thickness of 0'-6".

The front upstream slope is 2:1 and 1'-0" thick revetments were provided over a depth of 0'-6" quarry rubbish. The toe of the revetment was taken upto the level of +906.00. Rear down stream slope of the bund is 1 ½:1 with a berm of 3'-0" wide, to commence the toe drain whose bed level is +906.00. The drain is of 1½:1 slope, 2'-0" deep and bottom of the toe drain also pitched with rough stone of 9" thick. The top width of the bund is 15'-0" clear between parapets. The TBL is +915.00. The parapets are of R.R. masonry in clay 1'-6" width and pointed with cm 1:5. The down stream slope is turfed to avoid erosion during rainy season.

CROSS SECTION AT L.S. 2640'-0":

The average GL at this cross section is +896.00. After removing the top soil key trenches of 5'x1' with 1:1 slope at 15'-0" C/C are proposed. The revetment toe in the u/s is taken to +894.00. All other specifications are as per cross section at 660' except the pitching of toe drain in the bed 1' thick instead of 9" thick.

CROSS SECTION AT L.S.2970'-0":

The average GL is +894.00. The height of the bund comes to 21'-0". This cross section has got impervious and pervious zones with a cut off trench in the upstream side starting from the toe of hearting in the upstream side. The bed width of the cut off trench is 8'-0" and taken to a level of +883.50 i.e. to a depth of D/2. The side slopes are 1:1. Only one key trench is provided in the upstream side at the same size adopted in the previous cross section. The upstream side slope is 2.5:1 and toe of revetment was taken to +885.00. The size of the toe is 3'x3'. The revetment provided is 1'-6" thick upto FRL +906.00 over a quarry rubbish of 9" thick. Above FRL 1'-0" thick revetment over a layer of 6" thick quarry rubbish was provided. In the down stream side 1½:1 slope is provided. The impervious zone starts at 5' below TBL at +910.00. The top width of the hearting is 6'-0" with 1:1 side slope. In the toe of hearting in the upstream cut off trench is provided while in the downstream side graded filters are provided with the following specifications. Inverted graded toe filter of 3'-0" thick zonal filters are provided to the entire width of casing in the down stream side.

2'-0" thick graded material filters are spread to form toe drain at average 4'-0" thick rough stone dry pitching done in the slope with a berm of 4'. The toe drain with 4'-0"

bottom width and 1½:1 slope with a berm of 2'-0" upto the level of +891.00 is provided. The thickness of pitching 0'-9".

CROSS SECTION AT L.S.4950'-0":

The average GL is +875.00. The height of the bund at this cross section is 40'-0". All specifications except the following are the same including casing and hearting and cut off trenches. The front slope for he first depth from level +875.00 to 885.00 is 3:1. The next slope to a height of 10'-0" from level 885.00 to 895.00 is 2½:1 and the next 10' high from 895.00 to 915.00 is 2:1. In the rear slope 20'-0" from top of bund from level +915 to 895.00 has got a slope of 1½:1. At this level a berm of 6'-0" width is provided and the balance height from 895.00 to 882.00 upto top of rock toe is 2:1. The specification of zonal filter, rock toe are the same for the other cross sections.

CROSS SECTION AT L.S.5110'-0":

The average GL is +895.00. The maximum height of the earth dam falls at this L.S. is 56'-0". The front slope is varied at every 20'-0" height from top from 2:1, 2½:1 and 3:1. The specifications of revetment are all same. The rear slope is also varied from 1½:1, 2:1 and 2½:1 at every 20' height with a berm 6' wide. All other specifications are same. This cross section is the deepest one near the left wing wall touching the river bed. All other cross sections in the right flank beyond masonry dam are with same specifications depending upon the height of the earth dam.

Inspection notes of Executive Engineer, Pongalur division dt.16.07.74 deals with the preparation of detailed estimate. The lead particulars for the various materials to be used in the dam construction are discussed and proper guidance given to adopt the leads for the construction materials.

TRIAL PITS:

The results of the trial pits are discussed in the first para. The top soil upto 1'-0" is only earth and the further depths are hard strata ranging from dense medium rock to dense medium hard rock. It is instructed to have a trial pit along the centre line of the earth dam to depth of D/2 where D is the height of the earth dam. To assess the rock level in the foundation instructions were also given to excavate 15'-0" wide trench along the centre line starting from the river edge in the left flank to a length of 150'-0" to examine the rocky out crop, so that the surplus regulator position can be decided. Clear instructions were given in this inspection notes to engage job workers immediately and commence the excavation work.

The unique feature of the PAP works is taking decisions on the spot and executing the same immediately. The main reason for the completion of the project within three years is the adoption of the job work system which had several advantages over the tender system. The abnormal delays in the execution of works nowadays are common due to tender system. The entire project of PAP was completed under job work system, ofcourse observing the procedures and formalities quickly. Some of the advantages of the adoption of job work system are discussed below.

1) The job workers were available in plenty due to no deposit is to be remitted for the works entrusted to them.

2) The unit rates are approved to the various sites by the Chief Engineer and the agreement was entered in the job work system based on the approved rates.

3) The job workers were mainly under the full control of the Junior Engineer who has taken responsibility of executing the excellent quality of work.

4) The payments are very quick and centralised system of payment was made in the division by the Executive engineer.

5) Accounting of these works were largely due to central payment which will help in latter dates to finalise accounts of each estimate to prepare completion report.

Like this, there were several advantages in the job work system. It is worth mentioning here that almost all the projects after the independence of the country were adopting this job work system.

LEAD PARTICULARS:

The Executive Engineer Pongalur division clearly gives the lead particulars for various materials in his inspection notes which forms the basic key for the cost of the project.

CEMENT:

40 kms lead from Udumalpet R.S. via Kudimangalam and Poolavadi.

SAND:

Sand shoals in both the areas of downstream and upstream sides would provide entire sand requirements including filling. The average lead approved is 1 to 2 km cart tracks.

STONES:

The outcrops of rocks in the river bed and near Lakkambody village will be suitable for revetments only. For building purposes the quarry at Varapalayam may be adopted with the lead of 7 km M.R. and 3 Km C.T. This is adopted in the entire estimate.

Borrow earth for the dam both for pervious and impervious zones could be found in between the water spread area and the river bed. The average lead adopted for this area is 2 to 3 km cart track.

Bricks from Dharapuram with the lead of 12 to 13 km M.R. Lead of lime is 9 km M.R. from Kundadam. The Assistant Engineer was instructed to submit a detailed estimate based on the instruction given above, after completing the preliminary field works. Accordingly an estimate for Rs.55.00 lakhs was submitted and abstract of the estimate was already furnished.

CAMP COLONY:

Another important feature for the quick completion of the project is providing accommodation at the site of work. The human nature is to concentrate on the works only when their minds are free from worries. Especially personal worries of an individual is

to be minimised, when a man is to be fully involved in the job.

Among the various conveniences required for the staff who are engaged in the execution of the project such as dwelling places, education facilities, medical facilities, transport facilities, providing accommodation is the most essential.

In the execution of irrigation project, the aspect of amenities of providing water to the staff is invariably followed and it has served its purpose fully in the execution of the projects expeditiously.

Executive Engineer, Pongalur division has instructed in his inspection notes dt.10.06.64. to prepare estimates for the camp colony along with small rest house to a value of Rs.50,000 for accommodating the inspecting officers based on the lead particulars instructed.

He has given instruction to select a camp colony site in the right flank where the Dharapuram - Poolavadi road meets at the proposed sites of constructions of dam. The colony site is marked in the drawing showing the location of borewells prepared in Pollachi division in May 70 without number. The location is in the S.F.No.266, 267 and 168 just right side of the river and where the Dharapuram Poolavadi road and Kundadam road join.

Accordingly different types of quarters are proposed and estimates prepared for individual quarters and blocks as detailed below. The type designs of quarters proposed as per the designs adopted in various dam sites in PAP. The drawing no. nil dt. May 70 prepared in Pollachi division, the type design of quarters.

Types of quarters constructed.

1.	Junior Engineers quarters	1 no.
2.	Two block of clerks quarters	2 nos.
3.	Dormitory blocks	12 nos
4.	Lascars quarters	6 nos.
5.	Office buildings to accommodate sub divisions and sections	1 no.
6.	A small rest house with two suits and a dining hall with a kitchen block attached separately.	
7.	Labour sheds 6 nos. including workshop shed for repairing heavy machineries.	

These works were completed within a period of 6 months and the sub division hitherto functioning at Kundadam was shifted to dam site.

JUNIOR ENGINEERS QUARTERS:

The plinth area is about 950 sq.ft. consisting of sit out 10'x10', living 10'x12', kitchen 9'x10', during 9'6"x10',bed 10'x11'-9", water closet, fuel, block 13'6"x8' and open yard with compound wall 16'-3"x12'-3".

CLERKS QUARTERS:

It consists of closed varanda, bed, sitting, kitchen, bath and water closets and open yard. The plinth area is about 840 sq.ft. including open yard.

REST HOUSE:

This block consists of twin type model with plinth area of 770 sq.ft. for two suits. Varanda, dining, bath and water closets are in each suit. The rest house is located inbetween office building and J.E's quarters. 12 similar blocks were constructed to accommodated the staff.

LASCARS QUARTERS:

Each quarters has a plinth area of 400 sqft consisting of varanda, living, kitchen, open yard, bath and water closets. The constructions were started in January 1965 and completed in June 1965. In addition to the office buildings machinery yard, labour shed etc. were provided to accommodate the various staffs.

WATER SUPPLY AND ELECTRICITY:

A well is dug for the water supply of the camp colony with necessary overhead tanks. Individual quarters were provided with water supply and electricity. A separate transformer is installed by the Electricity Board on request with sufficient load to cater the needs of the Uppar dam including lifting of gates.

A BRIDGE BELOW DAM, ROAD FORMATION AND DIVERSION:

The road from Dharapuram leading to Poolavadi branches at 11th km to lead to Lakkambody which is now under water spread was leading upto the village. This road after crossing the Uppar odai leads to Kundadam by 7 km. Since this road is under submersion a new road leading to Kundadam is to be formed upto the existing point near zero L.S. of the Uppar dam. The diversion road work was taken up by Highways Department as contribution work of PWD including the bridge below the dam to cross the river. Since the flood flow expected was about 25,000 c/s. bridge across the river was constructed by the Highways department. The road leading to Kundadam was also formed to the specification including black topping.

FORMATION OF ROAD ON TOP OF BUND:

The earth dam work was completed in the beginning of the year 1968 and after allowing settling time, water bound macadam road formation done. A base for the WBM was done in two layers. 6" thick R.R. stones are spread and rolled well over which 3" metal to a thickness of 6" is spread and well rolled with water. The water bound macadam with 1.5" metal is formed with proper cambering to drain the rain water with the rise of 2" in the centre and sloping both the sides. Black topping done over the water bound macadam and maintained as on date. A road inside the colony connecting to the right flank end if the dam is also laid from the main road. A road from right flank end to Poolavadi-Dharapuram road is laid and maintained with black topping upto date.

SLUICES

GENERAL:

Being a small dam there is no necessity of providing river sluices. Providing sluices are main purpose for which the irrigation dams are built up to feed the ayacuts below the dam. The sill level of sluices are fixed based on the commandability of the localised ayacuts. The command of the Uppar dam is spread up on both the banks of the river. The left flank has got more ayacut of 3525 acres while the right flank is with 2535 acres. The sill level of the sluice is fixed at +882.00 based on the command level of the ayacut. The crest level of the dam is fixed at +888.000 with the minimum head of 6' available for irrigation. The vent sizes provided are 3'x4' on both the sluices.

LOCATION OF SLUICES:

Based on the above considerations, the location of the sluices are fixed at L.S. 3190' in the left flank, and 5610' in the right flank. The average ground level is 860.00

DESIGN OF CANAL SLUICES:

The command is wet ayacut for which duty adopted is 50.. The theoretical requirements for the left flank sluice is 3550/50 = 71.00 c/s. Assuming 50% etc. for evoporational, percolation losses, the discharge required is 106.50 c/s. Similarly the right flank canal discharge is to be designed for 75.3 c/s adopting the same norms as per the left flank sluice. The ayacut of the right flank sluice is 2510 acres.

SLUICE INLET TRANSTIONS:

The designs were evolved by the design circle, Madras first for the dams like Lower Bhavani. The transition should be capable of avoiding cavitation effect at the entrance due to end contractions. The page 250 of Lower Bhavani history manual Part I masonry dam deals eloborately about the designs of the rear transition and front transition of sluices. After construction of the major dams the design particulars and construction experiences are readily available and transition steel moulds for the inlet and outlet of the canal sluices of various vent sizes are manufactured by the PWD workshop and were utilised in different dams according to their requirements.

EXCAVATION OF FOUNDATION:

The average ground level is +886.00. The front wing wall foundation level was fixed at +880.00 while the barrel portion is at +879.00. The length of the barrel is 88'-6". The cut off trench bottom level at this cross section is +876.00. Hence to a width of 12'-0" at the cut off trench portion the foundation level is taken to +876.00. Concrete lugs are provided at the interval of 17'-6" to half of the length of the barrel. The width of the foundation is 11'-0" wide. The lugs provided are of size 3'-0"x2'-0" extra. The front headwall is 25' - 0" x 8'-0". The front wingwall length is 36'-0". The width at the foundation level and top is 12'-3" and 4'-0" respectively on both the sides. The rear head wall is 17'x4'. Rear transition in a length of 5' is 15' x 22'. The stilling basin is of 20' length with one row of babble blocks. The rear side of the sluice is completed with the road bridge of 24' wide with necessary abutments and deck slab.

FOUNDATION CONCRETE AND MASONRY:

The foundation concrete is 1'-9" thick with cement concrete 1:5:10 using 70% 1.5" metal and 30% ¾" metal. The barrel portion inside both for bottom and sides are of three line chisel dressed stone masonry to a thickness of 1'-6" thick embedded in R.R. masonry of overall width 5'-6" bottom and 2'-0" at top. The height of the barrel is 5'-0". The C.D. phase masonry is provided to minimise the co-efficient of rugosity. The rear outlet is of parabolic shape whose equation is $X^2/4^2+Y^2(4+5)^2) = 1$. The roof slab of the barrel is reinforced cement concrete 1:2:4 using 3/4" metal to a thickness of 9". A cone wrap revetments are provided in the front entry.

DRY WELL:

The diameter of the well at level +885.00 is 14'-6". The inner diameter of the dry well is 5'-6". The wall thickness is 3'-0" from level 885.00 to 897.00. From this level to 900.00 level thickness of the masonry is 2'-0" and above this upto the top of the road the width of the masonry is 1'-6".

POINTING THE MASONRY:

The front face of the dam will be subjected to a water pressure due to head of standing water against it. It is most important to make this face as impervious as possible so as to arrest the maximum seepage through joints and thereby avoid the uplift pressure under the masonry dam. Apart from the rich mix used upto the axis of the masonry dam width 1:2¾ mix mortar, pointing with the same mix after raking out the joints have proved in all the dams arresting the seepage effectively. This specification of the joints in R.R. masonry is ¾" thick. It should not be more than 1" to ½".

THE METHODS OF POINTING:

The mortar joints in the front phase are raked out well to a depth of 1 to 1½" and pointed with the special pointing mix. Special pointing mix is nothing but a cement mortar with sieved sand passing full in 8 mesh/inch, passing through 72 mesh/inch. The passing is about 30 to 25%. The joints raked out were cleaned well with water jet prior to the filling of the gap with mortar and cement slurry is brushed. The mortar with less water made up of thread form were pressed into the joints by the thumb and pressed. Then the joints are caulcked well with pointing tools, until the water squeezes out from the mortar. Mortar is applied on the edge of the stone to a width of 2 ½" - 3" covering 35% of the area of the stone.

GATE ERECTION:

575 mcft. of water is to be stored for one filling with an annual filling of 2 ½ times. The crest level is fixed at +888.00 and the F.R.L. is +906.00. Hence a vertical lift gates of three nos. of size 30'x18' were provided. Thus a major storing of water to a depth of 18'-0" is above the crest level with the aid of shutters. Thus the required storage and flood discharges are let out without reduction in the F.R.L. storage condition with the aids of the above vertical lift gates.

The gates are manufactured at Aliyar workshop. Initially the embedded parts with side grooves will be received and embedded as the masonry progresses. The crest beam

is also embedded to the shape in accordance with the shape of the ogee curve. The verticality of the grooves were correctly maintained before concreting. The shutter parts in pieces will be received and assembled in the gate positions and the revetting are carefully done for the water tightness.

Counter weight beam made of reinforced cement concrete will be cast insitu as per the designs with the provision of hooks. This will act as a balance weight during the operation of the shutters. The sides of the shutters are fixed with the rollers on rubber seals which will prevent the leakages in the side grooves. Necessary depth gauge plate and indicator will be provided for each gate to measure the height of opening or closing.

HOISTING ARRANGEMENTS:

Hoisting motors and operating equipments such as rope drums, operating gears etc. will be located on the operating platform made up to M.S. joists covered with the chequerred plates of ¼" thick. The joints are welded to the joists. The joints of the sheets are also welded. One electrical motor is fitted for each gate with reversible relations to lift and lower the gates. The gates can also be operated manually in case of power failure. The operating platform is of 6'-0" diameter round, room accommodating the passage to reach the hoisting operation platform from the top of the dam. In breast wall portion mass concrete to a thickness of 5'-6" laid. A provision of air vent with 9" dia. M.s. pipe is provided to avoid creation of vaccum in the entry during the shutter operation. A breast wall of 9" thick upto a level of +906 is of R.C.C. wall. An approach bridge from top of the dam is provided with R.C.C. T beam founded on earth dam over a mass concrete block of 4'x2' and on the other side over the masonry. Emergency gate groove is also provided in front of the service gate and operating platform is provided.

POWER FAILURE AND GENERATOR:

During rainy seasons, especially during north-east monsoon power failure are common due to many reasons the rain will occur mainly due to depression formed in the sea which brings forcible wind and rain. The electric posts are damaged due to wind and power failure is inevitable. But the heavy rain will bring enormous inflow to improve the storage position of the dam necessitating the operation of gates to allow the surplus. So it is the custom to provide generator with suitable capacity in a separate room and operated during the time of power failure.

INSTRUMENTATION:

There are three kinds of instruments usually fitted into the irrigation dams during construction period. They are 1) Joint meter, 2) Resistance Thermometer and 3) Strain meter. These instruments used to measure temperature, the expansion and contraction in the joints, and strains developed inside the masonry due to temperature, developed within the body of the dam due to heat generation in the hydration process of cement.

Since the Uppar dam is a small one, no drainage gallery is provided such instrumentation installation does not arise.

COMPLETION PLANS AND REPORTS

The Uppar dam works were physically completed in all respects during the month of September 1968. The dam was thrown open during the year 1971 for irrigation. In the

revised estimate prepared in 1977, a list is appended to mention the date of completion reports. The dates are furnished from the year 1968 to 1973. Estimate wise completion reports submitted to the division by the Assistant Engineer. A revised estimate was prepared to a value of Rs.87.000 lakhs based on these completion reports.

REHABILITATION OF DISTURBED PORTIONS DURING AND AFTER CONSTRUCTION

As already discussed the land acquisition for the construction of Uppar dam is arrived at 1120 acres in a major portion of the lands are patta lands. There was a village by name Lakkambody just 1 km west from the masonry dam inside the water spread. It is learnt that there were about 45 families dwelling and they have been vacated after paying the due compensation. There were two temples 1) Kanniamman koil, 2) Mahali amman koil. They were belonging to Chettiyar community and Goundars community respectively. Compensatory land in the acquired portion near camp colony below dam was alloted to them to an extent of 2 to 3 cents. The villages have constructed their temples and even now every year people from all over the state including Bangalore are assembling at the temple to celebrate the Mahasivarathiri day. Those who got the compensation for cultivated lands shifted to various places and purchased cultivating lands. The compensation paid was at the order of Rs.19,09,199/-. The village people after getting the compensation were continue to live during the construction period. During the flood of 9/66 the villagers were forced to vacate their houses. The flood report of the Executive Engineer, Pongalur division submitted to the Superintending Engineer, PAP canals in his no 1877 sc/d2/dt.28.09.66 furnishes the following particulars. On 26.09.66 evening at 6.00 P.M. a flood of 6380 c/s were observed. The flood level was +888.50. A watchman was posted 24 hours duty to warn the villages about the flood. Danger mark around the village was marked and the inmates of the village were requested to vacate before any damage is done by the flood during rainy season. On 27.09.66, Executive Engineer had inspected the site and personally requested the villagers to move to the safer places. Executive Engineer explained the situation to the villagers and permitted the Assistant Engineer to provide free transport facilities upto Dharapuram. However the villagers have vacated the village and no damage had been reported either to properties or lives.

ECOLOGY AND ENVIRONMENT

Executive Engineer, Pongalur division during the submission of the detailed estimates for Rs.55.00 lakhs during 7/64, mentions that the lands to be commanded are well prepared for cultivation and red soil lands were ploughed throughly during rainy seasons. The farmers will be readily receiving the water allowed from the storage and start cultivation from the beginning of the first irrigation itself. A statement showing the development of ayacut furnished in the hydrology reveals that the percentage of development is more than 80%. The dam has developed full storage in the year 1977-78 to the FRL level +906.00. The records reveal that the dam has reached FRL in 1977 - 78 and 1979-80.

ECOLOGY:

After storage commenced in the year 1971, there are dead storage of about 48 mcft. in the reservoir and due to trees development in the foreshore of water spread. Thou-

sands of various kind of birds are migrating in the seasons every year. The white birds like cranes (Kokhu, Narai) are dwelling in the dead storage water spread.

Fisheries Department has taken up the construction of fish ponds in the dam site. The fishes developed in the fish ponds are highly remunerative and the annual turnover is Rs.15.00 lakhs and above. Most of the fishes of daily catch is disposed off at the Uppar Dam site itself. If anything is unsold they are sent to Palghat, Kerala Dist.

ENVIRONMENTAL CHANGES:

Normal period of irrigation is about 4 ½ months from October to February every year. This incidently North East monsoon period. Supplementing the rainy season, the Uppar Dam ayacut has several open wells dug to a depth of 100' and above. The riots have raised coconut grooves in more than 10% ayacut area after the functioning of the Uppar reservoir. In the off season of irrigation the ground water level the wells are substantially raised and utilised for the dry second crops such as maize, ground nut etc. Cotton is a nine month crop and has developed well due to the irrigation water and well water. Lot of new terraced houses have comeup in the village of the Uppar ayacut regions. Socio economic status of the farmers have developed well in ayacut areas.

RAISING PLANTS IN THE VACANT SITE NEAR COLONY:

There are few acres of vacant lands available south of Camp colony to the end of the earth dam right flank. During 1970 the Assistant Engineer Thiru K.V.PADMANABHA RAO of the Pollachi division, who is naturally interested in developing plants and trees utilised the above vacant site for growing the following trees.

1.	Coconut Trees	1300 Nos.
2.	Suppotta Trees	50 nos.
3.	Mango Trees	50 nos.
4.	Guava Trees	20 nos.

The trees have grown up well and now a days fetch a sizeable income every year. They are maintained by pumping water from stilling basin with the aid of two electric motors of capacity 5 H.P. & 7.5 H.P.

COMMISSIONING AND MAINTENANCE UPTO DATE

The dam started functioning in the year 1969. From the records available, the irrigation has commenced in 1971 - 1972 and developments have recorded minimum 63% to maximum 93%. One subdivision was functioning upto 1969 end at the dam site. The only one maintenance section functioning at dam site with a Junior Engineer incharge and attached to the subdivision. Then the subdivision looking after the maintenance was at Pollachi under the control of Pollachi division upto 1972 and then upto 1977 attached to Dharapuram Remodeling subdivision under Udumalpet division. From 1977 - 1980 this was attached to regular subdivision Dharapuram under the control of Erode regular division. Once again in 1980 the control was given to Udumalpet division and Udumalpet subdivision upto date.

Since this a small dam with least rain fall and well built there is no tensional occation in the maintenance except the year 1979 when there was a historical flood of 62191 c/s. against the spillway capacity of 25,800 c/s capacity.

OBSERVED FLOODS

FIRST FLOOD IN 20.04.1965:

The foundation commenced during the month of 11/64 both for earth dam and masonry dam. The then Assistant Engineer dams on 21.04.65 has reported that there were some floods in the Uppar river at 9.00 P.M. on 20.04.1965. A guage post had already been installed in the river bed with datum +859.00. The observed flood level was 859.75. The calculated discharge was 104 c/s. All pumpsets and machineries were removed from the dam foundation and placed in the safer places including R.C. hume pipes. No Damage has been allowed to the machinery or to the work except the foundation pits were filled with water and no work was possible on 21.04.65. Assistant Engineer reports that the works will be resumed on 22.04.65 after dewatering the foundation with available pumpsets.

FLOOD ON 30.04.1965:

At about 1.45 A.M. a discharge of 120 c/s has been realised. No damage either to materials or to works. The works of excavation of foundation were resumed after dewatering with available pumpsets.

FLOOD ON 06.05.1965

On 06.05.65 at 7.30 a.m. a flood of about 1000 c/s occurred. In this flood temporary causeway provided below the dam in the river portion had been damaged. Pumpsets and machineries were removed from the excavation site earlier before the flood commenced. No damage to materials are to work in dam site except the temporary causeway breach mentioned above. The causeway was repaired as soon as the flood receded.

FLOOD ON 25.05.1965:

The flood at this time occurred at 3.45 a.m. on 25.05.65. Maximum flood at that time was estimated as 3885 c/s. The gauge reading was 4'-0" from sill level. That is at +863.00. The causeway were to be repaired by using the excavated spoils heaped near by areas.

FLOOD ON 26.09.1965:

The rain fall on 4 & 5.9.65 recorded at Dam site was 30.6 mm & 61.3 mm respectively. During 26.09.65 at 7.00 p.m. the river was in spate and at 7.30 a.m. a flood of 4144 c/s were realised. No damage to the machineries or materials are allowed.

FLOOD ON 06.10.1965 & 07.10.1965:

The maximum flood discharge was 999 c/s and no damage was allowed to any property. The temporary coffer dam level was raised by sand bags to level +862.00 and flow in to the excavated pit was avoided.

FLOOD ON 17.10.1965 & 18.10.1965:

The maximum flood was 710 c/s and no damage allowed for machinery and materials.

FLOOD ON 23.11.1965:

At 1.30 a.m. a flood discharge of 3857 c/s were realised and no damage allowed.

FLOOD ON 05.12.1965:

The maximum discharge of flood on 05.12.65 at 2.00 a.m. was 7500 c/s. In this flood heavy silting was expected in the excavated foundation.

FLOOD ON 10.07.1966:

There were small flood about 63 c/s and diverted over left half of the body wall while the work was carried in right half.

FLOOD ON 19.09.66 & 20.09.1966:

The maximum flood realised was 6381 c/s at 11.00 p.m. on 20.09.66. The central block to a width of 30'-0" was left as gap at level 881.00 and flood discharges were allowed to pass through the central block.

FLOOD ON 06.10.1966:

There was small flood to an extend of 1094 c/s. The storage at that time was at level +881.10.

FLOOD ON 16.10.1966 & 17.10.1966:

The maximum discharge was 2214 c/s at 2.00 p.m. on 17.10.66 and the discharge is allowed over the built up masonry. As per the statements prepared on 07.11.68, the storage in the reservoir was 161.50 mcft. The level upto which water raised was +892.50. That is 4.50' in the shutter was stored above rest level.

HISTORICAL FLOOD ON 19.11.79:

There was torrent of rain during the month of November 1979 between 13.11.79 to 19.11.79. The following table gives fair idea of the same.

Place	Max. Rainfall	Date
1. Thirumoorthy dam	165.00 mm	19.11.79
2. Poolankinar	127.00 mm	17.11.79
3. Pedappampatty	162.20 mm	19.11.79
4. Rudravathy	110.20 mm	11.11.79

Similar flood was also experienced in 11/77 in the catchment area of Uppar dam.

1. Udamalpet	115.70 mm	15.10.77
2. Varadarajapuram	95.00 mm	13.10.77
3. Sultanpet	205.00 mm	28.10.77

Superintending Engineer canal circle in his letter No.DB/AEI/F117C3/79/961 CE/ dt.06.12.79 reports as follows.

On 18.11.79 at 3.00 a.m. Superintending Engineer has rushed to the dam site at the instance of alarming raise of flood water in the dam. Udumalpet Executive Engineer was also already present at site.

The maximum inflow recorded was 62197 c/s at 3.50 a.m. on 19.11.79, and most fortunately the flood started receeding. If it is continued further half an hour, out flank of the earth dam could have happened and the whole earth dam could have been washed off. The discharge through 3 spillway gates which were fully opened was 40830 c/s at 7.30 a.m. on 19.11.1979. The maximum water level raised was +912.75 against the M.W.L. of +906.00. The T.B.L. of Dam is 915.00 and the water level was 912.75. Fortunately there was no wind and no wave action and the bund miraculously escaped. Due to this flood in 1979, several proposals were made to provide additional discharging capacities including raising the F.R.L. level and providing breaching sections at both the ends of flanks.

Superintending Engineer paid a whole hearted appreciation to the staff engaged in the flood works during that period and recommended to the Government through Chief Engineer to record appreciation to the staff who were actually engaged in the flood duty at that time.

The total discharge realised	62197 c/s	
The spill way capacity	25800 c/s	
Balance to be provided	**36397 c/s**	(or) **40,000 c/s**

The Superintending Engineer has suggested uncontrolled surplus weir at the left flank to a length of 1140'-0" and the expected 40000 c/s can be let into the river from left flank along the low level lands adjacent to the road below dam.

The hydraulic calculation is furnished below:

$Q = CLH^{3/2}$

Where,

Q = Max. Discharge

C = Co-efficient of discharge = 4.4

L = Length of weir required in feet

H = Head over sill of crest 4' assumed

The sill level of the surplus weir is assumed as 4906.00. That is FRL of dam.

$Q = 4.4 \times L \times H^{3/2}$

$40000 = 4.4 \times L \times 4^{3/2}$

Therefore L = 1136'-0" say 1140'-0"

Now the Dam safety Directorate is taking up the proposals seriously and proposals are submitted to provide fuse plug arrangements at 0.00 point in the left flank and an additional surplus regulator adjascent to the existing one.

1. The length of fuse plug is about 564 m and the max. capacity of discharging flood is 69738 c/s (1975 cumec)

2. An Additional spill way of 4 vents 12.2 m x 6.10 m of radial gates are proposed. The capacity of the additional spill way will be 79505 c/s (that is 2250 cumec.)

In addition to this proposal for wave deflecting parapet in front face is proposed. Relaying of B.T. road on the top of Dam and treatment of cracks formed on the top of earth dam on both flanks near spill way are also proposed. Additional facilities such as approach road, weather stations additional generator, life saving rings, VHF, wave height recorder etc. also proposed by the Dam safety Directorate. The approximate cost of this works work out to Rs.15.00 crores at this stage.

IMPROVEMENTS AND MODIFICATIONS CARRIED OUT IN THE DAM AFTER ORIGINAL CONSTRUCTION

After 1977 & 1979 flood there was several proposals and correspondences between Chief Engineer and designs Superintending Engineer Some of the references made in the flood report submitted by Superintending Engineer to Chief Engineer irrigation dated 06.12.79 are furnished.

1. C.E's Memo No.L3/96656/77-1, dt.02.11.77
2. C.E. Memo No.L3/96656/77-3, dt.24.06.78.
3. S.E. Design Circle No.AE E3/3003/78-1, dt.18.10.78.
4. S.E. Design Circle No.AEE 3/3003/78-3/21.03.79.
4. C.E. No.96656/77-7, dt.02.05.79.

TEST RESULTS:

There were several tests carried out both for soil and mortar and copies of test results are appended,

ACCIDENTS:

There was only one accident of fatal death in the year 1968. When the work was almost nearing completion, a L.C. scrapper working on the top of the dam has come

down suddenly in the rear slope near spill way. The operator Thiru. Ali lost the control over the scrapper and this scrapper was rushing down along the slope of earth dam. The operator jumped from the seat of scrapper and had head injury. He was taken to the General Hospital Coimbatore and treatment given. He passed away the next day and his soul was rest in peace. All officials and laboures paid homage to the operator. This is the only incident of loss of life during the construction period.

FORMATION OF VERTICAL CRACKS IN THE EARTH DAM:

There are vertical cracks in both the flanks adjascent to masonry dam just at the junction of impervious and semi pervious zones 6'-0" to 8'-0" depth. Detailed investigations of cut open reveal that no damage is done in the hearting zone. The crack developed may be due to slip of pervious zone due to settlement.

CONCLUSION:

In the part one of the history writing of Uppar Dam, various aspects of investigation, final selection of site, Govt. sanction preliminary works, preparation of plans and estimates, specifications of masonry dams, Earth Dam, sluices, bridge below dam, camp colony etc. were discussed in detail. As already mentioned this execution work was commenced in January 1965 and completed in September 1968.

Flood reports are discussed in detail and eloborate discussion is made on the flood occurred in 19.11.1979. The max. discharge was 62197 c/s. Whereas the spill way capacity is only 25800 c/s.

Dam safety authorities are taking the subject and proposals are made out additional spill way of 4 vents to discharge 40,000 cusecs, which is also discussed in detail in this report. A breaching section of 1140'-0" is also suggested.

REHABILITATION WORKS UNDERTAKEN BY DAM SAFETY ORGANISATION UNDER EXTERNALLY AIDED SCHEME.

The rehabilitation works of providing fuse plug arrangements from LS 25M to 589.5 Meters for a value 9.60 Millions and parapet wall for a value of Rs.3.90 Millions have been under taken under Dam safety organisation under World Bank aid and completed.

COPY OF:

Copy of Government Public Works Department G.O. (Ms) No.2977 dated 17th November 1964.

Sub: Irrigation - Parambikulam Aliyar Project - Construction of reservoir across Uppar Odai near Dasarapatti - orders issued.

Ref: From C.E. (Gl. and P.A.P) Lr.No.762/62 P 10 dated 04.09.64.

The Government sanction the estimate amounting to Rs.50/- lakhs for the construction of a reservoir across Uppar Odai near Dasarapatti, in Coimbatore District as part of the Parambikulam Aliyar Project.

2. The action of the Chief Engineer (General) and Parambikulam Aliyar Project in having proceeded with the preliminary works such as formation of camps, collection of materials etc. for the reservoir work in anticipation of administrative sanction of Government to the estimate is ratified.

3. The expenditure is debitable to '99 capital outlay on Irrigation, Navigation, Embankment, drainage etc. works (commercial) Un productive - Parambikulam Aliyar Project - works - forming small reservoir.

4. This order issues with the concurrence of the Finance Department -vide its U.O. Note No.11, dated 31.10.64.

/ By order of the Governor /

R. Tirumalai,
Secretary to Government.

To

The Chief Engineer (Gl. & P.A.P). Pollachi

/ True copy /

NOTE ON INSPECTION OF WORKS IN UPPAR RESERVOIR SCHEME

Dates of inspection 12.10.66 and 13.10.66

Small flows are still seen in the river over flowing the flood gap in the surplus regulator. Resumption of masonry in this flood gap is not immediate therefore possible. The earth bund has been however raised to +910 on either end of the regulator. Turfing work has been arranged with two transport lorries and is going ahead. It is the revetment that requires particular concentration still. The progress on the left flank is fairly satisfaction. However the low packets are to be pulled up fast so that the programme already drawn up for raising the revetment could be kept up without fail. Ofcourse the deficiently of transporting stones over the dam length has been there since drizzling was continous for nearly a week. Just now there is a break in the rains and the best use of the time that would be available before the on set of north east monsoon should be made.

On the right flank the revetment is in progress in low levels adjacent to the regulator. It is here that the quality should be carefully kept up and proper supervision arranged for. Inspite of the speed the specifications should not be watered down. Trimming the bund to the necessary section should be done in advance and the formation of the gravel backing layer also laid sufficiently in advance before packing of the stones. Building revetment should be closely supervision. The stones should be dressed with hammer wherever necessary to key into the joints properly. Only the inevitable spacing should be filled in with spalls and tightened with wedges. The sub divisional officers also should spend more of his time in the revetment work just at present as this is the most important work going in the sub division at present.

The low embankment on the right flank canal below the service road bridge has been completed diverting the heavy machinery for few loads. The banks may now be sectioned and trimmed to proper shape. This length of embankment which about 150 feet are so just below the service road may be given precast slab lining. Details may be worked out and the cost reported. Action may be taken to start casting the slabs required for this.

The masonry side walls for the right flank canal up to the service road bridge are in progress. Now that the rains have stopped, the walls may be raised a bit fast and completed in a weeks time. On the left wall somewhere in the middle a 5" dia. pipe may be inserted and built with a valve in rear. This may be of some use to draw when necessary canal water for any plantation that may be decided on the short up to the river.

Only one scraper was in working condition on the 13th. Arrangements have been made to obtain help from the machinery division for setting right the other two scrapers. Two scrapers are ofcourse permanently side with this starter motor burnt. The Executive Engineer M.A.S. division has taken action to obtain them but it looks as though it will take a few months.

For the short time the machinery may be left over in Uppar before being shifted out they may be judicially utilize for the completion of a few miscellaneous items left over in the order of priority given below.

1. Embankment near the acquiduct on the right flank at M.O.5.355

2. The embankment of left flank canal near the U.T. at M.O.2.310

3. Filling in first two large quarry pits in diversion road.

4. Levelling up and making up the ground below dam on the right flank.

The residents in Lakkambody village occupying hurts at low levels have since moved out. The problem of evacuation is not immediately there now.

Consideration of the second coat in the diversion road has been taken up. The road bridge abutments have been raised to deck level. The construction of the bridge should be expedited so that the road portion may be completed in full shape and handed over to the Highways department as early as possible. A small length in the alignment of this road could not be tackled still for the reason the land owner is objecting and particularly refusing entry. Several attempts have been made to convince this land owner and he has been obstinate. The special Deputy Collector, Land Acquisation has also been trying over this and is awaiting publication in notices to entry.

Both the main canal of this have been inspected for the wall lengths particularly to see how the cross masonry portions have functioned and the excavated canal stood the recent rains.

The left flank main canal has stood well for the considerable length. Only in certain location where we have been waiting to see the need for provision of cross drainage shutters little flows have been received. Towards the tail end where the canal runs round a local mound where the soil is rocky and the ground falling heavily the drainage from uplands have flown into the canals in one or two locations. It looks as though some cross drainage arrangements are necessary M.10.0.220 and M.10.0.550 an undertunnel looks desirable at M.10.0.220 probably a inlet may be tried at 10.0.550. Similarly at M.7.7.38 though a provision for a superpassage cum cart track was made in the original condensed L.S. It was not built with the hope that it could be avoided. The rains have brought in fairly good flows through this cart rack. Atleast the superpassage may have to be built in the places. In all these three location the catchment areas may be examined and necessary provisions for the crossing proposed and cent. The subdivisional officers is requested to prepare site surveys to collect hydraullic particulars and report immediately on the need for further construction at the place.

Foundations have been laid and masonry is in progress in the abutments at the acqueduct at M.5.3.160. The progress in masonry may be brought up fairly fast. A few of the D.I. sluices have constructed in the head reaches and some are in progress.

(Sd.) V.S. Ramaswamy 13.6
Superintending Engineer
P.A.P. Canals Circle.

Copy of letter No.DB/AE1/F.117 C.3/79, 961 CE, dated 6.12.79 of the S.E. PWD PAP Canals Circle, Pollachi - 3 addressed to the C.E.(I), Madras - 5.

Sub: Uppar Dam - Heavy inflow on 19.11.1979 - Report submitted - Regarding.

Ref: Arising.

I submit that there was very heavy and incessant rains in and around the catchment area of Uppar Dam for several days and especially on 18.11.1979 with much intensity. Consequently there was heavy inflow into the reservoir over and above the calculated inflow. I was informed of the alarming rise in the reservoir level by about 3.00 A.M. and immediately I rushed to the spot. The Executive Engineer also came to the dam.

There was heavy rainfall over 10mm as can be seen from the statistic enclosed as received from the Executive Engineer, Udumalpet Division.

The maximum inflow recorded in 62197 cusecs at 3.50 A.M. on 19.11.1979, and the discharge reached a maximum of 40830 cusecs at 7.30 A.M. on 19.11.1979. The maximum level that reached in 912.75 against the M.W.L. (06.00. The T.B.L. is 915.00 and the water level reached within 2.25' from the T.B.L.

All the precautionery measures have been taken as per flood rules and the people in low lying area and foreshore were evacuated.

There was no wind and as such no wave action on the bund and thus dam escaped miraculously. The inflow realised this year is more than the inflow realised during 1977 flood.

The rising of water level in the dam was very rapid and it was in the order of 0.2'/ every 5 to 10 minuted. When it reached 912.75 just 2.25' below T.B.L. the water level linquered for about 1/2 an hour and this has caused severe mental strain to the officers on the bund including myself. Providentially the water level slowly started receding bringing relief to every body present.

At this critical juncture the whole staff on the bund were very much co-operative. Hence, I am very happy to report to the Chief Engineer that the exemplary behaviour of the staff who whole heartedly co-operated and fearlessly discharged their duties in a most critical juncture and I strongly recommend to the Chief Engineer, (Irrigation) to take up the matter with Government to issue appreciation to the staff. In this connection, I also submit the following report for favour of Chief Engineer's perusal and immediate necessary action.

When we realised the maximum inflow of 41377 cusecs during the year 1977, several proposals towards permanent remedial measures to safeguard the dam against flood have been though of. The Executive Engineer, Udumalpet Division has suggested to raise the F.R.L. for absorption and additional discharging capacity for the existing spillway, and the Superintending Engineer (Designs) has suggested to have breaching section on either flank of earth Dam. Kind reference is invited to the following references on this proposal.

1. Chief Engineer's Memo No.L3/96656/77-1, dated 02.11.77.
2. Chief Engineer's Memo No.L3/96656/77-3, dt.24.06.78.
3. Superintending Engineer's (Design.) No.AEE.3/3003/78-1, dated 18.10.78.
4. Superintending Engineer's (Design.) No.AEE.3/3003/78-3, dated 21.03.79.
5. Chief Engineer's Memo No.96656/77-7, dated 02.05.79.
6. This Office L.No.AE.1/F.117-C.3/595, CE, dt.23.08.79.

The remedial measures thought of to safe-guard the Uppar Dam from the imminent danger due to enormous flood is still under correspondence and no proposal is finalised.

The inflow realised this year is so enormous and it is quite essential to reconsider the previous proposals of raising of F.R.L. or providing breaching sections as to whether these are practicable for this heavy inflow. Any how, occurance of this sort of heavy inflow cannot be ruled out in the near future and repeated occurrance will definitely cause heavy damages to the structures and hence, it is foremost important and urgent to finalise permanent remedial measures without any further loss of time.

The following proposal is suggested for favour of Chief Engineer's perusal.

The inflow realised this year is 62197 cusecs. The existing spill way is designed for 25800 cusecs hence safe outlet will have to be provided for the balance quantity of 36397 cusecs or at the maximum of 40,000 cusecs. The lands around the left flank of earth dam is just above F.R.L. and it is better to provide a flush escape of considerable length to allow the balance quantity of 40,000 cusecs. The sill of flush escape for the short crested weir as the case be fixed at 906.00 (i.e) F.R.L/M.W.L. of the dam. Assuming 4' height of flow, the length required will be about 1140'-0". This can be provided from the left end. The flood water can be allowed to join into the Uppar River below the down stream bridge. If approved, all this proposal will be worked out in detail. I also feel that it is better, the Superintending Engineer, Designs also inspects the dam so that we can discuss and formulate the proposal after detailed inspection of site at an early date.

As this is the most important problem to be attended to immediately or otherwise, I am rather afraid that any amount of precautionery measures cannot ensure the safety for the man made structure against nature's play.

Encl:

1. Statement (Table) of calculation of outflow and inflow of Uppar Dam.
2. Curve showing the inflow and outflow of Uppar Dam during 1979 floods.
3. Calculation sheet for length of short crested weir.

T.H.L. Narasimiah, 5.12,
Superintending Engineer,
PAP Canals Circle, Pollachi-3.

UPPAR RESERVOIR SCHEME

SMALL RESERVOIRS

Report to accompany the revised estimate for forming small reservoir (Uppar Reservoir Scheme)

Original Estimate	Rs.75.00 lakhs
Revised Estimate	Rs.87.20 lakhs
Excess	Rs.12.20 lakhs

In the original project report, it was proposed to form two reservoirs across Uppar Odai, one near Poolavadi village Udumalpet Taluk and the second near Dasarapatti in Dharapuram taluk. A third reservoir was proposed across No.1 alikarai near Chettipalayam village. An extent of 7500 acres was proposed to be irrigated under these three reservoirs.

On further examinations, it is found that it will be adequate to have only one reservoir across Uppar Odai near Dasarapatti. It will be more economical to construct anicuts instead of storage reservoirs in the Upper reaches of the drains in question. The main source of supply is the return flows from the ayacut under P.M.C. As long as water is supplied for the ayacut the return flows may be steadily available. Hence, the formation of reservoir in the Uppar reaches of the drainage course is not essential. In place of reservoirs it will be cheaper to construct anicuts from which supply channels can be run utilising the return flow equally well. A number of anicuts at suitable places will be much cheaper and can also irrigate nearby the same extent as the small reservoir. It is proposed to execute the anicut schemes sanctioned above as S.M.I.P. Schemes instead of saddling the Project with connected expenditure.

Taking the above factors into consideration, it is proposed to construct a single reservoir across Uppar Odai to store the flood flows of the drainage course and also the flood flows from Thirumurthi reservoir whenever they occur. It was considered advantageous to locate this reservoir at the tail end of the drainage course so that the catchment area which constributes to the storage will be substantial. On investigation it is seen that the submersible lands in the lower reaches of the drainage course are comparatively less developed. Therefore it was proposed to form the reservoir across Uppar Odai near Dasarapatti as this site affords better possibilities of impounding larger quantities of water at a lesser cost. The scheme is designed for a total of 2.5 fillings, two from its own catchment and the rest from the return flow from the P.M.C. ayacut and flood flows.

The Uppar Dam consists of an earth dam 7750 feet long with a masonry portion 170 feet long to accommodate the surplus regulator consisting of 3 spans of 20' x 18' fitted with lift gates. The crest level of the spillway is El.+888.00. The full reservoir level is El.+906 and the top of dam El.+915.00. The gross capacity of the reservoir at FRL is 576 M.Cft. The water spread at FRL would be 1120 acres. The total annual useful storage for 2.5 fillings would be 1330 M.cft. There are two canal sluices provided one on each flank of the drainage course from which the two canals take off. The right flank canal runs a length of 7 miles 7 furnlongs and 220 feet and the left flank for a length of 10 miles 6 furnlongs and 550 feet. The total ayacut localised under the scheme is 6061 acres (wet).

Detailed estimates for the earth dam, surplus regulators, canal sluices, the right flank and left flank canals and the distributaries and water courses are enclosed. The quantities of work involved, the rates adopted and the data in support of the rates have also been furnished. The total cost of all these works comes to Rs.87.20 lakhs.

The original project provision for the three small reservoirs is Rs.75.00 lakhs as below.

1.	Reservoir across Uppar at Poolavadi	Rs.30 lakhs
2.	Reservoir across Uppar at Dasarapatti	Rs.25 lakhs
3.	Reservoir across Nelalikarai at Chettipalayam	Rs.20 lakhs
	Total	**Rs.75 lakhs**

The cost of formation of a single reservoir across Uppar Odai near Dasarapatti now works out to Rs.87.20 lakhs. The excess of Rs.12.20 lakhs is due to modifying the scope of the scheme and also due to the increase in cost of labour materials and the conveyance.

Sd/-....
Executive Engineer,
Udumalpet Division.

UPPAR RESERVOIR SCHEME
REVISED PROJECT ESTIMATE

Sl. No.	Project Provision	Cost	Provision as per present revised estimate	Cost	More/ less	Less
		Rs. lakhs				
1.	Reservoir across Uppar near Poolavadi	Rs.30.00	Reservoir across Uppar near Dasarapatti.			
2.	Reservoir across Uppar near Dasarapatti	Rs.25.00		87.20 lakhs	12.20 lakhs	
3.	Reservoir across Nellalikarai near Chettipalayam	Rs.20.00				
	Total	**Rs.75.00 lakhs**				

UPPAR RESERVOIR SCHEME REVISED ESTIMATE

GENERAL ABSTRACT

Sl. No.	Sub head	I Head works	II M.C.S. U.R.F.	II M.C.S. U.L.F.	Grand Total
1.	'A' Preliminaries	4,181	1,715	2,977	8,873
2.	'B' Land	19,09,199	78,200	1,09,478	20,96,877
3.	'C' Works	23,53,141	27,028	41,761	24,21,930
4.	'D' Regulator	17,56,665	8,608	9,912	17,75,185
5.	'E' Falls and Weirs	-	-	2,03,090	2,03,090
6.	'F' Cross drainage works	-	1,52,616	1,45,310	2,97,926
7.	'G' Bridges	-	42,960	94,557	1,37,517
8.	'H' Escapes	-	-	1,539	1,539
9.	'K' Buildings	1,26,909	-	15,000	1,41,909
10.	'L' Earth work	-	2,33,841	3,71,240	6,05,081
11.	'M' Plantations	5,159	3,033	1,000	9,192
12.	'O' Miscellaneous	2,78,586	46,000	66,000	3,90,586
13.	'P' Maintenance	42,879	4,263	-	47,142
14.	III Distributories and V.Water course	-	1,34,513	4,47,966	5,82,479
		64,76,719	**7,32,777**	**15,09,830**	**87,19,326**

Grand Total : 87,19,326/- or 87,20 lakhs

UPPAR RESERVOIR SCHEME
REVISED ESTIMATE
99 Capital Outlay I Head works 'N' Tanks

Sl. No.	Sub-head	Expenditure
1.	'A' Preliminaries	4,181
2.	'B' Land	19,09,199
3.	'C' Works	23,53,141
4.	'D' Regulator	17,56,665
5.	'E' Falls and Weirs	-
6.	'F' Cross drainage works	-
7.	'G' Bridges	-
8.	'H' Escapes	-
9.	'N' Buildings	1,26,909
10.	'L' Earthwork	-
11.	'M' Plantations	5,159
12.	'O' Miscellaneous	2,78,586
13.	'P' Maintenance	42,879
		64,76,719

99 CAPITAL OUTLAY I HW 'N' TANKS

Name of work with Est.Rs and Dr.No.	Expenditure		Remarks
I. 'A' Preliminaries:			
1. Explanatory drilling at the river bed for Uppar reservoir site Est. Rs.1800/- DR.70 PNG/64-65.	1595	CR sent on 5.1.70	
2. Surveying and levelling operations for Uppar Reservoir. Est.Rs.2800/- Dr.79 PNG/64-65.	2586	"	13.9.69
	4181		
II. 'B' Land			
1. Land acquisition for Uppar Reservoir. RE.1675000/- CE's No.50E/69-70.	1690299	"	13.8.73
2. Land acquisition for Uppar dam in fringes Est.184000/- U/s.	184000		
3. Debit yet to be received from the Revenue department towards the land cost.	34900		
	1909199		
III. 'C' Works			
1. Formation of earthdam across Uppar river I reach ch.0 to 2640 Est.159000/- 45 SEC/66-67, 1460000 CE's No.12/66-67.	166883	"	24.9.71
2. FED across Uppar river II reach ch.2640 to 5110 Est.1610000 DR.CE's No.4/72-73.	1604373		
Final bills to be paid and TE's to be adjusted.	39296		
3. Formation of earthdam across Uppar River III reach ch.5280 to 4950 Est.Rs.358000/- DR.13 CE/66-67.	377871	"	
4. Formation of earthdam across Uppar river IV reach ch.5940 to 7920 Est.Rs.158000 DR.46 SEC/66-67.	164506	"	17.4.71
Expenditure effected during 75-76.	212		
	2353141		
IV. 'D' Regulator:			
1. Constructing canal sluice at ch.3190 of Uppar Reservoir. RE.71500/- 30 SEC/68-69.	70433	"	11.1.71
2. Constructing of canal sluice at.ch.5610 of Uppar Reservoir. RE 71800/- DR.35 SEC/68-69.	71755	"	
3. Constructing of a Regulator at Uppar Dam. Est.Rs.1600000/- DR.11 CE/66-67.	1589477	"	
Expenditure effected during 75-76.	10000		
Final bills to be paid	15000		
Total Rs.	**1756665**		

Name of work with Est.Rs And Dr.No.	Expenditure	Remarks
V. 'K' Buildings:		
1. Construction of lascar quarters one block of 6 units. Est.Rs.23000/DR.81 PNG/64-65.	23190	
2. Construction of H.M. quarters 2 block of 6 units I and II blocks Est.15000/- Dr.85 PNG/64-65	14477	
3. Construction of labour shed 2 blocks of 6 units. Est.Rs.8800/- DR.90 PNG/34-65.	9051	
4. Construction of Dormintary block of 2 units. Est.Rs.15000/- DR.181/68-69.	15412	
5. Construction of Section Officer's quarters. Est.Rs.10000/- DR.5 PNG/64-65.	10118	
6. Construction of Clerk Quarters one block of 2 units at Uppar dam site (RE) 15600 DR.103 PNG/66-67.	15181	
7. Construction of Section Office cum Telephone Shed.Est.Rs.6000/- DR.57 PNG/64-65.	5776	
8. Construction of cement Godown at Uppar dam site (RE) Est.7200/- DR.8/68-69.	7103	
9. Construction of H.M.Quarters 2 block of Unit III and IV. Est.Rs.6800/- DR.177 PNG/65-66.	7234	
10. Construction of Store Shed at Uppar Dam site. Est.Rs.2600/- DR.59 PNG/64-65.	2894	
11. Providing ceiling fans in Uppar rest house. Est.Rs.700/- DR.188 PNG/65-66.	592	
12. Construction of a Generator house at Uppar Dam. Est.Rs.6,400/- DR.72 PNG/67-66.		(Clubed with its 'O' Miscellaneous)
13. Improvements to head mazdoors Block No.I at Uppar Dam Colony. Est.1800/- u/s.	1800	
14. Improvements to Head mazdoors Block No.II at Uppar Dam colony Est.Rs.1,800/- u/s.	1800	
15. Improvements to labour shed at Uppar Dam. Est.Rs.1,200/- u/s.	1200	
16. Constructing a kitchen block at Uppardam Est.Rs.12000/- DR./75-76.	11081	
	126909	
VI. 'M' Plantations:		
1. Planting avenue trees and forming garden at Uppar Dam Est.Rs.5,000/- DR.211/68-69.	5159	CR submitted on 30.04.70
VII. 'O' Miscellaneous		
1. Rehabilitation of Lakkambody village. Est.Rs.40,000/- 520 PNG/66-67.	8875	
2. Formation of diversion road between 7/1 to 9/2 of Dharapuram Poolavadi Road. Est.Rs.78000/- DR.56 SEC/66-67.	79171	" 15.4.71

Name of work with Est.Rs end Dr.No.	Expenditure		Remarks
3. Formation service road at Uppar Reservoir site (RE) Est.3900/- DR.150/70-71.	3886	"	23.12.70
4. Construction of a Temporary causeway across Uppar River. Est.Rs.14,000/- DR.201 PNG/65-66.	14067	"	27.4.68
5. Providing and fixing rain gauge at Uppar Dam site Est.175/- DR.70 PNG/65-66.	121	"	4.8.68
6. Constructing Model Studies on URS at Irrigation research station. Est.8000/- DR.176 PNG/65-66.	3129	"	5.1.70
7. Furniture the Dorminary block or Uppar colony Est.Rs.2039/- DR.200 PNG/65-66.	2138	"	21.03.70
8. Providing temporary water supply for work at Uppar Dam. Est.Rs.13,000/- DR.490 PNG/39-70.	12807	"	28.07.70
9. Providing water supply arrangements for Uppar dam colony. Est.7000/- DR.73 PNG/65-66.	7464	"	02.05.69.
10. Excavation of a wall for Uppar Colony Est.8000/- DR.318 PNG/67-68.	8178	"	30.10.70
11. Providing Sanitary arrangements for Uppar Colony. Est.6250/- DR.72 PNG/65-66.	6299	"	17.09.68
12. Block topping the road on top of earthdam Est.Rs.	14856		
13. Dismantling and re-errection of power lines in the waters read area of Uppar dam. Est.23,180/- DR.268 PNG/67-68.	23180	"	18.10.69
14. Taking photo in Pollachi Division for 67-68. Est.900/- DR.209 PNG/67-68.	72	"	31.01.70
15. Installation of a Generator at Uppardam site Est.Rs.44,000/- DR.2 SEC/68-69.	38643		
16. Repairs to diversion road between 7/1 - 9/2 of Dharapuram - Poolavadi.	25700	"	30.04.70
17. Rehabilitation of Lakkambodi Villages yet to be paid.	25000		
Block tapping final to be paid.	5000		
Total Rs.	**278586**		
VIII. 'P' Maintenance:			
1. Maintaining PAP Colony at Uppar Dam for 1965-66 Est.5600/- DR.166 PNG/65-66.	5284		
2. Maintaining PAP Colony at Uppar Dam for 1966-67 (RE) Est.15,500/- DR.78/68-69.	15246		
3. Maintaining PAP Colony at Uppardam for 1967-68 (RE) Est.Rs.15,500/- DR.79/68-69.	15604		
4. Maintaining PAP Colony at Uppar dam for 1968-69 Est. 7500/- DR./43/68-69.	6655		
	42789.		

UPPAR RESERVOIR SCHEME

REVISED ESTIMATE

ABSTRACT

99 Capital Outlay II MCB
Uppar Right Flank Canal

Sl. No.	Sub Head	Expenditure	Remarks
1.	'A' Preliminaries	1715	
2.	'B' Land	77070	
3.	'C' Works	27028	
4.	'D' Regulator	8608	
5.	'E' Falls and weirs	--	
6.	'F' Cross drainage works	152616	
7.	'G' Bridges	42960	
8.	'I' Earthwork	233841	
9.	'M' Plantation	3033	
10.	'O' Miscellaneous	46000	
11.	'P' Maintenance	4263	
12.	III Distributories	47499	(47499)
13.	V Water course	89830	
	Total Rs.	734463	

II MCB 'N' TANKS UPPAR RIGHT FLANK CANAL

Name of work with Est.Rs and Dr.No.	Expenditure	Remarks
I. 'A' Preliminaries:		
Surveying and levelling operation for Uppar right flank canal. Est.Rs.1750/- DR.88 PNG/65-66.	1715.00	CR submitted
II. 'B' Land:		
Acquisition of land for Canals. Est.Rs.50,000/- DR.51 SEC/66-67.	77070.00	" 06.09.63
III. 'C' Works		
Construction D.I. Sluice in the reach O/o to 3/0/330 of Uppar Right Flank canal. Est.Rs.8300/- DR.521 PNG/66-67.	8264.00	" 28.07.70
Construction of D.I. Sluice in the reach 3.0.330 to 4.7.440 of Uppar Right Flank canal. Est.Rs.1800/- DR.530 PNG/56-57.	6797.00	- do -
Construction of D.I. Souice in the reach 4.7.440 to 6.5.110 of Uppar Right Flank Canal Est.Rs.4700/- DR.115 PNG/67-68.	4882.00	- do -
Construction of D.I. Sluice in the reach 6.5.110 to 7.7.220 of Uppar Right Flank Canal. Est.Rs.1900/- DR.113 PNG/67-68.	2308.00	- do -
Construction of a head sluice at mile 4.7.440 of Uppar Right Flank canal. Est.Rs.2,000/- 158 PNG/67-68.	2064.00	CR submitted
Constructing a tail dam at mile 7.7.220 of Uppar right flank canal. Est.Rs.2,500/- 301 PNG/67-68.	2713.00	" 31.12.68.
	27028.00	
IV. 'B' Regulator:		
Construction of a Regulator cum head sluice at M 6.5.110 of Uppar right flank canal. Est.Rs.8500/- DR.7 PNG/67-68.	8608.00	CR submitted on 19.12.70
V. 'F' Cross Drainage Works:		
1. Construction of an acquduct at mile 0.5.225 of Uppar right flank canal. Est. Rs.66,000/- DR.74 SEC/66-67.	68487.00	" 06.02.70
2. Construction of an under tunnel at mile 1.0.600 of U.R.F. canal. Est.Rs.3600/- 284 PNG/65-66.	3607.00	" 17.09.68
3. Construction of an under tunnel at mile 1.2.201 of URF canal. Est.Rs.4450/- 285 PNG/65-66.	4720.00	" 27.04.68

Name of work with Est.Rs and Dr.No.	Expenditure		Remarks
4. Construction of canal syphon at mile 1.7.230 of URF canal. Est.Rs.10,500/- 93 PNG/66-67	10344.00		04.08.68
5. Construction of a under tunnel at mile2.2.110 of URF canal Est.Rs.5400/- 94 PNG/66-67.	4846.00	"	17.09.68
6. Construction of an under tunnel at mile 2.5.620 of URF canal. Est. Rs.14,500/- 155 PNG/66-67.	14194.00	"	30.06.68
7. Construction of canal super passage at mile 3.3.600 of Uppar RF canal. Est.5,500/- DR.155 PNG/66-67.	4793.00	"	25.12.68
8. Construction of under tunnel at mile 3.7.220 of URF canal. Est.Rs.4000/- 97 PHG/66-67.	3599.00	"	17.09.68
9. Construction of under tunnel at mile 4.2.110 of URF canal Est.Rs.4,100/- 99 PNG/66-67.	3462.00	"	04.08.68
10. Construction of under tunnel at mile 4.4.00 of URF canal Est.Rs.5500/- 100 PNG/66-67.	4982.00	-do-	
11. Construction of under tunnel super passage at mile 4.5.440 of URF canal. Est.Rs.4,100/- DR.101 PNG/66-67.	3246.00	-do-	
12. Construction of under tunnel at mile 5.1.410 of URF canal. Est.Rs.7000/- DR.184 PNG/66-67.	7139.00	"	25.12.68
13. Construction of under tunnel at mile 5.6.150 of URF canal. Est.Rs.4300/- DR.289 PNG/66-67.	4305.00	"	02.05.68
14. Construction of under tunnel at mile 5.7.440 of URF canal. Est.Rs.4000/- DR.186 PNG/66-67.	4350.00	"	18.10.68
15. Construction of under tunnel at mile 6.7.000 of URF canal. Est.Rs.2700/- DR.230 PNG/66-67	2172.00	"	21.08.68
16. Construction of under tunnel at mile 7.2.450 of URF canal. Est.Rs.3900/- DR.231 PNG/66-67.	3245.00	"	11.
17. Construction of under tunnel at mile 7.4.110 of URF canal. Est.36000/- 359 PNG/66-67	5125.00		
	152616.00		
'P' Maintenance			
Maintaining URF and LCF canals for 68-69 Est. Rs.9900/- 17 PNG/68-69.	**4263.00**		
VI. 'G' Bridges:			
1. Construction of 24' wide bridge at mile 0.0.205 of URF canal. Est.R.10,000/- DR.282 PNG/65-66.	10024.00		07.03.70
2. Construction of 12' wide bridge at mile 0.2.360 of URF canal. Est.Rs.4050/- Dr.283 PNG/65-66.	3527.00	"	17.09.68

Name of work with Est.Rs and Dr.No.	Expenditure		Remarks
3. Construction of 24' wide bridge at mile 1.3.430 of Uppar Right flank canal. Est.Rs.7800/- DR.288 PNG/65-66.	6690.00	"	17.09.68
4. Construction of bridge cum super passage at mile 2.1.280. Est.Rs.5700/- DR.287 PNG/65-66.	4395.00	"	04.08.68
5. Construction of bridge cum superpassage at mile 2.4.240 Est. Rs.4700/- DR.95 PNG/66-67.	3819.00	"	17.09.68
6. Construction of bridge cum super passage at mile 3.2.110. Est.Rs.5300/- DR.171 PNG/66-67.	3895.00	"	17.09.68
7. Construction of 12' wide bridge at mile 4.1.330 Est. Rs.4000/- DR.98 PNG/66-67.	2975.00	"	17.09.68
8. Construction of 12' wide bridge at mile 5.3.330 Est.Rs.322/- DR.185 PNG/66-67.	3257.00	"	26.10.68
9. Construction of 12' wide bridge at mile 6.1.210 Est.Rs.2700/- DR.187 PNG/66-67.	2463.00	"	23.02.69
10. Construction of 12' wide bridge at mile 7.5.210 Est.Rs.2500/- DR.360 PNG/66-67.	1915.00	"	17.09.68
	42960.00		
VII. 'L' Earth Works:			
1. Excavation of Uppar right flank canal from mile 0/0 to 3.0.330 of HRF canal. Est.Rs.1,02,000/- DR.47 SEC/66-67.	106839.00	"	29.12.70
2. Excavation of Uppar right flank canal from mile 3.0.330 to 4.7.440 Est.Rs.60,000/- DR.48 SEC/66-67.	59884.00	"	27.09.70
3. Excavation of Uppar right flank canal from mile 4.7.440 mto 6.5.110 (RE) Est. Rs.48000/- DR.22 SEC/68-69.	47793.00	"	14.08.70
4. Excavation of URF canal from mile 6.5.110 to 7.7.220 ESt.Rs.18500/- 202 PNG/66-67.	19325.00	"	20.06.69
	233841.00		
VIII. M. Plantation			
1. Planting avenue trees Uppar flank and Uppar right flank canal. Est.5000/- DR.210/68-69.	3033.00		30.04.70
'O' Miscellaneous:			
Metalling the jeep track of uppar right flank canal (Anticipated)	**46000.00**		
III. Distributory 'N' Tanks			
1. Acquisition of land for excavating Distributory in URF canal. Est.3500/- 24 PNG/67-68.	1464.00	"	30.04.70
2. Surveying and levelling operation for distributories in URF canal. Est.Rs.1800/- DR.93 PNG/67-68.	1786.00	:	09.10.70

Name of work with Est.Rs and Dr.No.	Expenditure		Remarks
3. Excavating chinnayagoundanpalayam distributory (13.1) at mile 04.07.440 of URF canal. Est. Rs.8200/- 154 PNG/67-68.	8199.00	"	25.02.70
4. Construction of Drops in Chinnayagoundenpalayam Distributory (13.1) at mile 4.7.440 of URF canal. Est. Rs.4500/- 162 PNG/67-68.	4582.00	"	30.04.70
5. Construction of DI Sluice in Chinnayagoundenpalayam Distributory (13.1) at mile 4.7.440 of URF canal. Est.Rs.4350/- 152 PNG/67-68.	4345.00	"	30.04.70
6. Construction of culverts in Chinnayagoundenpalayam Distributory (13.1) at mile 4.7.440 of URF canal. Est.Rs.4500/- 162 PNG/67-68.	4582.00	"	
7. Escavation of Venkitapalayam Distributory (18L) at mile 6.5.110 of URF canal. Est.7400/- 155 PNG/67-68.	7398.00		30.04.70
8. Construction of D.I. sluices in (18L) in Venkitipalayam Distributory of URF canal. Est.Rs.5575/- 159 PNG/67-68.	5630.00		10.01.70
9. Construction of drops in Venkitipalayam Disty. (19I) at mile 6.5.110 of URF canal. Est. Rs.3000/- DR.161 PNG/67-68.	2995.00	"	30.04.70
10. Construction of culverts cum dividing cistern in Venkitipalayam disty. (18L) at mile 6.5.110 of URF canal. Est.Rs.3700/- 300 PNG/67-68.	3702.00		30.04.70
Total	**47499.00**		
V. Water Courses			
1. Excavating water courses 2L 1.0.330 of U.R.F. canal. Est.Rs.800/- 508 PNG/66-67.	539.00	CR submitted on	21.11.68
2. Excavating water courses 3L 1.3.330 of U.R.F. canal. Est.Rs.5500/- 509 PNG/66-67.	5254.00	"	30.04.70
3. Excavating water courses 4L 1.3.550 of URF Canal Est.Rs.1625/- 510 PNG/66-67.	1588.00	"	07.01.70
4. Excavating Water course 6L 2.4.330 of URF canal. Est.Rs.2400/- 511 PNG/66-67.	2377.00	"	08.02.70
5. Excavating water courses 7L 2.7.330 of URF canal. Est.Rs.7100/- 512 PNG/66-67.	6038.00	"	07.01.70
6. Excavating water courses 8L 3.6.550 of URF canal Est. Rs.950/- 5131 MG/66-67.	939.00	"	13.03.70
7. Excavating water course 9L 4.0.110 of URF canal Est.Rs.5700/- 514 PNG/67-68.	5793.00	"	13.03.70
8. Excavating water courses 10L 4.1.440 of URF canal. Est. Rs.4000/- 515 PNG/67-68.	3244.00	"	10.04.70

Name of work with Est.Rs and Dr.No.	Expenditure		Remarks
9. Excavating water courses under Chinnayagoundenpalayam Disty. 13 1 at mile 4.7.440 Est.Rs.1200/- 193 PNG/67-68.	1257.00	"	30.04.70
10. Excavating water courses 14L at mile 5.3.330 of URF canal. Est.Rs.7150/- 6 PNG/67-68.	7067.00	"	07.01.70
11. Excavating water courses 15L at mile 5.4.220 of URF canal. Est.Rs.8200/- 5 PNG/67-68.	8119.00	"	30.04.70
12. Excavating water courses in Venkitipalayam Disty. 18 L at mile 6.5.110 of URF canal. Est. Rs.23,000/- 116 PNG/67-68.	23096.00	"	30.04.70
13. Excavating water courses 19L at mile 7.0.220 of URF canal. Est.Rs.4000/- 4 PNG/67-68.	3168.00	"	32.01.70
14. Excavating water courses from tail dam at 7.7.220 of URF canal. Est.Rs.2650/- 112 PNG/67-68.	2661.00	"	02.05.69
15. Acquisition of land for water course in URF canal. Est.17500/- 93/67-68. R.E. 31600/- 67/73-73.	18280.00		

UPPAR RESERVOIR SCHEME

REVISED ESTIMATE

ABSTRACT

99 Capital Outlay II MCB Uppar Left Flank Canal

Sl. No.	Sub Head	Expenditure	Remarks
1.	'A' Preliminaries	2,977	
2.	'B' Land	1,09,478	
3.	'C' Works	41761	
4.	'D' Regulator	9,912	
5.	'E' Falls end Weirs	2,03,090	
6.	'F' Cross drainage works	1,45,310	
7.	'G' Bridges	94,557	
8.	'H' Escapes	1,539	
9.	'K' Buildings	15,000	
10.	'L' Earthwork	3,71,240	
11.	'M' Plantations	1,000	
12.	'O' Miscellaneous	66,000	
13.	III Distributories	2,84,120	
14.	V Water Course	1,62,446	
	Total Rs.	**15,08,430**	

Name of work with Est.Rs and Dr.No.	Expenditure	Remarks
I. 'A' Preliminaries:		
1. Surveying and levelling operation for ULF canal. Est.Rs.3000/- 67 PNG/65-66.	2977.00	CR submitted on 27.04.68
II. 'B' Land:		
1. Acquisition of land for ULF canal I reach o/o to 2.7.440 Est.Rs.19000/- 32 PNG/65-66 RE.59000/- CR 6 SEC/72-72.	49195.00	
2. Acquisition of land for ULF canal from 3.7.440 to 10.06.550 (Est.Rs.27000/-) 332 PNG 65-66, RE.800000/- CR.No.7 SEC/71-72.	55283.00	
Payment yet to be made.	5000.00	
	109478.00	
III. 'C' Works:		
1. Construction of sluice in the reach o/o to 2/0 of ULF canal. Est.Rs.9600/- DR.156 PNG/87-68.	9573.00	" 25.12.69
2. Constructing sluice in the reach 2/0 to 4/0 Est.Rs.10400/- 157 PNG/67-68.	10431.00	" 25.12.69
3. Constructing sluice in the reach 4/0 to 6/0 Est.Rs.3700/- 250 PNG/67-68.	3691.00	" 25.12.69
4. Constructing sluice in the reach 6/0 to 8/0 Est. Rs.8700/- 251 PNG/67-68.	8697.00	"
5. Constructing sluice in the reach 8/0 to tailend. Est.Rs.9800/- 252 PNG/67-68.	9161.00	"
6. Taildam at 10.06.490 of ULF canal Est. Rs.250/- 231/67-68.	208.00	" 26.03.69
IV. 'D' Regulator:		
1. Constructing of a Regulator cum headsluice at mile 9.1.550 of ULF canal. Est.Rs.10,000/- 2 PNG/67-68.	9912.00	" 21.07.70
V. 'F' Falls and Weirs:		
1. Construction of Drops in the reach V and VI and ULF canal. Est.Rs.22800/- 228 PNG/66-67.	20390.000	" 27.04.68
VI. 'F' Gross Drainage Works:		
1. Construction of under tunnel at mile 0.2.310 of ULF canal. Est.Rs.23,200/- 292 PNG/65-66.	22725.00	CR sub.on 27.04.66

Name of work with Est.Rs and Dr.No.	Expenditure		Remarks
2. Construction of under tunnel at mile 1.1.475 of ULF canal. Est.Rs.9400/- 296 PNG/65-66.	8983.00	""	
3. Construction of super passage at mile 1.7.280 of ULF canal. Est.Rs.9500/- 323 PNG/65-66.	9109.00	"	13.09.
4. Construction of under tunnel at mile 2.2.475 of ULF canal. Est.Rs.5000/- 294 PNG/65-66.	5106.00	"	12.02
5. Construction of super passage at mile 2.6.235 of ULF canal. Est.Rs.2750/- 127 PNG/66-67	1979.00	"	23.2.
6. Construction of under tunnel at mile 2.7.270 of ULF canal. Est.Rs.4300/- 295 PNG/65-66.	4405.00	"	11.12
7. Construction of under tunnel at mile 3.1.055 of ULF canal.Est.Rs.4200/- 325 PNG/65-66	4511.00	"	21.04.
8. Construction of under tunnel at mile 3.3.365 of ULF canal. Est.Rs.4300/- 326 PNG/65-66.	4323.00	:	22.07.
9. Construction of under tunnel at mile 4.1.280 of ULF canal. Est.Rs.5300/- 125 PNG/66-67.	4761.00	""	
10. Construction of under tunnel at mile 4.4.110 of ULF canal. Est. Rs.5250/- 335 PNG/65-66.	4943.00	""	
11. Construction of Acquduct at mile 5.3.160 of ULF canal (RE) 47200/- 28 SE/68-69.	47092.00	"	13.2
12. Construction of super passage at mile 7.0.330 of ULF canal. Est.Rs.3500/- 191 PNG/66-67.	3293.00	"	22.07.
13. Construction of under tunnel at mile 7.2.380 of ULF canal. Est.Rs.6200/- 152 PNG/66-67.	6317.00	"	27.04
14. Construction of under tunnel at mile 7.4.440 of ULF canal. Est.Rs.6000/-153 PNG/66-67.	6262.00	"	23.04.
15. Construction of super passage at mile 8.4.550 of ULF canal. Est.Rs.3800/- 476 PNG/66-67.	3996.00		21.08.69
16. Construction of under tunnel at mile 9.0.100 of ULF canal. (RE) Est.Rs.4700/- 183 PNG/68-69.	4629.00	"	30.04.69
17. Construction of under tunnel at mile 10.1.000 of ULF canal. Est.Rs.2650/- 483 PNG/66-67.	2876.00	"	07.10.70
	145310.00		
VII. 'G' Bridges:			
1. Construction of 12'0 wide bridge at 0.3.600 Est.Rs.5100/- 290 PNG/65-66.	4397.00	"	27.04.68
2. Construcion of super passage cum C.T. at mile 0.5.460 Est.Rs.7500/- 293 PNG/65-66.	6500.00	"	"

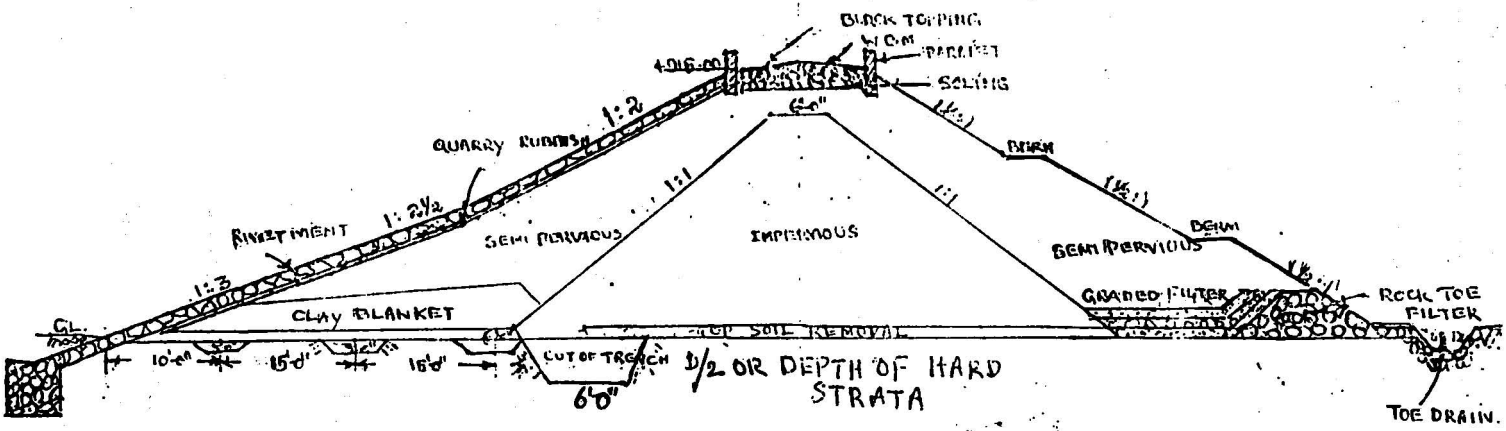
Name of work with Est.Rs and Dr.No.	Expenditure		Remarks
3. Construction of bridge cum super passage at 0.7.250 Est.Rs.7050/- 291 PNG/65-66.	6209.00	"	"
4. Construction of wide bridges at mile 1.5.350. Est.Rs.8000/- 297 PNG/65-66.	6702.00	"	"
5. Construction of wide bridge at mile 2.1.250. Est.Rs.5650/- 289 PNG/65-66.	5073.00	"	10.04.69
6. Construction of 12-0 wide bridge at mile 3.1.645. Est.Rs.5200/- 298 PNG/65-66.	4155.00	"	22.07.68
7. Construction of 12-0 wide bridge at mile 4.1.490. Est.Rs.4300/- 126 PNG/66-67.	4090.00	:	03.10.69
8. Construction of 12-0 wide bridge at mile 5.3.340 Est.Rs.4500/- 124 PNG/66-67.	4655.00	"	27.04.68
9. Construction of 12-0 wide bridge at mile 5/7 Est.Rs.6750/- 189 PNG/66-67.	6652.00	"	30.06.69
10. Construction of 12-0 wide bridge at mile 6.1.110. Est.Rs.4800/- 190 PNG/66-67.	4719.00	"	21.08.69
11. Construction of 12-0 wide bridge at mile 6.4.285. Est.Rs.4700/- 188 PNG/66-67.	4281.00	"	21.11.68.
12. Construction of 12-0 wide bridge at mile 7/4 Est.Rs.4400/- 334 PNG/65-66.	3122.00	"	12.11.68
13. Construction of 12-0 wide bridge at mile 7.6.650 Est.Rs.10,500/- 331 PNG/65-66.	10691.00	"	23.04.68
14. Construction of 12-0 wide bridge at mile 8.6.440 Est.Rs.3450/- 192 PNG/65-66.	3299.00	"	18.12.68
15. Construction of 12-0 wide bridge at mile 9.3.310. Est.Rs.3700/- 324 PNG/65-66.	3704.00	"	27.04.68
16. Construction of 12-0 wide bridge at mile 10.3.260. Est.Rs.3200/- 324 PNG/65-66.	3420.00	"	26.10.68
17. Construction of 12-0 wide bridge at mile 10.6.460. Est.Rs.1500/- 357 PNG/65-66.	1388.00	"	26.10.68
18. Construction of bridge on the service road at 0.0.101 below axis of dam. Est.Rs.11,500/- 154 PNG/66-67.	11500.00	"	22.07.68
	94557.00		
VIII. 'H' Escapes			
1. Constructing an in let at mile 3.6.155. Est.Rs.330/- 488 PNG/66-67.	330.00		
2. Constructing an in let at mile 6.7.440. Est.Rs.775/- 489 PNG/66-67.	1209.00	"	10.03.70
	1539.00		

Name of work with Est.Rs and Dr.No.	Expenditure	Remarks
IX. 'L' Earthwork:		
1. Earthwork excavation in the I reach from 0/0 to 3.7.440. RE.1,37,000/- 12SEc/69-70.	137394.00	CR sub.on 16.03.71
2. Earthwork excavation in the II reach from 3.7.440 to 6.2.220. RE.96,000/- 32 SEC/68-69.	95969.00	" 06.02.70
3. Earthwork excavation in the III reach from 6.2.220 to 7.7.550. Est.Rs.67000/- 65 SEC/66-67.	70199.00	
4. Earthwork excavation in the IV reach from 7.7.550 to 9.1.550. Est.Rs.35,000/- 387 PNG/66-67.	36611.00	
5. Earthwork excavation in the V reach from 9.1.550 to 10.2.000. Est.Rs.23,000/- 388 PNG/66-67.	23018.00	07.03.70
6. Earthwork excavation in the VI Reach from 10.2.000 to 10.6.550. Est.Rs.8000/- 38 PNG/66-67.	8049.00	" 07.03.70
	371240.00	
X. K. Buildings:		
1. Construction of lascar quarters in Uppar LF canal.(anticipated).	15000.00	
XI. 'O' Miscellaneous:		
1. Metalling the Jeep track of Uppar L.F. canal.	46000.00	
2. Provision for printing block maps for left flank and right flank canal.	20000.00	
	66000.00	
XII. 'N' Plantations:		
1. Plantation avenue trees on the canal beds.	1000.00	
XIII. III Distributories 'N' Tanks:		
1. Acquisition of land for excavation in distributory in ULF canal. Est.Rs.28,000/- 96 PNG/67-68.	210.00	" 27.04.68
2. Surveying and levelling operation for distributory and water courses in ULF canal. Est.Rs.2,500/- 175 PNG/66-67.	2484.00	-do -
3. Excavating Mamangam distributory taking off at mile 6.2.220 of ULF canal. Est.Rs.12,000/- 232 PNG/66-67.	11991.00	". 13.09.69
4. Construction of drops in Mamangam distributory taking of at mile 6.2.220 of ULF canal. Est. Rs.3,200/- 257/67-68.	3191.00	" 13.09.69

Name of work with Est.Rs and Dr.No.	Expenditure		Remarks
5. Construction of DI sluices in Mamangam distributory taking off at mile 6.2.220 of ULF canal. Est.Rs.3100/- 266/67-68.	3089.00	"	13.09.69.
6. Construction of a Taildam at mile 1.0.070 of Mamangam Disty. taking of at mile 6.2.220 of ULF canal. Est.Rs.240/- 258/67-68.	230.00		28.03.69
a. LA for ULF I reach 0/0 to 3.7.44 Est. 190000/- 322 PNG/65-66.	89912.00		
b. LA for ULF (Disty.) Est.Rs.2,80,000/- 90 PNG/67-68.	140182.00		
7. Construction of a C.T. crossing at mile 0.4.060 of Mamangam Dist. taking of at mile 6.2.220 of ULF canal. Est.Rs.900/- 256/67-68.	723.00	"	21.08.69
8. Excavating Valapalayam distributory taking off at mile 7.7.440 of ULF canal. Est.Rs.3800/- 241/67-68.	3834.00	"	21.08.68.
9, Construction of D.I. sluice in Varapalayam distributory taking off at mile 7.7.440 of ULF canal. Est.Rs.800/- 259/67-68.	739.00	"	11.12.69.
10. Construction of Taildam at mile 0.1.220 of Varapalayam distributory taking of at mile 7.7.440 of ULF canal. Est.Rs.220/- 260/67-68.	201.00	"	21.08.69
11. Construction of a road crossing at mile of Varapalayam Dist. taking off at mile 7.7.440 of ULF canal (Gross Thiruppur Dharapuram Road). Es.Rs.1300/- 270/67-68,	1290.00	"	11.12.69
12. Excavating Kannan Koil Disty. taking off at mile 9.1.550 of ULF canal. Est.Rs.13,500/- 9 PNG./67-68.	13733.00	"	02.05.70
13. Construction of Drops in Kannan Koil Disty. taking off at mile 2.1.550 of ULF canal. Est.Rs.8850/- 8 PNG/67-68.	8719.00	"	31.01.70
14. Construction of D.I. sluice in Kannan Koil Disty. taking off at mile 9.1.550 of ULF canal. Est.Rs.5800/- 262/67-68.	137.00	"	
15. Construction of super passage at mile 0.0.275 of KannanKoil Disty. taking off at mile 9.1.550 of ULF canal. Est.Rs.1800/- 285/67-68.	1817.00	"	
16. Construction of a (Gobi-Dharapuram) Road grossing cum 4'0" drop at mile 1.1.220 of Kannan Koil Disty. taking off at mile 9.1.550 of ULF canal. Est.Rs.2000/- 264/67-68.	1870.00	"	
17. Construction of taildam at mile 1.1.440 of Kannan Koil Disty. taking off at mile 9.1.550 of ULF canal. Est.Rs.160/- 263/67-68.	168.00		28.03.69
(284120.00) Total Rs.	**284120.00**		

Name of work with Est.Rs and Dr.No.	Expenditure		Remarks
XIV. Water Courses:			
1. Excavating water courses taking off at mile 0.1.220 of ULF canal. Est.Rs.100/- 98 PNG/67-68.	78.00		18.10.69
2. Excavating water courses taking off at mile 0.2.410 of ULF canal. Est.Rs.400/- 99 PNG/67-68.	421.00	"	19.04.69
3. Excavating water courses taking off at mile 0.5.220 of ULF canal. Est.Rs.150/- 100 PNG/67-68.	142.00	"	13.03.70
4. Excavating water course taking off at mile 0.6.550 of ULF canal. Est.Rs.600/- 107 PNG/67-68.	574.00	"	18.10.69
5. Excavating water courses taking off at mile 1.0.440 of ULF canal. Est.Rs.350/- 102 PNG/67-68.	330.00	"	"
6. Excavating water courses taking off at mile 1.2.220 of ULF canal. Est.Rs.2800/- 103 PNG/67-68.	2939.00	"	26.06.69
7. Excavating water courses taking off at mile 1.4.440 of ULF canal. Est.Rs.1500/- 104 PNG/67-68.	1677.00	"	08.10.69
8. Excavating water courses taking off at mile 1.6.550 of ULF canal. Rs.4800/- 221/68-69.	4382.00	"	27.10.69
9. Excavating water courses taking off at mile 2.3.000 at ULF canal. Est.Rs.4600/- 221/68-69.	4100.00	"	27.10.69
10. Excavating water courses taking off at mile 2.7.130 of ULF canal. Est.Rs.1050/- 107 PNG/67-68.	1003.00	"	27.12.69
11. Excavating water courses taking off at mile 3.0.330 of ULF canal. Est.Rs.1050/- 107 PNG/67-68.	1493.00	"	13.03.70
12. Excavating water courses taking off at mile 3.1.220 of ULF canal. Est.Rs.1000/- 109 PNG/67-68.	955.00	"	27.12.69
13. Excavating water courses taking off at mile 3.6.330 of ULF canal. Est.Rs.3600/- 111 PNG/67-68.	3865.00		26.06.69
14. Excavating water courses taking off at mile 3.7.440 of ULF canal. Est.Rs.6800/- 234 PNG/67-68.	6848.00	"	28.03.70
15. Excavating water courses taking off at mile 4.2.440 of ULF canal. Est.Rs.2550/- 235/67-68.	1900.00	"	21.08.65
16. Excavating water courses taking off at mile 4.7.410 of ULF canal. Est.Rs.1700/- 236/67-68.	1681.00	"	21.08.65
17. Excavating water courses taking off from the Mamangam disty.taking off at mile 6.2.220 of ULF canal. Est.Rs.9300/- 237/67-68.	9283.00	"	13.09.69.
18. Excavating water courses taking off at mile 6.4.385 of ULF canal. Est.Rs.7300/- 238/67-68.	7297.00	"	13.09.69

Name of work with Est.Rs and Dr.No.	Expenditure		Remarks
19. Excavating water courses taking off at mile 7.4.110 of ULF canal. Est.Rs.1500/- 239/67-68.	1163.00	-do	
20. Excavating water courses taking off at mile 7.6.330 of ULF canal. Est.Rs.2,300/- 240/67-68.	2254.00	"	21.08.69
21. Excavating water courses taking off from the Varapalayam Disty., taking off at mile 7.7.440 of ULF canal. Est.Rs.11,100/- 233/67-68.	11138.00	"	10.04.70
22. Excavating water course taking off at mile 8.2.050 of ULF canal. Est.Rs.300/- 242/67-68.	273.00	"	02.05.69
23. Excavating water course taking off at mile 8.6.330 of ULF canal. Est.Rs.2100/- 243/67-68.	2334.00	"	21.08.69
24. Excavating water course taking off at mile from the Kannan Koil Disty. taking off at mile 9.1.550 of ULF canal. Est.Rs.13,800/- 261/67-68.	14027.00	"	
25. Excavating water courses taking off at mile 9.3.385 of ULF canal. Est.Rs.1650/- 242/67-68.	1848.00	"	
26. Excavating water course taking off at mile 9.7.495 of ULF canal. Est.Rs.2,900/- 345/67-68.	2182.00	"	
27. Excavating water course taking off at mile 9.7.495 of ULF canal. Est.Rs.8200/- 243/67-68.	8388.00		
28. Excavating water course taking off at mile 10.1.440 of ULF canal. Est.Rs.3800/- 247/67-68.	3737.00		30.04.70
29. Excavating water course taking off at mile 10.5.110 of ULF canal. Est.Rs.220/- 16/68-69.	217.00	"	18.10.69
30. Excavating water course taking off from the left vent of tail dam at mile 10.6.490 of ULF canal. Est.Rs.2800/- 248/67-68.	2107.00	"	21.08.69
31. Excavating water course taking off from the right vent of the tail dam at mile 10.6.490 of ULF canal. Est.Rs.3500/- 249 PNG/67-68.	3262.00	- do-	
32. Excavating water course taking off at mile 2.1.440 of ULF canal. Rs.1300/- 197/68-69.	1230.00	"	21.03.70
33. Excavating water course taking off at mile 3.4.440 of ULF canal. Est.Rs.575/- 110 PNG/67-68.	425.00	"	09.02.70
34. Acquisition of land for water courses under the distributory and water courses of ULF canal. Rs.10400/- 97/67-69. CR.No.24SEC/72-73.	59893.00		
Total Rs.	**162446.00**		



TYPICAL CROSS SECTION OF EARTH DAM

PART II - EARTH DAM

CHAPTER I

PREAMBLE:

Earth is one of the basic substances among five major ingredients namely Earth, Water, Fire, Air, and sky. The world is made up of these five substances. Among them earth is the base for the other four components mentioned above except sky. Earth is the place of fulcrum for the existence of water, fire and air.

In ancient Tamil versions it is expressed well by Saint MANIKKAVASAKAR in his THIRUVASAKAM and in THEVARAM by sain APPAR SWAMYGAL.

பாரிடை அய்ந்தாய்ப் பரந்தாய் போற்றி
(மணிவாசகர்)

இருநிலனாய்த் தீயாகி நீருமாகி
இயமானனாய் எரியும் காற்றுமாகி...
(அப்பர் சுவாமிகள்)

Hence Earth has be basic role in any activities of the world.

HISTORY

Tamilnadu has got good old ancient history and culture of formation of irrigation tanks. The earth bunds formed by the ancient rulers of the irrigation tanks by CHERAS, CHOLAS, and PANDIYAS are all still maintained in good condition. Veeranam tank, Mathuranthakam tank are few examples for our old earth dams. They are all still in tact and serves its purpose.

Those days science on soil mechanism was not well developed as now. Scientific methods of formation of earth dams was not existing in Tamilnadu before Independence in 1947. Elaborate studies were made and decisions were taken on the earth dam construction only when the Lower Bhavani project was executed. This forms the basic concepts and guidelines for all other dams in Tamilnadu, constructed after Independence. Nowadays earth dams play major role in the construction of storage reservoirs in the non-spillway portions. Earth dam has replaced the masonry dam to a very great extent mainly reducing the cost of construction.

SALIENT FEATURE OF EARTH DAM

Earth Dam:

Length of Left flank	5110'-0"
Masonry Dam	118-0"
Length of Right Flank	2640-0"
Total Length:	**7868'-0"**

F.R.L. of Reservoir	+906.00
M.W.L. of the Reservoir	+908.00
Top Level of the E.Dam	+915.00
Water spread Area at FRL 1120. Aers	
Width of Road way at Top 15'-0"	
The max. height of Earth Dam at L.S. 5110'-0"	66'-0"

CHAPTER II

EARTH DAM GENERAL FEATURES AND VARIOUS COMPONENTS

DESIGN:

Most of the earth dams are designed based on the slip circle method which forms the basis for the determination of front and rear slopes. Normally earth dam sections are homogeneous upto a height of 20'-0'. Above this height, the formation of earth dams are made with two zones namely impervious zone or hearting and semipervious zone or casing together with cut off trenches.

PROCEDURE OF THE EARTH DAM CONSTRUCTION

There are several steps to be carefully followed in the construction of earth dam. They may be classified broadly under two headings.

1. Preliminary survey and estimating.
2. Execution of work including locating borrow areas with suitability test.

PRELIMINARY WORKS:

After the finalisation of the alignment of the dam location, the first and foremost work is marking the centreline at an interval of one furlong using demarcation stones from one end either right flank or left flank. There are usually two flanks left and right of masonry dam. Generally the masonry dam is in the river bed with surplus arrangements. Earth dam adorns the masonry dam of both left and right flank in most of the reservoirs. Site is cleared for conducting levelling operations for preparing condensed L.S. Generally Cross sections are taken at an interval of 330'-0". Cross sections are taken at the points where abnormal sudden fall or rise is there in the G.L. to represent the proper land undulations.

ESTIMATING

The cross sections of the earth dam are prepared at required intervals and proposals are drawn showing the following details.

1. Average ground level.
2. Position of key trenches.
3. Cut off trench
4. Impervious zone.
5. Semipervious zone.
6. Front and rear slopes with required berm.
7. Formation of clay blankets in front semipervios zones

8. Horizontal filters along with rock toe filters in the down stream semipervous zone.

9. Toe drain

10. Front slope quarry rubbish backing to receive rivetments

11. Rivetments of various thickness according to the height of the dam.

12. Top road formation

13. Parapets

14. Turfing details in rear slopes.

15. Drainage chutes in rear slopes.

Cross sectional areas of each item are arrived at and average cross sectional areas are arrived at between the adjacent cross sections. The average area is multiplied by the distance between the cross sections to arrive at the contents. Datas are prepared for the various items of the works based on the approved lead particulars and estimate cost worked out. Then the sanction of estimate by the competent authorities and fixing agencies are the part of process before commencing the execution of works.

EXECUTION OF WORKS

Based on the centreline marking, landmark pillars at an interval of one furlong is placed in the downstream of earth dam such that the land mark pillars are not disturbed till the completion of work. In the side of the pillar, the L.S. distance and distance from the centreline is inscribed. Of course the pillars are located at right angles to the centre line and the line is marked on the top by theodolite marking.

REMOVAL OF TREES:

The trees, if any, within the cross sectional areas are all to be uprooted with the entire roots removed. The vegetation including top soil is removed to an average depth of 0-6".

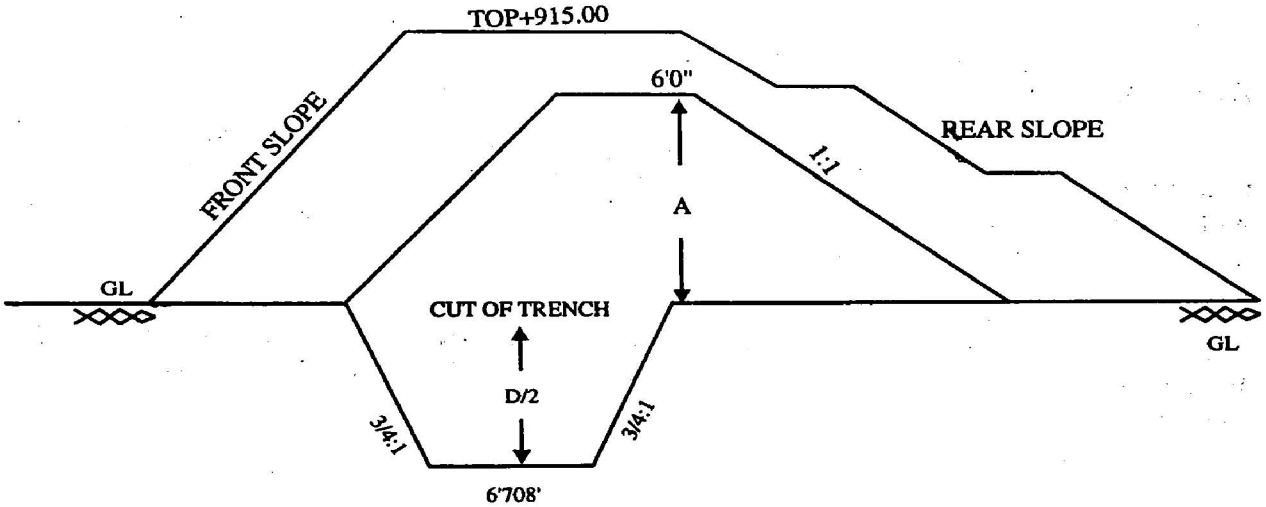
Now the key trenches are marked with reference to centre line measured from land mark pillars and pegs are driven at every cross section for the various key trenches. Similarly at convenient interval the key trenches are marked.

CUT-OFF TRENCHES:

Cut-off trenches in the earth dam plays in important role. It acts as a pivet to the earth dam. The cut-off trench is located at the toe point of impervious zone where it meets the G.L. The depth of the cut-of trench is half the height of the earth dam or upto the depth of hard strata such as rock whichever is possible. The bottom width will be according to the depth of earth dam with side slaps 3/4:1. To mark this, the toe points in front and rear of centre line the impervious zone and semipervious zone, the distance from centre lines are arrived at and peg marked. The front toe of the impervious zone is

the starting point of the cut off trenches and tentative width of key trench is peg marked. First vertical portion at centre to the bottom width is excavated and then the slopes are formed.

If the cut-off trench is in rock portion one or two rows of cut off walls of random rubble masonry in C.M. 1:5 is constructed to operate as key as well as increasing the creeping length of the seepage. After excavation of cut off trench to the required depth, power rollers are brought in to the trench and rolled well and watered. The impervious zone soil in already selected areas of borrow pits are brought and spread in a layer of 8" thick and rolled to 6"thick Similarly entire cut off trench is filled with impervious soil upto G.L. This part of formation of earth dam plays an important role in the stability of the earth dam.



SKETCH SHOWING CUT OF TRENCH

REMOVAL OF TOP SOIL AND VEGETATION

A convenient length of about 200'-0" along the longitudinal section is tackled at a time. the loose soils along with vegetation is removed at top as already mentioned to a depth of 0'-6". The entire surface is rolled well and watered. It is a little bit difficult job in the earth dams to form homegeneous binding between the natural ground and earth dam.

After wetting well, the new layer of earth in the respective zones are dumped and spread to a uniform layer of 8" thick loose soil. The levelling of the dumped earth are made by levellers generally. In Uppar Dam the levelling was done by the scrapers themselves. The layer then was wetted and consolidated to 6" layer.

CLAY BLANKET

The front semi pervious zone is provided with a clay blanket with 3'-0" thick at front toe and 6'-0" depth at the beginning of impervious zone. This layer of blanket forms a basis of water tightness of the earth dam in the foundation level ie at G.L. This part of the earth dam mostly ensures the reduction of the seepage losses and increases the stability.

HORIZONTAL FILTERS

At G.L. in the rear slope between rear toe and end of impervious zone, the graded filters are formed. The function of the horizontal filters is to release the water pressure if any that may be developed due to creeping of water through earth particles.

This will act as a filter allowing only filtered water to the toe drains without any disturbance to the earth particles of the earth dam. Pressure will be built up if the seepage water is not properly drained through these filters. Hence the important function of building up of internal pressure due to storage of water is avoided and stability of the earth dam is no way affected. The horizontal zoned filters is 3'-O" thick. The bottom layer 1'-0" thick is coarse and and 1'-0" thick mid layer is graded from 3/4" thick to 3" thick blue granite stones. Over this layer 1'-0" thick fine sand spread. Thus the graded zoned filter is 3'-0" thick. The depth of horizontal filter will vary according to the height of the earth dam.

ROCK TOE FILTER

Over the horizontal filters in the rear toe of the earth dam there is a rock toe formation with the following specifications. The top with of the rock toe is generally 6'-0" wide with 1 :1 side slopes on both the faces. The rock toe filter height is 3'-0" above the horizontal filter.

The rock toe will be made up of boulders ranging from 3"-6" cubes of random rubble stones. The top layer is formed as a revetment with 6" size random rubble stones. Inside slope of the rock toe will be the continuation of horizontal filters of three layers of the same grade.

TOE DRAIN

The rear end of the cross section of the earth dam ends with the toe drain to drain off the collected seepage water in the earth dam portion. The depth of the toe drain is normally kept at 2'-O. The bottom width is normally 4'-0" wide with side slopes of 1 ½:1. In shallow depth of the earth dams the bottom of the toe drains is pitched with 6" rough stone dry packing and side slopes with turfing. In deeper earth dam sections the entire to drains is pitched with 6" to 9" thick rough stone dry packing.

EARTH DAM IMPERVIOUS ZONE

This part of the earth dam is called hearting zone made of impervious soil with more clay content. The top width of the zone is kept minimum 6'-0" wide to any required width according to the height of the earth dam. The impervious zone normally ends at 5'-0" below the tope of the earth dam. The side slopes are generally adopted as 1:1. The hearting portion will be exactly at the centre line of the earth dam. This part of earth dams is formed along with the semipervious zone both in front and rear slope, layer by layer with the hearting soil. The soils is of clay in nature with the clay content of 15 to 20%. The borrow areas were surveyed located and soil samples were tested to suit the pervious zone. The quantities of the earth for the respective zones are assessed in the borrow areas and lands are selected in such a way that there is not interruption in the formation of the earth dam.

SEMIPERVIOUS ZONE

This is an encasement of hearting zone with semipervious soil. The front slope varies according to the height of the earth dam at the interval of 10'-0" height. In shallow depth, it is 1 ½:1. In deep sections, the top 10'-0" height is 2:1 and next 10'-0" height is 2 ½:1 an subsequent 10'-0" height are increased with slopes of 3:1 and 3 ½:1. The slopes are decided to keep the hydraulic gradient line drawn in 1:4 slope to lie with in the cross section of the earth dam. The rear slope of the earth dams is adopted as 1 ½:1 to the entire depth of the cross sections with necessary berms according to the height of the earth dam.

CLAY BLANKETS

Bottom most layer of the front portion of the semi pervious zone is made up of puddle clay with the downward slope towards front toe. The thickness of the front toe will be about 3'-0" thick and at the end of casing zone 6'-0" thick. This is formed in an uniform layer of 6" thick as adopted to the formation of the earth dam laying and spreading loose earth in 8" layers and consolidating to 6" thick. The clay blanket serves as a retardation agent of percolation of water when the storages is built up. Incidentally it will act as a cushion keeping the dampness for a long duration so as to enable the semipervious gravelly soil particles to be in tact which is less cohesive in nature.

The front and rear semipervious zones are marked in ground along with the impervious zone and earth from borrow areas are conveyed sufficiently and placed in the mrespective zones in uniform layers and consolidated to the required density. The earth dam will be progressed with the camber in centre so that the water during rain collected will be disposed off easily to the ends of the earth dam. This will enable the resumption of work quickly.

EXTRA WIDTH FORMATION

The front and rear slopes are formed extra 2'-0" width. This is due to the difficulty of proper consolidation by power rollers in the edges of the bund. This extra width is cut and reused so that the consolidated hard surface is obtained to receive quarry rubbish in front slope and turf in the rear slope. To avoid lift problems the slopes are cut and reused with in a height of 10'-0" height.

The impervious zone is stopped at 5'-0" below the top of the dam and the entire section above this level will be formed as homogeneous sections with semipervious soils. Conveyance of earth will be stopped sufficiently in advance according to the availability of the loose earth to be cut in rear and front slpe so as to form the earth dam upto top of earth dam without wasting the conveyed earth the earth dam will be stopped just 1'-0" below the top of the dam to accommodate the formation of the road.

FORMATION OF RIVETMENT

The front slope is in direct contact with the water at the time of storage. It is also subjected to wave action due to wind. This will cause damage to the front slope. There is also another phonomena of sucking out the earth particles where there is a sudden draw down in the storage position. To protect the earth dam from these calamities revetments over a layer of quarry rubbish which is free from clay content is used to act as a filter to

release the internal pressure developed due to storage. The thickness of the quarry rubbish layer varies from 6" to 9" thick according to the height of the earth dam. The quarry rubbish are spread in layers after forming model sections at an interval of 20'-0" to 30'-0". Inbetween these model sections the quarry rubbish spread in layers and ramped well with rammers. The formation is taken up between berm to berm.

RIVETMENT

Large sizes of jeedy stones are used for rivetment formation in front slope. The quality of the stone will be generally hard granite stones. It need not be as good as the stones for masonry buildings. The sizes of the stones may vary from 2'-0" to 0'-9". The stones need not be in regular shapes. The excavated stones from the foundation in the masonry dam will be fully utilised for rivetment purposes apart from breaking 1 ½' and ¾" metal for concrete. The rock out crops in the water spread near the dam will also be utilised for quarrying the rivetment stones.

A reach of normally 20'-0" length is taken up to a slope height of 15'-0". A model section on the both the ends are formed to the required depth keeping the required slopes at the sections. Then the gap is filled with rivetments. The stones are placed in position with less gaps between the stones. The large size gaps are filled with suitable sizes of small stones and hammered well. The gaps are filled with small stones 6" below the top of the rivetment and the balanced depth is packed with bigger stones. The toe of the rivetments is taken atleast 2'-0" below ground level and rock toe is formed as base to retain the subsequent layers of rivetments. Thus the rivetments to the entire length of the dam is completed simultaneously and when the earth dams is completed.

REAR SLOPE TURFING

The rear slope of the earth dam is turfed with grass. The slopes are trimmed to the required slope and well watered to receive the turf. The turf blankets of size 1'-0" x 1'-0" are cut in the river bed with the roots of grass and mother earth. They are conveyed to the site and placed it in position along the slopes of the earth dam and rammed well, so as to stick on the surface of the earth dam. The finished surfaces of turf are watered for 45 days. The turfs are brought from the Amaravathi river bed near Dharmpauram.

CHUTE FORMATION

The rear slope is provided with chuts built in random rubble masonry in cement mortar 1:5 to a thickness of 0'-9" both bottom and sides at an interval of 100'-0". The size of the chut is 1'-0" width at bottom and 0'-9" height on both the sides. The width of sides are 0'-9" thick. The earth work excavation is done below turf surface to a depth of 1'-6"x2'-6" width. The bottom layers is built with R.R. masonry in cement mortar 1:5 to a width of 2'-6" and depth of 0'-9". over this layer two side walls of 0'-9" thick to a height of 0'-9" is built to form the chute leaving a gap of 1'-0" in the centre. The chutes are then pointed with cement mortor 1:5 and top surface is finished with plastering in cement mortor 1:5, ¾' thick. Thus the entire length of the earth dam of both right and left blanks are provided with chutes to drain off the rain water without damaging the turfed slopes.

PARAPETS

Keeping the clear width of the roadway as 15'-0" wide, the parapets 1'-3" thick on either side are constructed with R.R. masonry in clay to a height of 2'-3" height width plasters at an interval of 10'-0". The R.R. in clay is pointed with cement morter 1:5 after racking out the joints to a thickness of ¾" thick. The parapets are all done in both the flank is only after an year completing the earth dam allowing on e or two rainy seasons for well settle down of earth dam. The parapets are just a guide wall taking only self weight and hence no foundation concrete is necessary. The earth work for foundation is done to a depth of 2'-0" approximately and straight away R.R. masonry in clay is built up. On the top of parapets coping concrete of 3" thick in cement concrete 1:3:6 using ¾" metal with a projection of ½" on either side. The coping works are finished with cement plastering in cement morter 1:3.

ROAD FORMATION ON THE TOP OF EARTH DAM

The road works on the top of earth dam are done only during 1969 after allowing sufficient settling time of the earth dam. The top layer of 1'-0" thick earth dam was not formed to receive the base of soling stone of 6" thick and two layers of 3" thick water bound macadam road with 1 ½" metal.

The top surface of the earth dam is trimmed the keep the level +914.00, watered and rolled well before spreading the soling stones with proper camber in centre. Cambering will be 1:36 to 1:48. For bitumen roads the camber is 1:72. The soling stones are well hand packed with small joints keeping the templates at proper intervals. The model sections are built up at an interval of 20'-0" to 30'-0" to a width of 1'-6". Inbetween the model sections the soling stones are well packed by hand with small space of joints.

ROLLING THE BASE

The power roller of 6 to 8 tonne capacity is used for rolling the base. Number of passes that may be required will be 6 to 8 times. The rolling should be commenced at the end roller will be moved with sufficient overlapping towards the centre of the load. Similarly the other half of the road from the other edge towards the centre of the road is rolled. A test to check the proper consolidation of the soling is to pass the roller over 25 mm metal placed on the consolidated surface. The well consolidated layer will not allow the 25 mm metal to penetrate down. The metal will be crushed to powder when the soling stones are consolidated properly. This soling stones base plays an important role in the road formation. It is the media to take the entire traffic loads. The poor quality of base work will always lead to quick damage of the road surface. In earth dams the road is for mostly inspection purposes where light vehicles such as jeeps, cars and vans only moving and that too not in frequent intervals. However the minimum specification for the road formation are as follows.

1. The base of soling stone 6" thick
2. One layer of 3" to 1 ½2" graded metal of 3" thick water bound macadam.
3. Another layer of 3" thick water bound macadam using 1 ½" metal.

After completing the soling stone a layer of 3/4" thick red gravel is spread over the rolled surface and watered after rolling. This forms the binding media of the soling stones. This is called blending of the base.

WATER BOUND MACADAM

Over the blended soling stone surface 3" thick layer of hard broken graded stones of size varying from 1 ½" to 3" are spread. The metal is hand packed to uniform surface and rolled sufficiently as described already for soiling stone. The red gravel with sufficient cohesive in nature is stacked and used for the blending of WBM road. After spreading the grave list sufficient to fill up the voids in the coarse aggregate. Copious water is sprinkled over the gravel and consolidation done by power roller as described before for soling stones. Care is taken to not allow any traffic over the newly formed water bound macadam, for atleast 24 hours. After allowing sufficient time for drying, the second layer of WBM of 3" thick with 1 ½" metal is spread and consolidated as done for the first layer.

SURFACE DRESSING WITH BITUMIN OR BLACK TOPPING

Block topping is a layer of ¾" thick hard broken stone mixed with approved grade of bitumin. This acts as a cushion between the tyres of the vehicle and the base of the road. It drains the rain water quickly and dries up. It does not spread any dust when the vehicles are passing over the road as in the case of WBM road.

LAYING OF BITUMIN ROAD

The water bound macadam road surface is well cleaned with were brushes. Road tar of RT2 grade are bitumin 30/40 grade as per Highways road specification is heated to 93 degree C. to 104 degree C. is sprinkled over the cleaned surface so that the entire surfaces is covered with bitumin. The the ¾" metal mixed with bitumin in the mixture durm is spread over the bitumin sprinkled surface and spread to the template height.

Rolling is done from the end towards centre as is done for water bound macadam.

Quarry dust or sand sprinkled over the rolled surface to form void proof finished surface. The first black toping will be 3" thick where as subsequent renewals are of ¾" to 1" thick.

BORROW AREA SELECTION AND FIELD TEST

Selection of borrow areas in water spread where commenced as early as in 1962 by the investigation subdividion and various test were conducted in soil mechanics and research laboratory, Chepauk, Chennai-5 and Parambikulam earth dam laboratory. The suitability of the earth where certified by the both laboratories. They are appended in the part I of the History writing. They were about 32 nos trial pits tested and earth quantity assessed. The entire required quantity of earth suitable for hearting and casing are located in the water spread areas itself and no difficulties are experienced for the borrowed earth.

MACHINERY EMPLOYED.

Being a small dam and earth work involved is not so much only 3 nos of LC scrapers, 1 grader with 2 rollers the earth dam works are tackled by the machinery subdivision Aliyar Dam.

FIELD TEST

field tests conducted then and there to determine the wet density of the rolled surface by taking out the cores in the rolled surfaces at frequent intervals and tested at field laboratory. The rerolling is ordered when field tests are not upto the standards. The best co-operation of field staff, Machinary subdivision, and clear instruction of the higher officials, made easy to the complete the earth dam in stipulated time.

PECULIAR PHENOMENA OF EARTH DAM IN UPPAR DAM

In Uppar dam a are crack is developed in the juncture of front casing and hear tin gone the both the flanks. The details studies are made by cutting open the earth dam at various sections to a depth of 5' to 10' height. The cracks are observed only in the casing zone, but not in the hearting. It is only a crack developed in the casing zone alone which may be due to unequal settlement of casing zone in front slope.

CHAPTER III

FORMATION OF THE EARTH DAM IN UPPAR DAM

GENERAL

Uppar Dam consists of 2 nos of earth dam flanks, one on the right and one on the left of the masonry dam. the zero chainage of the dam commences at left flank and ends right flank.

The total length of the dam is	7868'-0"
Left flank earth dam is	5110'-0"
The masonry dam length is	118'-0"
Right flank earth dam is	2640'-0"
Formation of the earth dam 0 Ls to	2640'

The earth dam left flank upto this chainange is a homogeneous section since the height of the earth dam is less then 20'-" height. The average ground level at L.S. 660' is + 908.00. The top of bound level is +915.00. Hence the average height of the earth dam in this reach is only 3.5'. This portion of the earth dam is tackled when the adjust lower reaches have reached the level of +908.00

Preliminary works such as clearing the vegetation and preparing the bed by removing the top soil to a thickness of 0'-6" by the scrapers at the time of formation of the bound. The exaction of key trenches were done. The first key is 10' from the centre line of the dam. The centre line other key trenches are at the interval of 15'-0" centre to centre. The depth of key trench is one foot and bottom width 5'-0". The side slopes are 1:1.

METHODS OF FORMATION

The various steps described in chapter I from clearing the vegetation to top of the bund are elaborately dealt with. Following the same procedures the earth dam is formed. The following specification are adopted in various sections of earth dam as detailed below.

Description	**c.s.at 2640**	**c.s. at 2970**	**c.s. at 4950**	**c.s.at 5110**
Ground level	+897.00	+891.00	+874.00	+860.00
Top of bund	+915.00	+915.00	+915.00	+915.00
Height of bund	18'-0"	24'-0"	41'-0"	66'-0"
Bottom width	77'6"	133'-0"	247'-6"	284'-6"
Front slope from level +906.00 to +915.00	2:1	2:1	2:1	2:1

from level +897.00 to +906.00	2 ½:1	2 ½:1	2 ½:1	2 ½:1
Rear slope	1 ½:1	1 ½:1	1 ½:1	1 ½:1
Quarry rubbish packing below +906.00	0'9'	0'-9"	0'-9"	0'-9"
Above +906.00	0'-6"	0'-6"	0'-6"	0'-6"
Rivetment above+906.00	1'-0"	1'-0"	1'-0"	1'-0"
Below+906.00	1'-6"	1'-6"	1'-6"	1'-6"
Key trench of size				
1'X $\frac{5'+6'}{2}$	1	3	4	6
Cut off trench	nil	$\frac{8'+19'}{2}$ X7'-6"	$\frac{8'+29'}{2}$ X14'	$\frac{6+25"}{2}$ X 13'-6"
Clay blanket	nil	nil	$\frac{3'+6'}{2}$ X 60'	$\frac{3'+6'}{2}$ X 90'
Horizontal filter	nil	55'x3'	45'x3'	80'x3'
Rock toe	nil	nil	$\frac{4'+22}{2}$ X 6'	$\frac{6'+33'}{2}$ X 9'
Toe drain	nil	$\frac{4'+8'}{2}$ X 2'	$\frac{2'+10'}{2}$ X 2'	$\frac{2'+7'}{2}$ X 2'

Based on the above particulars the centre line, key trench, cut off trench lay blanket, horizontal filter, rock toe and toe drain position are marked with reference to centre line. The centre line mark is located from the land mark pillars already planned at every furlong interval at the down stream of the earth dam. Filling up of key trench to formation of earth dam including casing and heart in gear carried out as described in Chapter I.

RIGHT FLANK EARTH DAM

Various cross sections at different levels in coincidence with left flank cross sections are marked out on ground. The same procedure is adopted from top soil removal up to the formation of the top of the bund. The constructions. of parapet formation of road, rivetment in the front slope turfing in the rear slope and formation of chutes are carried out exactly indentical with the left flank.

APPROACH ROAD

The Poolavadi - Dharapuram road just touches the camp colony at 11th km from Dharapuram. The camp colony road continues below the right flank and joints the top of the earth dam at right flank end. From there an approach road is formed to join the Poolavadi-Dharapuram Highways road to length of about two furlongs. The road formation is done from soling to black topping as per the specifications and maintained to till date.

CONCLUSION

Uppar dam is a small dam consisting of earth and masonry dam. In part-II the formation of earth dam is dealt with according to the procedure carried out during the execution of the project work. This specifications from clearing the top soil to formation of black topping are clearly described. Formation of earth dam was commenced in 11/64 and completed in 9/68. Ofcourse formation of road on the top, and constructions of parapet works were carried out after the bund is allowed to settle down to one or to rainy seasons. The entire work was completed some where in September 1969 including erection of shutters. The dam was thrown open for irrigation in the year 1970 by the local officers themselves with simple inauguration function.

PART III - MASONRY DAM

CHAPTER - I

PREAMBLE:

Dams are classified into three categories according to the Author H.G. Arthur who has written the chapter III on a heading "selection of types of Dams" in the book design of small dam.

They are

1. According to use
2. Hydraulic designs
3. Materials comprising the structure

1. ACCORDING TO USE

Dams are classified according to the broad functions such as storage, diversion or detention.

Storage dams are constructed to impound water in period of surplus supply and just it in periods of deficient supply. The storage dams can further be classified according to the utility of the storage such as

1. Water supply
2. Irrigation
3. Hydraulic power generation
4. Recreation
5. Fish & wild life

2. DIVISERTION DAMS:

These are dams constructed to provide head for carrying water in the channels or other conveyance of water to the place of use mostly they are utilised for the improvement for diversion of live stream to an of take channel.

DETENSION DAMS

They are constructed to retard the flood run off and minimize the sudden effects of floods. They are two types. One is to store water at the time of flood and slowly release according to the capacity of the out lets and channels. The other is to store water and allow to perculate in the storage water spread and improve the ground water potential in adjacent areas. In other words it is called perculation tanks.

ACCORDING TO HYDRAULIC DESIGN:

Here the dams are classified as "over flow" or "non over flow" dams. Over flow dams are designed to carry the discharge over the crests. They must be made of either concrete or masonry. Now over flow dams are not designed to be over topped. This type of design extents the choise of materials to include earth fill & rock fill dams.

ACCORDING TO CLASSIFICATION OF MATERIALS:

The most common classifications are made based on the materials used on the construction such as

1. Masonry gravity dam
2. Concrete gravity dam
3. Concrete arch dam
4. Concrete buttress dam
5. Earth fill dam
6. Rock fill dam

Uppar Dam is the comibination of both masonry gravity dam and Earth fill dam. In Tamilnadu it is the usual practice adopted in irrigation or water supply storage dams to combine the above categories.

Usually the masonry dam portion will be located in the river portion to serve as a surplus regulator arrangements to discharge the excess storage realised more than its capacity. The other portions of shallow depths are made up of earth fill dams. Accordingly Uppar dam comprises of

1. Masonry gravity dam to serve as surplus regular.
2. Earth fill dam to have the required storage.

VARIOUS COMPONENTS OF THE MASONRY DAM

Uppar masonry dam portion is located in between the chainages 5192' to 5310' (+1582 m to 1618m). The length of the masonry dam is only 118'-0" out of total length of 7868'-0".

1.	Left flank earth dam	51110'-0"
2.	Masonry dam	118'-0"
3.	Right flank earth dam	2640'-0"
	Total length of the dam	**7868'-0"**

The maximum height of the masonry dam from lowest foundation level to crest level is 38'-0" (+888'-0" - 858.00) only. Because of the necessity of surplus arrangements

to regulate flood flows, the masonry spillway is needed. Otherwise the surplus regulator could have been replaced by the earth dam itself. This is a small weir with necessary surplus regulating arrangements.

Hence there is no elaborate arrangements such as drainage inspection gallery or major diversion works of coffer dam extra are necessary in the Uppar dam construction.

The following are the main components of the masonry dam in Uppar dam.

1. Two Nos abutments to serve as retaining walls for earth dams of both left and right flanks.
2. Body wall of ogee type masonry with first sort double line chisel dressed masonry so as to enable to discharge the flood to a capacity of 25000 c\s.
3. Energy decipation arrangements such as stilling basins with baffle blocks.
4. Two Nos piers of 10' - 0" size over the crest to provide shutter arrangements.
5. Deck bridge arrangements to connect the earth dam of Left and Right flank for the inspection purposes.
6. Shutter arrangements with necessary hoisting operating platform to operate shutters.
7. Utility towers to have approach for the hoisting platform.
8. River training works upto bridge below dam which is a main road from Dharapuram to Kundadam.
9. Talus aprons below the stilling basin and in the upstream to protect the erosion of earth.

VARIOUS STAGES OF EXECUTION

The masonry dam execution consists of the following various stages.

1. Earth work excavation for foundation.
2. Examination of suitability of media for the construction of dam and locating grout holes at vulnerable points.
3. Providing levelling course and foundation concrete.
4. Building masonry over the foundation concrete with ogee curve surplus arrangements.
5. Providing energy decipation arrangements in the down stream.
6. Construction of piers and providing embedded parts for the shutter arrangements.
7. Providing R.C.C. deck bridge to connect the earth dam on both the sides for inspection purposes.
8. Construction of utility towers.
9. Erection of shutters including hoisting platforms.

CHAPTER II

1. EARTH WORK EXCAVATION FOR FOUNDATION

Location of masonry dam:

The masonry dam is location the deep river bed between the chainage 5192' to 5310.

The length being 118'-0". The earth work excavation for foundation is taken up as early as in November 1964. The river bed is exposed with boulders and rockout crops with soil stripes. The average width of foundation to be excavated including abutments on both the flanks is (118'-0"+33'-0"+33'-0") 184'-0". The average ground level of the river bed is +860.00. The deepest foundation level including stilling basin is +845.50. Hence the average depth of the excavation of foundation is only 14'6". The width of the excavation of foundation excluding abutements is about 125'-0". Hence an area of 200'-0"x150'-0" is taken up for the excavation of foundation of the masonry dam including stilling basin. Allowing farely a side slopes of 1/4: 1. There is no specific problem in the earth work excavation of foundation for the masonry dam. There is no weak zone portions such as pegmatite zone or large cleavages posing foundation problems. A sheet of hard blue granite rock is met with. The masonry dam is founded on this sheet rock at an average level of +850.00.

EXCAVATION OF FOUNDATION FOR ABUTMENTS

Similarly the excavation of foundation of both the abutments are taken up simultaneously. The upstream splay wings are 2 2 ½ degree splayed to the horizondal. The length of the upstream splay wings are (38'-0" +33'-0"+26'-3"+29'-3") 126'-6". The bottom width in the masonry portion is 36'-0" and in wing return portion is 14'-0". The width of the return wall at bottom is 8.82'. The downstream abutment is 29'-3" at bottom and in the end 15'-0". The length of the downstream abutments are 89'-0" with returns of 30'-0" x 14'-0". The depth of foundation is the same as for the body wall of the masonry dam. The average foundation level is +850.00 for the abutements also. The earth work excavation of foundation is done with the slope of 1/4:1 approximately in order to save the side slips during the excavation of foundation.

EXAMINATION OF SUITABILITY OF FOUNDATION MEDIA AND LOCATING GROUT HOLES AT VULNARABLE POINTS

The foundation surfaces are carefully inspected and observed the visibility of any weak zone strata or cleavages. For this purpose on operation chipping and chiselling the hard rock surface to a depth of 4" thick is taken up the loose portions adhering to the hard strata due to blastering are removed and benchings are made to have proper homogeneous grip between masonry and foundation rock. In Uppar dam, there is no foundation problem practically met with and the excavation of foundation works were over within 6 months.

DETAILING OF GROUT HOLES

After examining the foundation the location of grout holes are made commencing 2'-0" down of upstream edge. The horizondal & vertical distance between two bore hole

is maintained as 20'-0". An approved pattern of grout hole drilling is adopted as explained in part I. After locating the bore holes, a 3" diameter GI pipes of length 3'-0" approximately threaded at one end is placed in position by concrete of each hole, the levelling course of plain cement concrete 1:3:6 using ¾" hard granite blue stones to level up of the pockets etc excavated due to hard rock blasting. Necessary dovel bars of 5/8" diameter M.S. rods projecting 2'-0" above the surface are provided by drilling holes in the rock grouted inserting the rods to have proper tie between the rock surface and the masonry or concrete. This is specially provided where the excavation are undulating with vertical slopes more than 1'-0" height. By this operation, the surface of the foundation is made fairly level.

CHAPTER III

FOUNDATION CONCRETE

Then the foundation concrete in cement concrete 1:4 ½:8 using 1 ½" hard blue granite stones to a thickness of 1"-6" average is laid. This type of foundation concrete is done both for body wall as well as abutments. The thickness of foundation concrete in the abutment portion varies from 3'-0" thick to 1'-0" thick according to the sections of the abutments.

BUILDING MASONRY DAM

The building of masonry dam is done simultaneously both for abutments and body wall. The masonry is built layer by layer. The method of construction is explained in part I in detail. The size of the masonry stones should be not less than 1'x1'-6". The broader face should be placed at the bottom while the narrow portion is to be kept at top. After spreading sufficient mortar over the foundation concrete fairly big size stones are fixed in position by applying morter in the sides of the adjacent stones and making close to sides as well as tops. The joints are filled with loose morter and packed well with wedges, so that the width of the mortar joints do not exceed 1". The packing man should jerk each stone by a M.S. rod ½" diameter 2' long, so that the mortar is properly replacing the air pockets if any in between these stones.

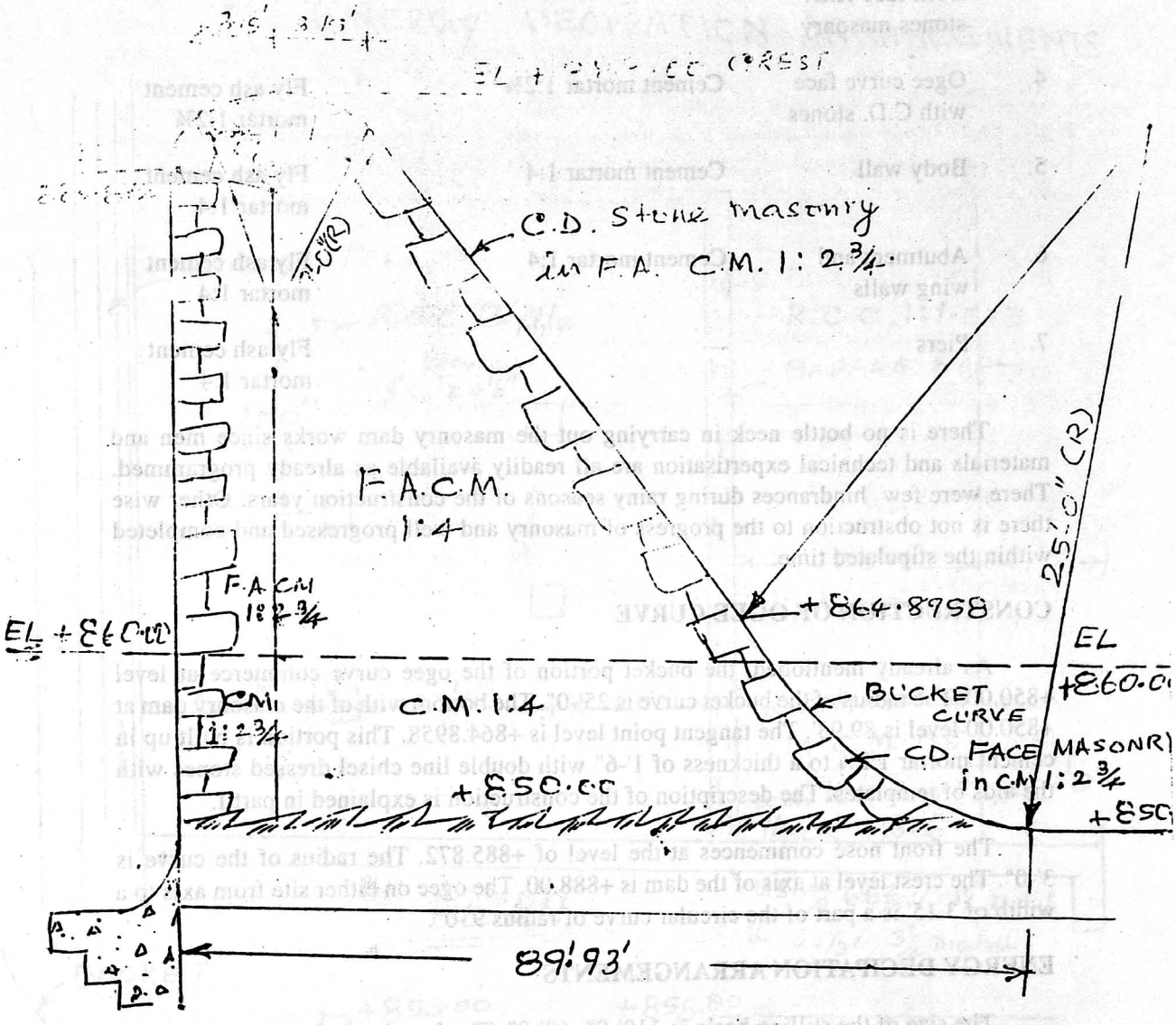
The various proportion of mortars for building the masonry are adopted as detailed below.

BODY WALL

1. The front face work up to the axis of the dam is built with cement morter 1:2 ¾ up to the level +860.00. Above +860.00 upto level+880.00 in fly ash cement mortar 1:2 ¾. The front face is built with hammer dressed stones to a thickness of 1'-6" above ground level. The balancing portion of the body wall is built in cement mortar 1:4 upto elevation+860.00 and above with fly ash cement morter 1:4 upto the level+886.00.

Similarly the ogee curve of the masonry dam is built with double lined chisel dressed stones in cement mortar 1:2 ¾ upto level+860.00 and above with fly ash cement mortar 1:2 ¾. The hearting portion of the body of dam is built up with cement mortar 1:4 upto +860.00 level and above the level the mortar used is fly ash cement mortar 1:4. This may be tabulated as follows.

S.No.	Description	Upto level+860.00	Above +860.00
1.	Levelling course	Plain concrete 1:3:6 using ¾" metal	-
2.	Foundation Concrete	Cement concrete 1:4 ½:8 using 1 ½" metal	-
3.	Front face upto Axis including	Cement mortar 1:2¾	Fly ash cement mortar 1:2¾



BODY WALL DETAILS

DIAGRAM 1

	front face H.D. stones masonry		
4.	Ogee curve face with C.D. stones	Cement mortar 1:2¾	Fly ash cement mortar 1:2¾
5.	Body wall	Cement mortar 1:4	Fly ash cement mortar 1:4
6.	Abutment and wing walls	Cement mortar 1:4	Fly ash cement mortar 1:4
7.	Piers	—	Fly ash cement mortar 1:4

There is no bottle neck in carrying out the masonry dam works since men and materials and technical expertisation are all readily available as already programmed. There were few hindrances during rainy seasons of the construction years. Other wise there is not obstruction to the progress of masonry and well progressed and completed within the stipulated time.

CONSTRUCTION OF OGEE CURVE

As already mentioned, the bucket portion of the ogee curve commerce at level +850.00. The radius of the bucket curve is 25'-0". The bottom with of the masonry dam at +850.00 level is 89.93'. The tangent point level is +864.8958. This portion is built up in cement mortar 1:2¾ to a thickness of 1'-6" with double line chisel dressed stones with the aids of templates. The description of the construction is explained in part I.

The front nose commences at the level of +885.872. The radius of the curve is 3'-0". The crest level at axis of the dam is +888.00. The ogee on either site from axis to a width of 3.15' is a part of the circular curve of radius 9'-0".

ENERGY DECIPATION ARRANGEMENTS

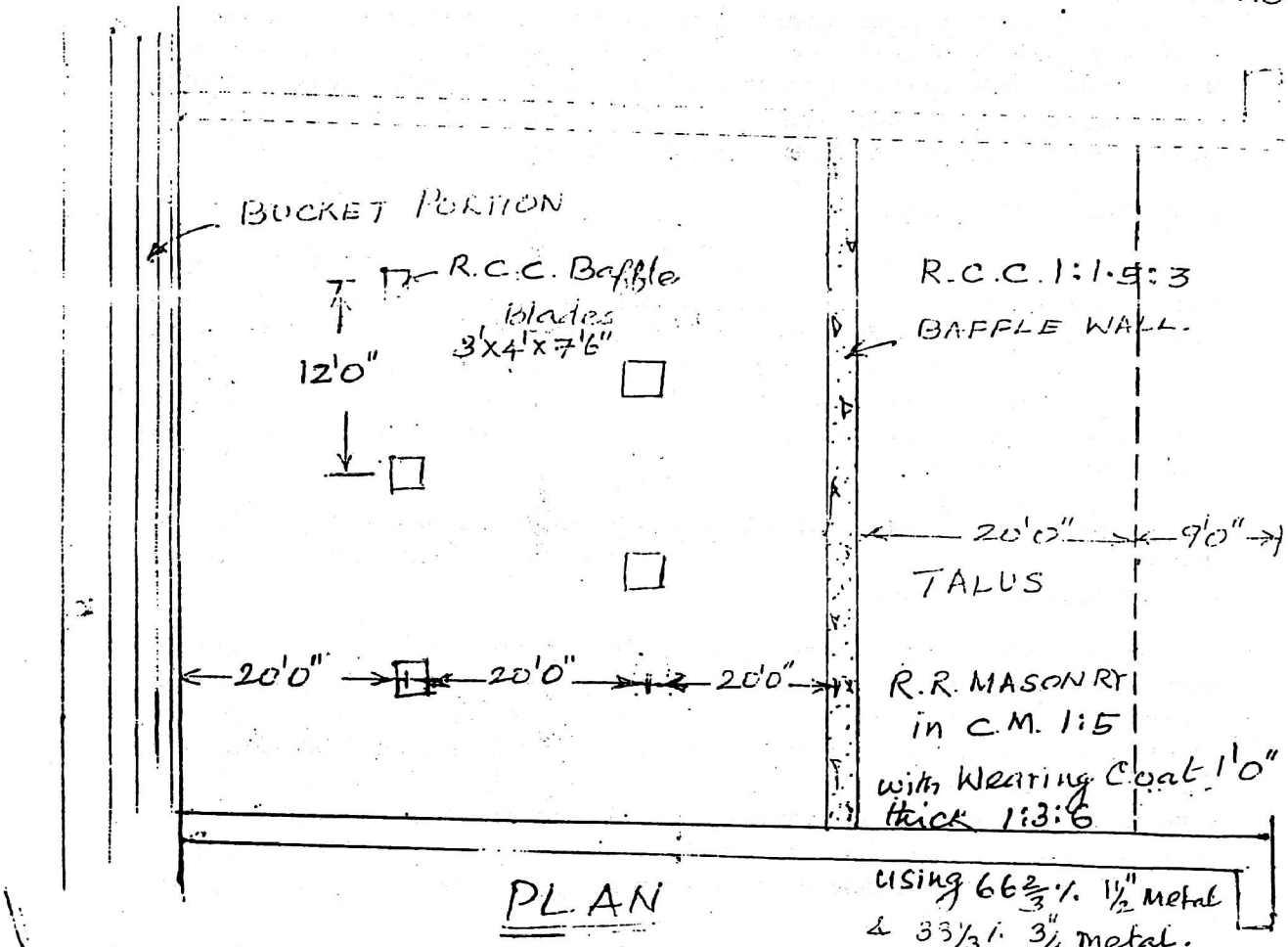
The size of the stilling basin is 110'-0"x60'-0". The foundation level of the stilling basin is +845.50. The foundation concrete is 1:4½8 using 1½" metal to an average thickness of 1'-0" and over which a wearing coat of 0'-6" thick with cement concrete 1:2:4 using ¾" metal is placed.

BAFFLE BLOCKS AND BAFFLE WALL

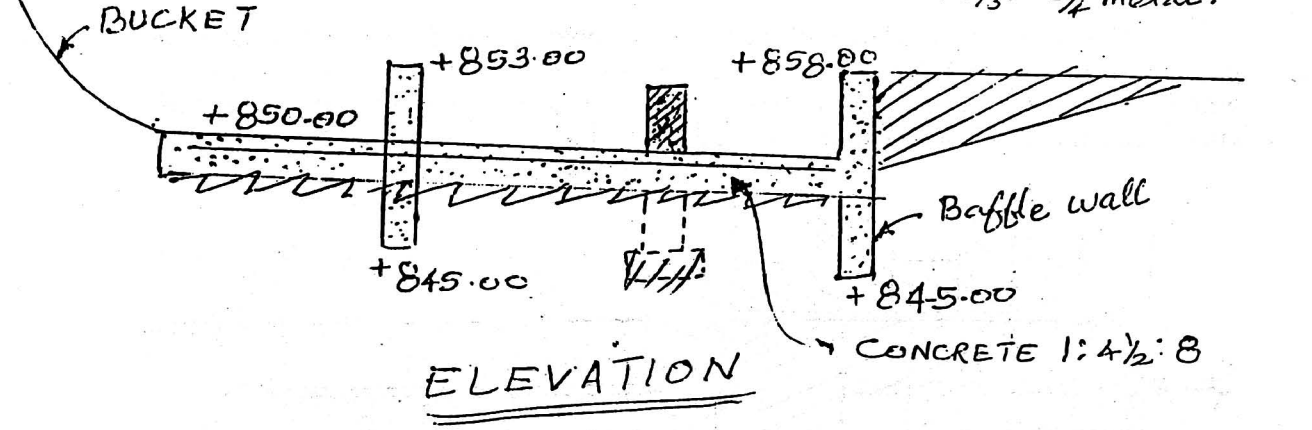
There are two rows of baffle blocks at an interval of 20'-0" c/c. The interval between the two blocks are 12'-0

". The size of the baffle blocks are 4'-x3'x7'-6" made up of R.C.C. 1:1½: 3 using ¾" metal. The foundation level of the baffle blocks are +845.50 and top level is 853.00. The two rows are positioned in zic zac manner. The baffle wall at the end of stilling basin is of size 110'-0"x3'-0"x12'6". casted in R.C.C. 1: 1½:3 using ¾" metal at a distance 60'-0" from the toe of the masonry dam. The foundation level is +845.50 and top level is +858.00.

ENERGY DECIPATION ARRANGEMENTS



PLAN



ELEVATION

DOWNSTREAM APRONS

Beyond baffle wall, a 29'-0" length apron is provided for smooth flow of flood. Most of the strata are hard rock beyond this point in the river bed, no eloborate arrangements are required for Talus portion. A width of 20'-0" from baffle wall is provided with Random rubble masonry in cm 1:5 with a wearing coat of 1'-0" thick in cement concrete 1:3:6 using 662/3%. 1 ½" metal and 33 1/3% of ¾" metal. The total length of the Talus apron is 29'- 0" to merge with the existing hard rock ground level in the river bed.

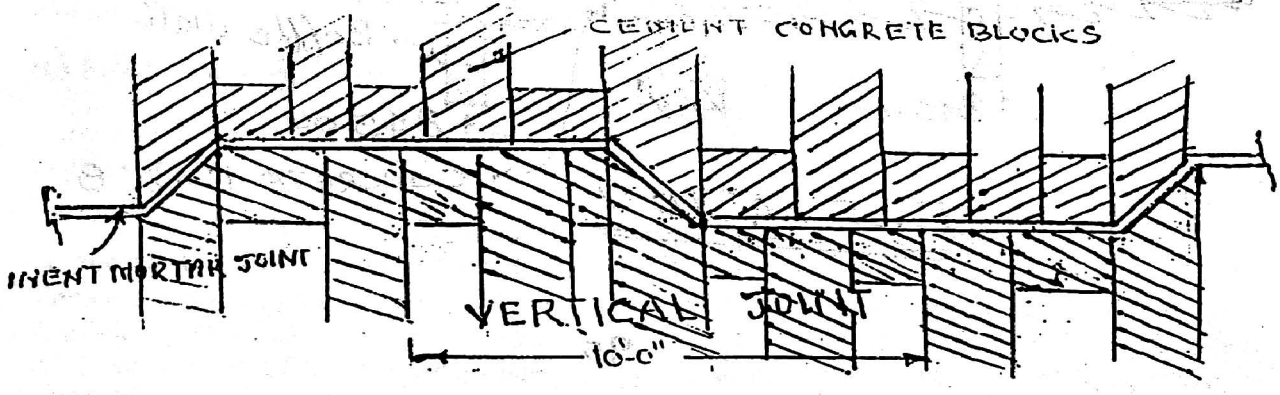
CONSTRUCTION JOINTS

The body wall 118'-0" is divided into 3 blocks with 2 nos. of constructions joints The central block is of 80'-0" length and other two blocks are of 19'-0" each. The central block stopped at level +867.00 to form the passage of flood water and other two blocks adjacent to abutments are raised up to crest level and then only the middle block was raised up crest level. The methods of providing templates in the construction of front face and filling with maxphalt in the construction joints etc. are all explained below and also in part I.

As per inspection notes of SE/PAP canals Lr. No.JE 3/2156/66 Dt. 10-6-676 the middle block is stopped for diversion of floods at level +867.00. The copy of inspection notes are appended in part I.

The built up masonries are susceptible of Temperature changes. It is subjected to temprature raise in summer season or cool down during winter season. this phenomenon of expansion and contraction leads to development of cracks in the masonry dam. So it is a custom to built masonry dam in blocks, ordinarily of 90'-0" in length. But there is not fixed rule on the length of the blocks. It varies according to the site conditions. In Uppar dam, the total length of the masonry is only 118'-0", and the bottom width of abutments on the both the flanks are 33'-0" each, the Uppar dam body wall is divided in to three blocks. The length of the middle block is 80-0" while the other two end blocks are 19'-0" each with 33'-0" width of abutments at bottom.

The blocks are built to butt with each other without any bond. The butting faces are provided with keys at 10'-0" intervals either with double line chisel dressed stones or with concrete blocks. Since chisel dressed masonry is a consulter one, the precast concrete block masonry is adopted in Uppar Dam.

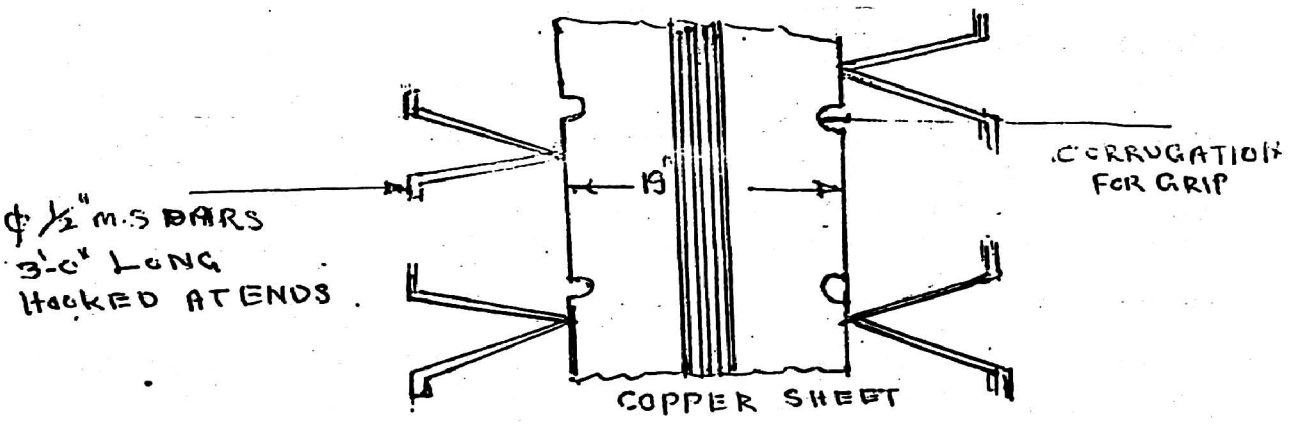


The keys are formed in the cross sections as shows in the the sketh with concrete blocks. Masonry will be allowed to progress only in alternate blocks leaving a gap of one block in between. After building 20 to 25 courses each course a day, the build block is being allowed for settlement for some days and left out block in between the built up masonry is taken up. The masonry built up is to be butt on the keys so as to form a vertical joint. The vertical joint is filled with lime cement mortar.

The idea in providing the contraction joints in the masonry dam is to allow cracks if any in predetermined and fixed place. The contraction may happen either due to out-side climate change or due to the descipation of the exothermic heat of hydration of cement used. Seepage of water through these joints are arrested by the provisions of 3/8" thick copper plate just 1'-6" near of the front face.

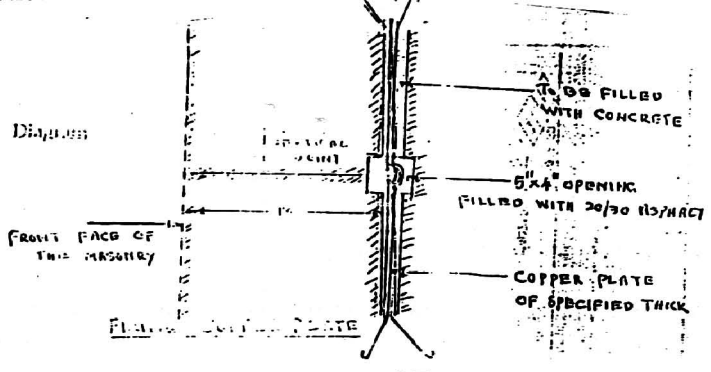
COPPERSEAL

Copper seal is a plate of specified thickness of 3'x 2" so as to be handled easily. This plate is bent with circular bulge of ¾" radius at the centre of the plate, to allow for the automatic adjustments of the copper strip when there is contraction or expansion between the adjacent blocks. The sketch below will give fair idea.



In order to get effective bond between the masonry and copper sheets, the end of the sheet snipped at 6" interval. In addition to this, anchorages are provided at 3'-0" height intervals, on both the sides of the copper plate by welding ½" dia. ms rods as shows in the sketch above.

The copper sheets are fixed in the masonry 18" inside the front face of the masonry as shown in the sketch below.



The copper sheet is first placed over 2" thick mortar. On half of the sheet clear of the budge was built in the masonry as the masonry progressed, the other half is being left free to be embeded in the adjacent block when it is built up. A 5"x6" rectangular groove is left in both the masonries as shown in the sketch. When one course of 1'-0" height is built up, the hole is cleaned and filled with 20/30 grade asphalt to give flexibility to the copper sheet during expansion and contraction. After allowing 24 hours after built one course, the joint is cleaned with pressure water and then filled with inert cement mortar. This process is continued upto 2'-0' top of crest level of masonry. an 8" dia. 12 gauge steel plate is weldged to the steel pipe and placed around the asphaltic groove. A 4' dia. G.I. pipe over this plate is welded with the other end threaded. In the 4" dia G.I. coupling 4" dia. counter sunk plug is fixed 1'-0" blow the top of masonry.

PIERS ABOVE CREST LEVEL OF MASONRY

Two nos of piers 26' x 10' dividing the spillway portion into 3 spans of 30'-0" each are commenced ogee portion at level +870.10 itself to accommodate deck bridge at +915.00 level. hoisting platform is provided at the level of +937.88 The masonry built for the piers upto this level is double line chisel dressed masonry in fly ash cement mortar 1:4. The top level of hoisting bridge is +938.88.

EMBEDED PARTS AND SILL BEAM GROOVES

The top of sill beam level in the ogee curve is +887.4312. Necessary grooves are left in the masonry to fix the sill beam with plain cement concrete 1: 1½:3. Similarly grooves on both the sides of central piers and in one side on the abutments are left to a width of 3'-0" and guide angles are fixed and concreted for each 3'-0" height. Fixing of sill beam, is described in the chapter erection of shutters.

ABUTMENTS

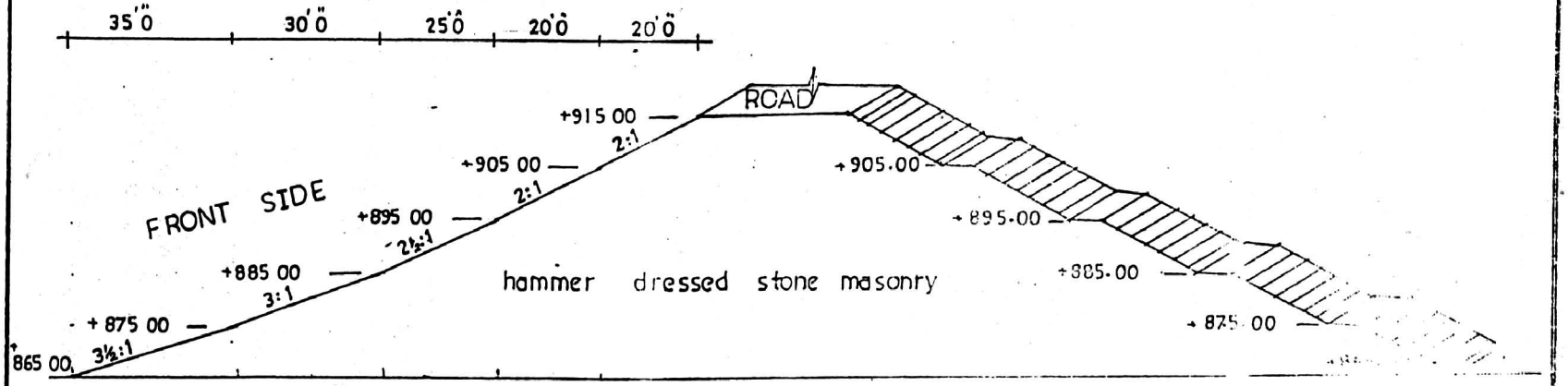
The average foundation of the abutements is +851.00. The front abutments are 1'-0" above the earth dam to retain the same. The bottom most levels is +865 and top level is +915.00. The top width of the abutment is 3'-0" wide and slopes are varied according to the earth dam slope as follows.

R.L.	Slope	Upto level
+865.00	3½:1	+875.00
+875.00	3:1	+885.00
+885.00	2½:1	+895.00
+895.00	2:1	+905.00
+905.00	2:1	+915.00

The down stream abutments are also furnished in the same pattern with uniform slope of 2:1 with landing at every 10'-0" height.

The inside exposed face is built hammer dressed stones to a thickness of 1'-6" above ground level to +915.00. In fly ash cement mortar 1:4 and pointed with cm 1:4. Similarly

DIAGRAM 14 (2)



SKETCH SHOWING THE FRONT AND REAR SLOPES OF ABUTMENT

the front face of the body wall is also built in hammer dressed stones to a thickness of 1'-6" with fly nash cement mortar 1:2 ¾ above +860 level upto nose of the crest.

DECK BRIDGE

The length of the deck bridge is 118'-0" to a width of 15'-0" clear to connect the earth dam flanks for inspection purposes and approach to utility towers. There are two nos of R.C.C. verb 1'-0"x1'-0". Deck bridge is of R.C.C. slab 0'-6" thick. Over two nos. of R.C.C. 1:2:4 Tee beams of size 1'-3"x3'-3" including the thickness of road slab 0'-6" thick. The Tee beams are placed over the abutments and piers on R.C.C. Bed blocks of 1'-0" thick. The arrangements of the deck bridge placement is shown in the part I, the design of deck bridge is evolved by the Pollachi Division PAP based on the Highways manual volume III p. 365.

UTILITY TOWERS

There are two nos. of utility towers on both the abutments immediately after deck bridge. They are of 6'-0" dia clear room construction in R.R. masonry in fly ash c.m. 1:5 to accommodate the steps to reach the Hoisting platform. The floor level of the utility tower is +915.00 and top of dome level is 950.00. the deck bridge landing is at the level of +939.88. The height of head room over deck bridge is 10'-0" in the utility tower. The overall arrangements and placements of various components of the masonry dam is shown the drawing enclosed as per the plan No.385 PWD/66 of Pongaloor Division, PAP Dt.23.9.66.

POINTING THE MASONRY

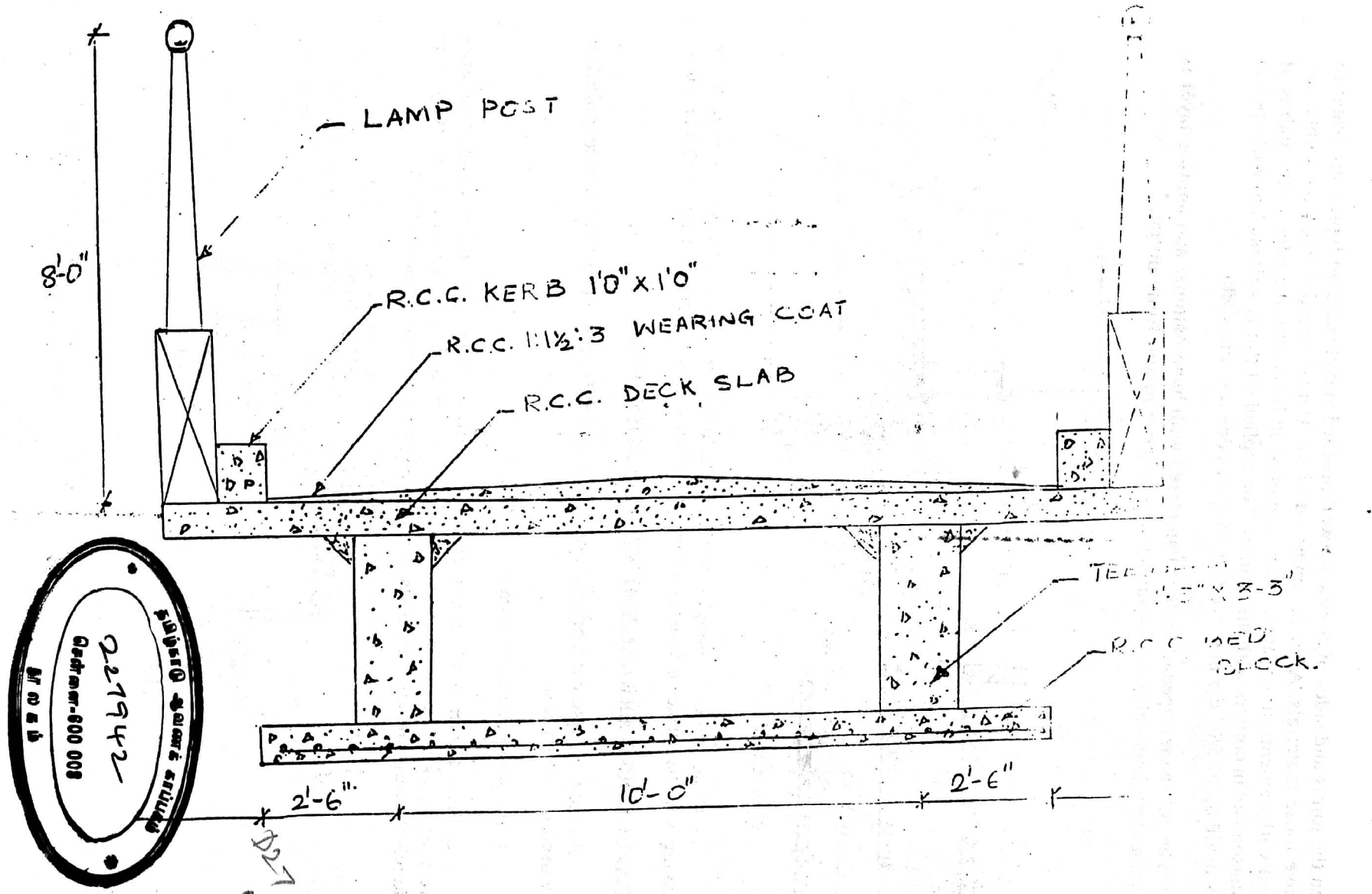
The front face of the body wall of surplus regulator above the ground level and two abutments face exposed to the water surface are pointed. Front faces of the masonry is pointed with cement mortar 1:2 to increase the impermeability of the face. The front face will always be subjected to water pressure due to storage of water. So the front face is to be made as water tight as possible so as to prevent the seepage of water through joints and consequent uplift pressure at bottom. apart from building the masonry of front face in rich cement mortar or fly ash cement mortar of 1:2¾, the pointing with cement mortar 1:2 is necessary to make the face water tight as much as possible. The experience gained in other dams of Tamilnadu built alreay were utilised in the process of pointing.

The front faces are built with hammer dressed stones with joints not exceeding to the thickness of ½' to 1".

METHOD OF POINTING

The mortar joints in the faces are racked out to a depth of 2 ½" to 3" and pointed with a special pointing mix. The special pointing mix is nothing but a mix with seized fine sand and cement and with water added being just the minimum required for hydration. The correct consistency is that which will give out a shining film of water at the surface, when rammed with special tools. Well graded sand and all passing through the seive of eight meshes per inch is only used.

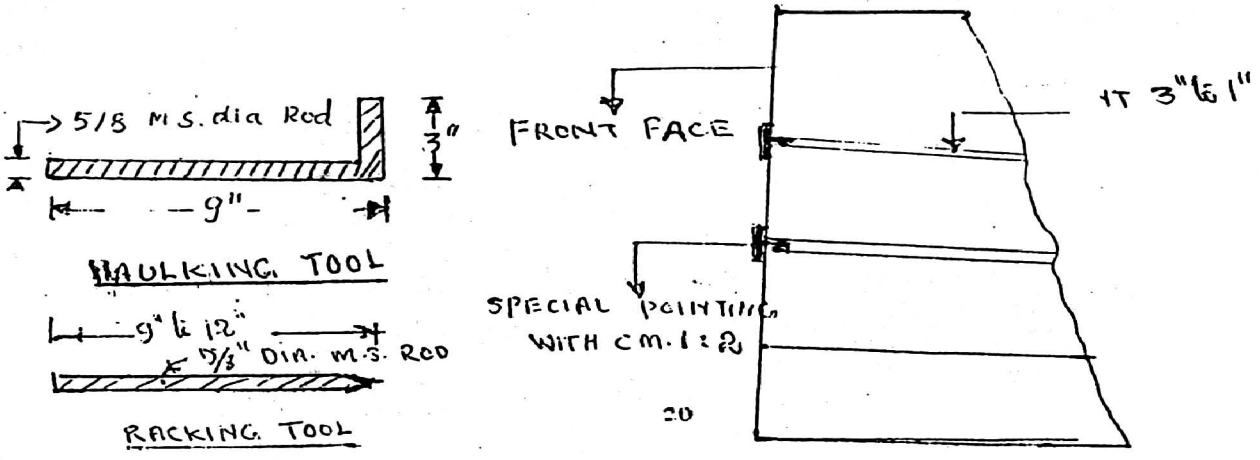
The joints were all racked out to a depth of 2 ½" to 3". The face of the stones 1" on all faces were also racked with chisel to have fresh surface to receive the pointing mortar.



DETAILS OF R.C.C. DECK BRIDGE

When the joints and sides of stones are well brushed and cleaned with pressure water to remove loose materials. After the approval of the Departmental officer, the joints are coated with cements slurry and mortar is applied in balls with the edge of the palms of the mason and in corners with the thumbs. The applied mortar is well packed with speical tools made up of 5/8" dia m.s. rod to L shape as down in the sketh.

The 'L' shaped special tools is hammered with hand hammer and another layer is placed and packed well so as to appear water squeezing out from mortar.



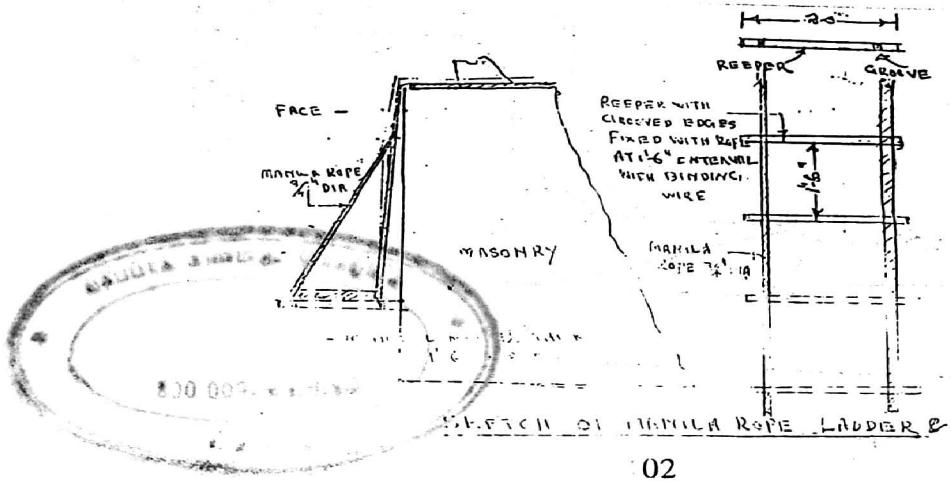
The stone surface covered with the mortar does not exceed 35% of the area. After packing well the surface is finished smooth with masons travel and over stone with brushes.

SCAFFOLDING ARRANGEMENTS FOR POINTING

As the dam upto deck bridge level is nearby 65'-0", the scoffolding for the pointing are used in two stages.

1. for going and downs the coir ladder

2. the platform 6'-0" length and 1'-6" width made up of wooden planks and coirs are used so as to enable to men to sit on the platform and do work conveniently. The sketch showing the arrangements of platform coir ladder or shown below.



CHAPTER IV

SHUTTER ERECTION

In all irrigation reservoirs, it is quite essential to provide sufficient surplus arrangements to let off flood waters anticipated during monsoon periods. In such surplus arrangements it is necessary to install gates of adequate dimensions over the crest of the spillway and these gates are to be operated by suitable hoisting arrangements. There are two types of spillway gates namely, vertical lift gates and radial gates. Radial gates are found to be economical where larger vent sizes are required in the reservoirs for high floods. The radial gates are nowadays popular than vertial gates and economical in cost also.

For Uppar dam having storage capacity of 16.31 million cumecs, it was decided to provided the spillway at the river course to discharge 25,000 cusecs at MWL conditions at +908.00. Three numbers of vertical lift gates of vent size 30'-0"x18'-0". (9.14m x 5.49m) each have been installed. Two piers and two abutments have been constructed over the masonry spillway portion to accomodate the above mentioned sizes of the three numbers of gates. The front portion of the abutments and piers have been raised to sufficient height to accomodate steel deck bridges on which hoisting equipments are installed to operate the gates as and when necessity arises.

GROOVE FRAMES

Sill beam consisting of RS Joists builded with mild steel flats and machined has been embeded on the crest of the spillway. The gate rests on this sill beam. Roller tracks consisting of Rs.joists with mild steel flats and machined have been provided on the down stream side of the groove. Sealing angles are installed on the upstream covers of the groove to take stanchion pipes for side sealing. Sill beam, roller tracks and sealing angles are connected with cross channel frames at convenient intergals to keep the groove frames in position. all these members are embeded in the masonry structure during the process of construction.

Necessary sufficient grooves with extra space are allowed in the masonry for the fixation of sill beam as well as side vertical grooves. Operating wooden plate forms are made with centering materials since the front portion of the spillway is a curved one. Separate platforms at sill level is provided for each vent. During erection of shutters these platforms were utilised as working space for the erection of shutters and a space for the men who are engaged in the process of erection of shutters. The pre assembled sill beam is placed in position with reference to the sill of the masonry dam in the ogee portion. Then the grooves are concreted with plain cement concrete 1:1½: 3 using hard broken ¾" metal. Similarly the side grooves to an approximate height of about 3'-0" are assembled and verticality checked. Then the 3'-0" height frame is embeded in the same concrete as per the sill beam. This process is continued by 3'-0" by 3'-0" in succession with assembling of groove frames.

HOISTING BRIDGES

The hoisting bridges are fabricated out two longitudinal RS joists spanning between the piers with sufficient bearing on either end. The ends of the RS joists are pro-

vided with base plates and the two girders are fixed on the piers with the suitable foundation bolts. The longitudinal girders are connected with sufficient members of cross girders and channels by means bolts and nuts. The top of the deck bridge is covered with M.S. chequered plates to facilitate easy movements over the bridge. Thus the hoisting bridges are ready to receive the hoisting equipments. Necessary drawings are enclosed for reference.

GATES

The spillway lift gate consists of 12 mm thick M.S. plates in front and supported by suitable truss frames made out of M.S. channels. These trusses are connected with vertical and cross bracing angles to keep the trusses in position.

Two sets of roller box frames out RS joists are provided on either ends of the gates and cast iron rollers are fixed in these roller boxes to facilitate smooth operation of the gates. The gates are fabricated in the Aliyar workshop in several parts, holes drilled, to receive the rivets and match marked for easy identification at the time of assembling of the shutters at site. The fabricated gates are dismantled in different pieces and transported to the Uppar dam site.

HOSITING EQUIPMENTS

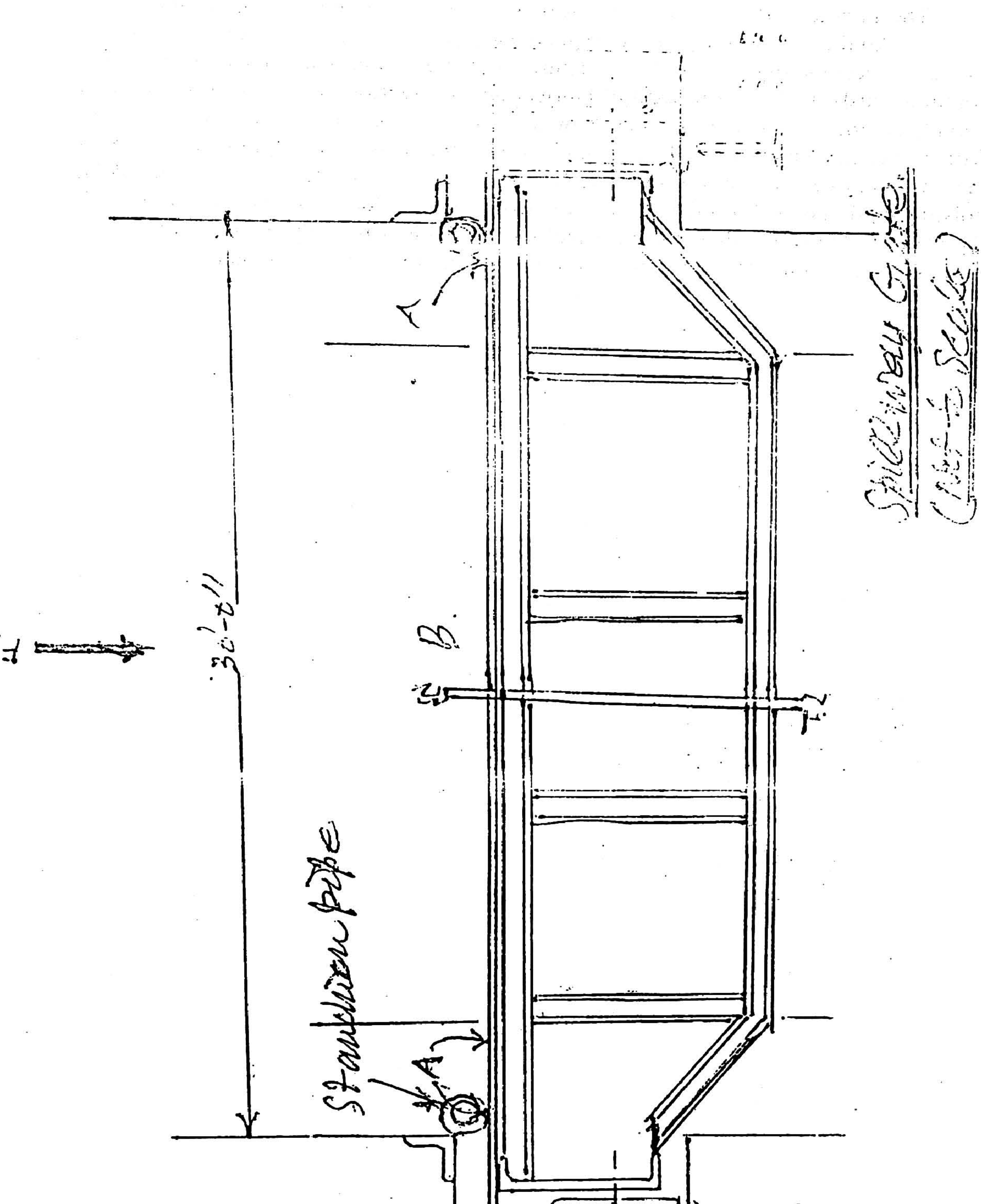
In order to lift and lower the lift gates placed over the crest of spillway, hoisting equipments consisting of spur gears and pinions fitted on the drive shafts which are again connected to sufficient reduction gears and radicon box and coupled to electric motor. To reduce the effort required to lift the gate under water pressure, RCC counter weight beam is provided in the rear of the gates. The gate and the counter weight beam are connected with two link chians on either end of the gates. The gates get operated by the hoisting equipments driven by electric motor as well as generated power from the generator. In case of emergency, an axillary drive gear is provided and the gate can be operated manually with handles. The necessary drawing are enclosed for reference.

FABRICATION AND ERECTION

The hoisting bridges, spillway gates and the hoisting equipments have been designed by PWD workshop, Madras. Manufacture of groove frames and hoisting equipments have been done at PWD workshop, Madras and the fabrication of gates and hoisting bridges have been done at the central workshop, Aliyar.

Entire erection works of all these equipments has been carried out by a dedicated team of skilled and unskilled staffs from the Aliyar workshop. It will not be out of place to mention that fabrication and erection works were monitored with PERT chart and with the active coordination of engineers at the dam site.

The roller boxes and the portion of gates mentioned 'A' in the sketch were positioned over the spillway with the bolts and nuts. After checking about the corrections of the dimensions, the end pieces were pneumatically reverted to ensure water tightness. The joints of the skin plates were welded and painted. These two end portions were moved inside the grooves and kept suspended with suitable pulley blocks fitted in the hoisting bridges.


FLOW
30'-8"
Stanchion pipe
A
B
Spillway Gate
(Not to Scale)

The middle portions of the gate was then assembled and skin plates mounted in position. All the parts of the gates were pneumatically riveted and the joints were welded. The gates become one monolithic structure. As the erection works have been taken up simultaneously, the whole process of fabrication and erection of shutters at site could be completed with in six months time. Now the gates are connected to the counter widths with suspension end chains and kept in position from the hoisting equipments. Approximate weight of each gate was 18 tonnes and they can now be operated by the motorised hoisting equipments. Thus the gates were made ready for fool proof operation to receive the water in the reservoir for storage and the reservoir was ready to store water in the same year and facilitated to throw open for the irrigation of the command.

CHAPTER V

CONCLUSION

The Uppar masonry dam is a surplus regulator provided for the discharging the flood flows during rainy seasons. It is constructed at the river bed where sound rock strata are expected. The overall length of the masonry surplus regulator is only 180'-0" There is not foundation problem such as weak zones or large size of cleavages. There is no problem in grouting the foundation also. The overall depth of excavation of foundation was only about 15'-0" from ground level. The excavation of foundation was done at a time for abutments, regulators and stilling basin. The excavation of foundation was started in November 1964 and completed in the year 1968. Thus the Uppar masonry dams is small wier with surplus arrangements and built with great care and enthusiasm by the PWD Engineers.

HISTORY OF UPPAR DAM

PART IV

PREAMBLE

Uppar is a dam constructed across Uppar Odai near Poolavadi on the junction of the streams namely Uppar Odai and Senjerikarai Odai. Its latitude and longitude are 10° - 47' - N and 77° - 25' - 20" E. It is located at 7/2 m (11.4 km) of Dharapuram Poolavadi road.

NECESSITY OF THE DAM

The Parambikulam Aliyar project is a multi purpose irrigation as well as power project. Diverting the west flowing rivers in Kerala state to Eastern direction and bringing to this eastern slope of Palani hills and storing water in Aliyar dam and at Thirumoorthy dam by an unique adventurous contour canal of 50 km length locating in the middle height of hill slopes crossing valleys, drainages including tunnels.

In the project report of P.A.P. it is mentioned to utilise the local drains along with the harnessing of P>A>P> seepage water during irrigation seasons. The Parambikulam main canal taking off at Thirumoorthy dam runs more than 100 kms and along its travel there are lot of drainages which are receiving rain water to a considerable extend. Few such odais crossing the Parambikulam main canal are

1. Uppar Odai
2. Senjerikarai Odai
3. Nelalikarai Odai

These are the major drains which have got substantial catchment area in various taluks. Based on the aim of utilising all such drainages for irrigation purposes there were proposals to have small dams across these drains at various locations and detailed investigations were carried out and finalised to have only one Dam with a capacity of 432 mcft. at the junction of Uppar Odai and Senjerikarai Odai.

Preliminary investigations were carried out as early as in 1962 and a separate Division was formed at Palladam to execute the Prambikulam Aliyar project canals in 1962. This division mainly concentrated on the finalisation of the project of the Uppar dam. Among the various proposals at various sites, the present one was finalised near Lakkambody village, which had submerged in the water spread.

The project was sanctioned for 50.00 lakhs in G.O.No.2977 PWD/dt.17.11.64 Coimbatore district (PAP)

PERIOD OF COMPLETION

The actual execution of works were commenced in 11/64 and practically completed by the end of 1969 including shutter erections and formation of road on the top of dam. Since the maximum storage capacity is above the crest level +888.00 and stored with the

aid of the shutters only. The dam was ready to receive the storage for irrigation from 1970 onwards. From the records available, the irrigation seasons had first commenced only during 1971-72. The period of irrigation is from 07.10.71 to 31.03.72 and the records show that the first irrigation season itself had yielded 63.29% of development of ayacut.

There were no irrigation for the following years.

(1974 - 75) , (1983 - 84), (1985 - 86), (1986 - 87), (1988 - 98), (1991 - 92)

Out of 22 years from 1971 - 72 to 1992 - 93, there are six failure years as shown above. This is mainly due to monsoon failure and deficiency in the expectations of seepage water from P.A.P. main canal ayacuts. The shortage in the expected seepage quantity is mainly due to intermittent irrigation seasons of ayacuts around Uppar dam. The entire ayacut of Parambikulam main canal and Udumalpet canal comes under three zones. Under turn system the above ayacuts get water only once in 18 months period. That too now transformed in to 4 zone pattern and water will be released only once in 24 months to these areas. So the question of availability of seepage water from Parambikulam main canal ayacut is absolutely non reliable and the irrigation under Uppar dam mainly depended on the monsoon rain flow from its own catchment. Due to failure of monsoon the above mentioned years were failure one. Considering all the difficulties, Superintending Engineer, Pollachi circle formulated a proposal during the year 1992 to spare at least 300 mcft. from the PAP sources and Government has accepted the same and ordered to supply at least 300 mfct. from PAP sources every year.

ECONOMY OF THE PROJECT

Parambikulam Aliyar project is one example for the economic execution of projects. Ten dams including Uppar dam and Uthamapalayam dam and net work of irrigation system over many hundreds of kms length of canals have costed only 80 crores. The total period of execution is only 10 years from 1959 to 1969. The approximate cost of the Uppar dam is only 80.00 lakhs. Due to consideration of economy, there was no function of Inaguration of the dam in a large scale and first throwing open of irrigation in 1971 - 72 was done with a simple function with District Collector and Superintending Engineer PAP canals circle. The main feature of economy and quick completion of project is due to able guidance and quick decision of the eminent Engineers of higher ranks in the process of execution of work.

The Government sanction for Uppar dam was given in 11/64 and the execution of project started in full swing in the same month. The excavation of foundation for masonry dam and cut off trench excavated for earth dam on both the flanks were commenced simultaneously in 11/64 itself. Completion of staff quarters were within six months. Hence great economy is maintained in the execution of the project.

APPRECIATION TO THE ENGINEERS

Some of the eminent engineers of those days who had involved in the execution of projects are worth mentioning at this juncture. The Chief Engineer Thiru U. Anantha Rao is the Chief Architect in the whole process of execution of PAP. The eminent Superintending Engineer fully involved in those projects were Thiru Muthukrishnan, Thiru Lakshmi Narashimmaiya, Thiru V.S. Ramaswamy and others.

The Executive Engineers involved in Uppar dam execution are Thiru Mohana Krishnan, Thiru P. Kuppusamy, Thiru Mallikarjunan and others. Thiru Mohana Krishnan has contributed a lot for the proper execution of the Uppar Dam by his instructure inspection notes every month guiding the engineers in proper way. In fact his inspection notes have helped a lot in writing the History of the Uppar dam. This aspect is described then the there in the part I of this history writing. Thiru P. Kuppuswamy, Executive Engineer had contributed a lot in the completion stage. Thiru Mallikarjunan, Executive Engineer of Udumalpet division has acted promptly during the historical flood of 19.07.1979 and he is the sole cause for the safety of the dam during that crucial period. The Assistant Executive Engineers who had involved fully in the completion of Uppar dam project were Mr. Samana Pillai, Mr. K.V. Padmanabha Rao and Mr. Rajalingam. They had keen interest in completing the project in time with great care for economy. Thiru K.V. Padmanabha Rao had shaped the project in the end and he was the man responsible for the raising of coconut tope and orchards in the vacant site and now a days if fetches a considerable income to the Department every year.

CHAPTER II

REHABILITATION

There are two categories come under this heading.

1. Evacuation of inhabitants in the submersible area.

2. Paying compensation to the lands occupied for the cause of the project including barrow areas.

EVACUATION OF INHABITANTS

As already discussed in Part I the total area of requirement for the entire project was assessed at 1120 acres both patta and puramboke lands. A small village by name Lakkambody located just 1 km west of the proposed dam line was the only one village susceptable of submersion. there were about 45 families living in the village. Necessary assesments of individuals were made carefully and compensation proposed as per revenue rules. All formalities by the special Deputy Collector Land acquisition PAP had been observed including 4 (a) notification. Villagers were also informed properly then and there about the situation and they were mentally prepared to vacate their holdings after getting the due compensation. Even after receiving payment of compensation, they were continuing to occupy the dewellings. On 29.06.1966, there was heavy rain and flood discharge was about 6380 c/s and level raised upto +888.50. The lowest submersible portion in the Lakkambody village was +892.00. The villagers were continously alarmed to vacate the dewellings and as a warning a watchman 24 hours duty were engaged to warn the villagers about floor condition. Danger mark level were demarcated around the village and the villagers were made understand the danger of flood. On 27.09.66, during the inspection of Executive Engineer, the Asst. Exe. Engineer was permitted to give free conveyance upto Dharapuram in order to vacate the village. However with some difficulty the entire village was vacated during the month of 10/66. This is the only village where people and live stocks were to be safeguard against the flood danger. Apart from this, there were two No. of temples 1. Kanniamman koil, 2. Mahaliamman koil for the villagers as common property. Three cents of land for each temple below the dam in the acquired portion were allotted and the villagers had built up the temples and are celebrating the festival every year in a grand manner till date.

LAND COMPENSATION

As already mentioned the total acquisition of land was about 1116 or 1120 acres (932 acres patta and 184 acres puramboke) for the entire project at dam site including camp colony, water spread and barrow area. Necessary proposals for land acquisition were sorted out through the Special Deputy Collector, PAP. Pollachi and lands were taken possession by obtaining consent statement from the land owners under the condition that due compensation will be paid at the existing Government rate including interest from the date of taking possession of the land by the PWD.

Most of the land owners have co-operated very well and left their lands peacefully to enable the department to proceed with the execution of the project. There were few stray cases in the barrow area necessiating the explanation of the Superintending Engineer in person to allow the lands to borrow the earth. However there is no delay in the execution of the project due to land acquisition. The total cost of the land acquisition as per the revised estimate is Rs.19,09,199/- (Ninteen lakhs, nine thousand and one hundred ninety nine).

CHAPTER III

ECOLOGY

Being a small storage, there is no scope of vivid ecological change around the storage reservoir. However there is a dead storage of about 44 mcft. left unutilised below the sill level of canal sluices. This perennial water stagnation has invited various kinds of cranes (kokku and narai) during the off season in thousands migrating from elsewhere and continued to live up to the next storage year. Observations from the zero point of earth dam in left flank, the view of birds coming and going will be a grand one for Ecologists.

FISH POND

Fisheries department has developed a large scale fish ponds. Annual turn over is said to be nearing 15.00 lakhs. The catches are disposed off locally at the spot and any balance are disposed off at Palghat city, Kerala. Thus it is a substantial income to the Government by the way of fish culture.

DEVELOPMENT OF ORCHARADS AND COCONUT TREES

As already mentioned in the Part I there are about 1420 trees including 1300 coconut trees. Their annual revenue is more than 2 lakhs. This has developed a magnificent view to the dam occupying the downstream in the right flank vacant site adjacent to the camp colony.

CHAPTER IV

OPERATION AND MAINTENANCE

Being a small dam, operation and maintenance have not posed any problems so far. The dam is maintained properly as per the norms and all the structure are intact upto date.

STAFF PATTERN

Maintenance come under the control of an Executive Engineer who has got many other jurisdiction apart from this. Similarly an Assistant Executive Engineer who will be incharge of this dam with head quarters at Pollachi, Dharapuram or Udumalpet. There is only one section at dam site looking after the maintenance of the dam who is the sole person to look after the bads and goods of the dam.

Under one Junior Engineer or Assistant Engineer, there are about 10 numbers of luskers including shutter operator, pump operator, generator operator etc. The maintenance gang of shutter operator are regularly looking after the cleaning of shutters, oiling and greasing according to the specifications. Details of shutter maintenance such as painting, oiling and greasing tabulated in dam at utility towers. Ofcourse the canal maintenance are also looked after by the separate luskers.

To have watch over the luskers' work there were Work Inspectors experienced during the construction period. The dam work after completion was maintained by several Divisions in various periods. Initially the maintenance was under the control of the Executive Engineer, Pollachi Division. Then it was transferred to the control of PAP Division, Udumalpet. After some years, it was handed over to the Regular Division, Erode which is out side PAP. Now it is transferred to W.R.C.P. Division just started functioning at Kangeyam.

CHAPTER V

DAM SAFETY ORGANISATION AND ITS FUNCTIONS

In PWD, Dam Safety cell under one Superintending Engineer at Madras is functioning as early as from 1990 with necessary staffs. Under World Bank aid, Irrigation basins are formed and PWD is divided into two wings.

1. Water Resources and Consolidation Project Maintenance
2. Buildings and its maintenance

World Bank Aid is sought for all the irrigation projects under WRCP schemes. Various regions of irrigation basins are formed under the control of 4 Regional Chief Engineers

1. Regional Chief Engineer, Madras.
2. Regional Chief Engineer, Trichy.
3. Regional Chief Engineer, Madurai.
4. Regional Chief Engineer, Pollachi.

Over all control is under the control of Engineer-in-Chief. As per the reform of WRCP scheme, Uppar dam comes under the control of Engineers as follows:

CHIEF ENGINEER

Regional Chief Engineer, Pollachi.

SUPERINTENDING ENGINEER

WRCP Circle at Udumalpet

EXECUTIVE ENGINEER

WRCP Division at Karur.

ASSISTANT EXECUTIVE ENGINEER

Two sub divisions are formed recently at dam site to look after the rehabilitation works of dam as well as lining works of canals.

ASSISTANT ENGINEER

Each sub division has got 4 sections looking after various works in dam as well as canal.

WRCP WORKS

There are about 7 dams initially taken up under WRCP works in the State. One among them is Uppar dam.

VERTICAL CRACK IN THE EARTH DAM

The earth dam both the flanks adjacent to the masonry dam abutments have developed vertical cracks at the junction of semi pervious zone and impervious zone.

Expert committees have studied in detail about the cracks in the earth dam and the abnormal floods during 11/79 to the tune of 68000 c/s. This has necessiated a deep study and included in WRCP works, under World Bank aid. There are proposals for providing a fuse plug arrangements at `O' - L.S. of earth dam left flank and four more additional vents of the same size with shutter provision of radial gates. The estimated cost of the dam rehabilitation is 15.00 crores.

CHAPTER VI

ENVIRONMENTAL CHANGES

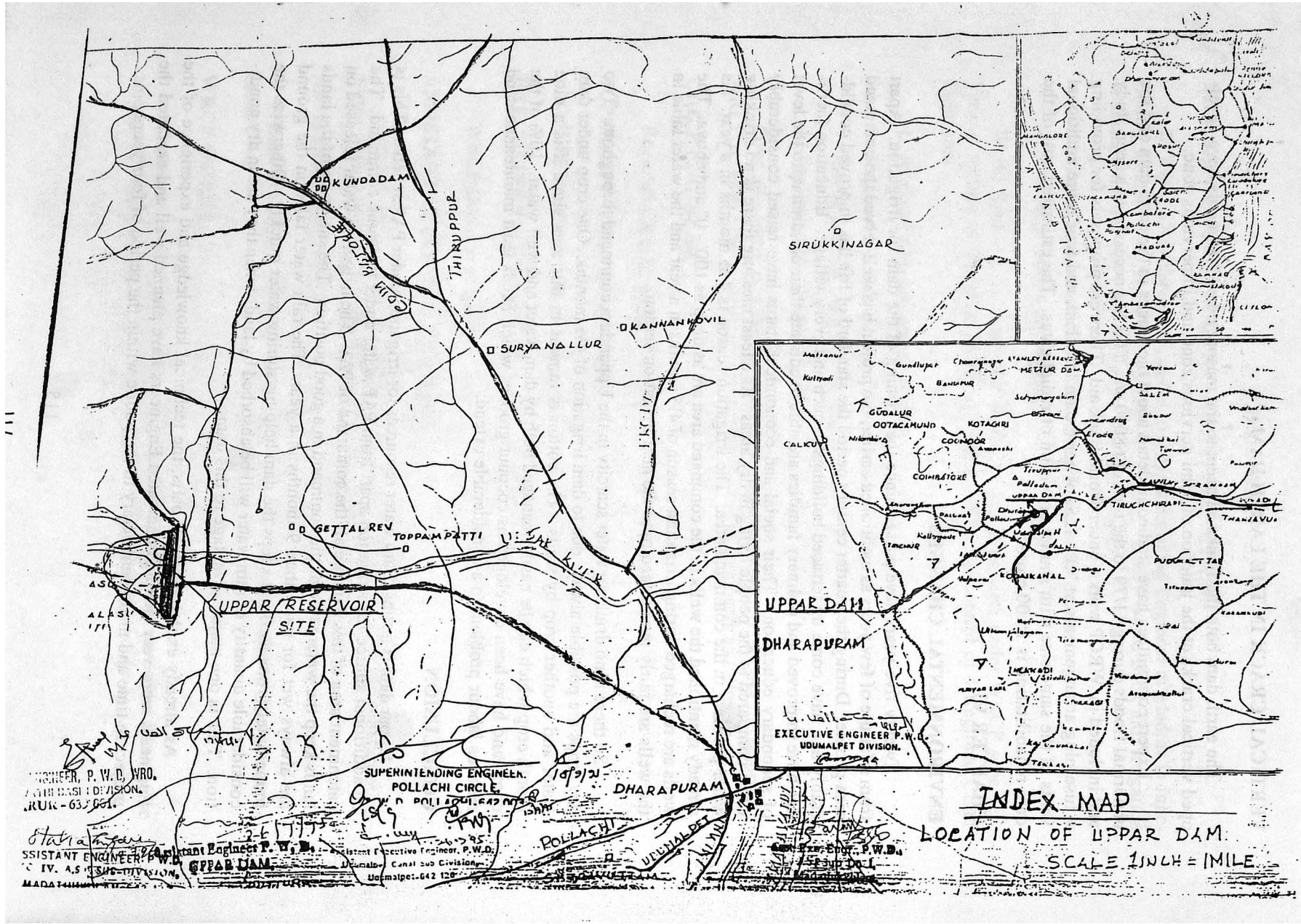
Twenty five years have passed since the opening of the dam for irrigation. Apart from a failure of few years as mentioned earlier, the project has well served the command area people. During the quarter century period the standard of life has improved considerably and have come up terraced buildings in each and every village. Education facilities have improved and ordinary families are able to educate their children upto the level of secondary education. Their social and economical status have raised considerably when compared to the people living in dry areas. As a least measure there is no drinking water problem in the command area. The irrigation season is 4 ½ months in a year. As already mentioned the wells in the command area are as deep as 100' - 0" and above. The wells are recharged during irrigation season of 4½ months in a year and the water table in the wells are fairly maintained upto the next irrigation season.

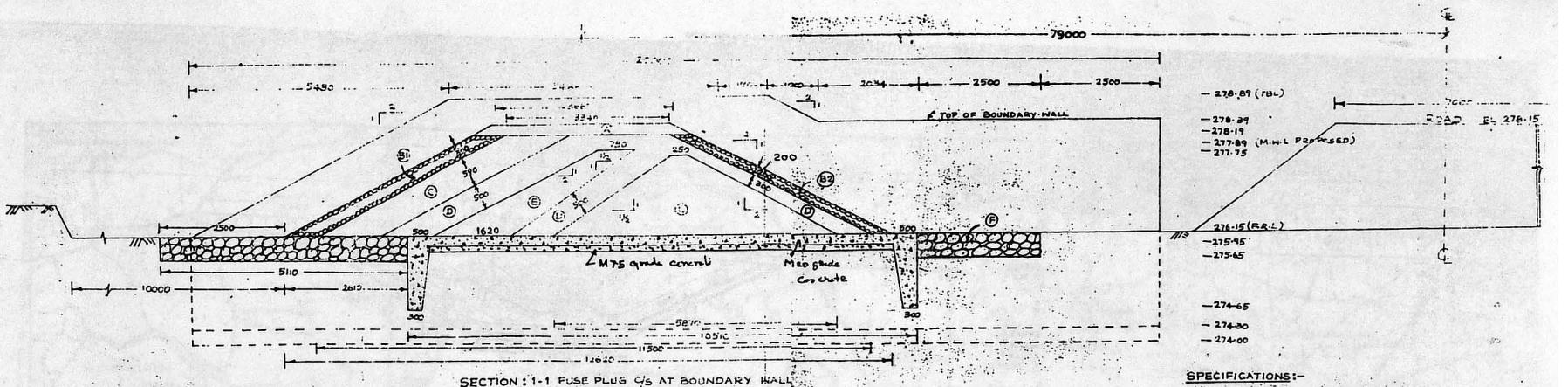
So there is no drinking water scarcity in the Uppar dam command throughout. Two dry crops are possible always due to dam irrigation of 4½ months. One crop under dam water and another crop by wells. The cotton is famous in this area since it is a nine month crop which can be easily managed both by dam water and well water. 10% of the command have been developed as coconut grooves which needs least maintenance and reduces labour problem to a considerable extend.

CONCLUSION

Uppar dam is a subsidiary water resources for irrigation under PAP scheme. This is an additional source for irrigation apart from PAP water under the same command. The catchment area of this dam are all the command of PAP. The irrigation water released on lands keep the water table of the command in a good position. The sub strata of the lands are always wet for more than 9 months in a year. The rain water falls on the ground immediately runs as flood keeps the dam helping storing water quickly. Otherwise the considerable quantity of rain water will be absorbed by lands when they are in dry condition. This is one major advantage to this dam.

As already explained in all parts, the technical knowledge and experience of the Engineers were very rich and dedicated Engineers have planned well and executed the project in time and made beneficiary to the public within the period of four years.

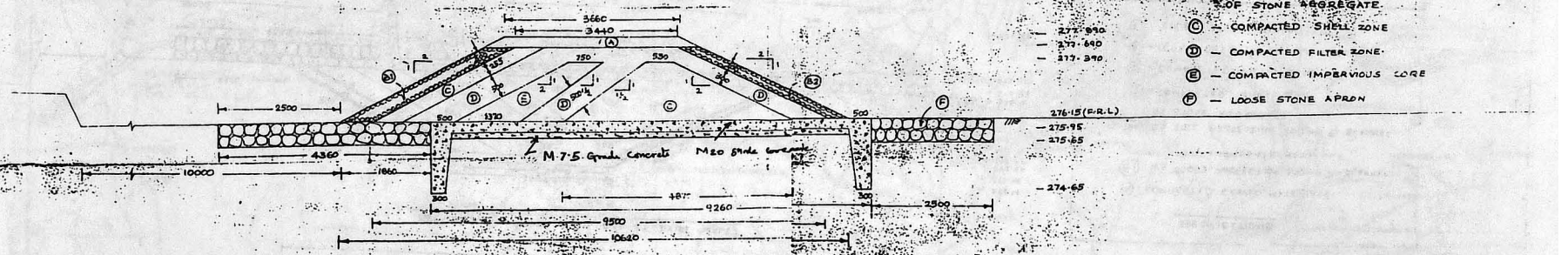

KUNDADAM
THIRUPPUR
SIRUKKINAGAR
KANNANKOVIL
SURYANALLUR
GETTALREV
TOPPAMPATTI
UPPAR RESERVOIR SITE
DHARAPURAM
POLLACHI
UDUMALPET
UPPAR DAM
DHARAPURAM
EXECUTIVE ENGINEER P.W.D.
UDUMALPET DIVISION.
SUPERINTENDING ENGINEER.
POLLACHI CIRCLE.
Assistant Engineer P. W. D.
UPPAR DAM.
Assistant Executive Engineer, P.W.D.
Udumalpet Canal Sub Division.
Udumalpet-642 126.
Sub Div.
INDEX MAP
LOCATION OF UPPAR DAM.
SCALE 1 INCH = 1 MILE.



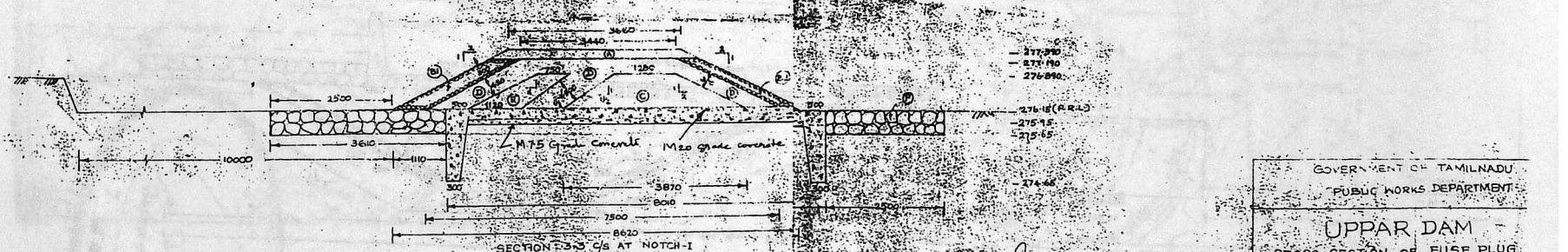
SECTION : 1-1 FUSE PLUG C/S AT BOUNDARY WALL

SPECIFICATIONS:-

- (A) — COMPACTED GRAVEL MATERIAL
- (B1) — U/S SLOPE PROTECTION 300MM TK BLANKET OF STONE AGGREGATE 40MM SIZE
- (B2) — D/S SLOPE PROTECTION 200MM TK BLANKET OF STONE AGGREGATE
- (C) — COMPACTED SHELL ZONE
- (D) — COMPACTED FILTER ZONE
- (E) — COMPACTED IMPERVIOUS CORE
- (F) — LOOSE STONE APRON



SECTION : 2-2 C/S BETWEEN BOUNDARY WALL AND NOTCH-I



SECTION : 3-3 C/S AT NOTCH-I

GOVERNMENT OF TAMILNADU
PUBLIC WORKS DEPARTMENT

UPPAR DAM

CROSS SECTION OF FUSE PLUG

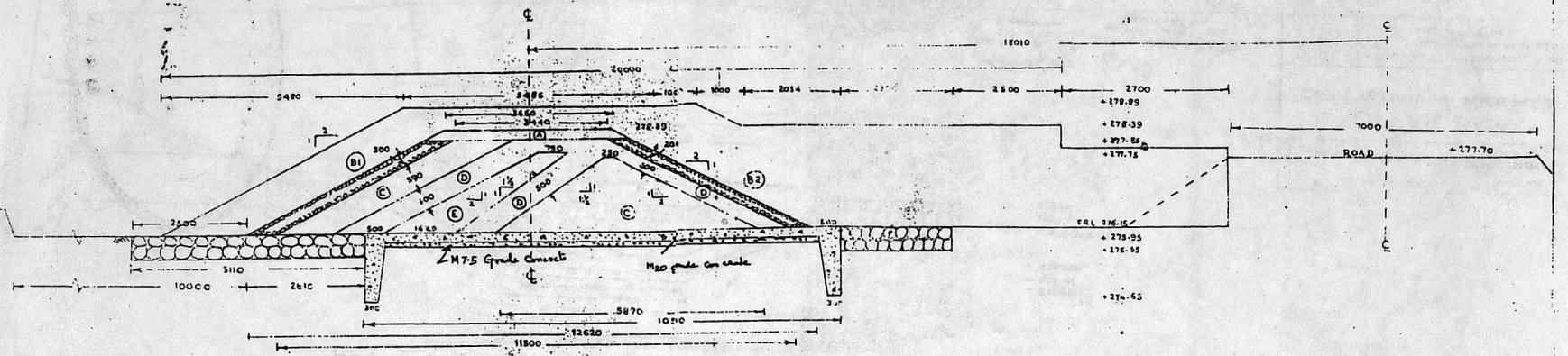
SCALE 1-50

NOTE: ALL DIMENSIONS ARE IN MILLIMETRES AND LEVELS ARE IN METRES.

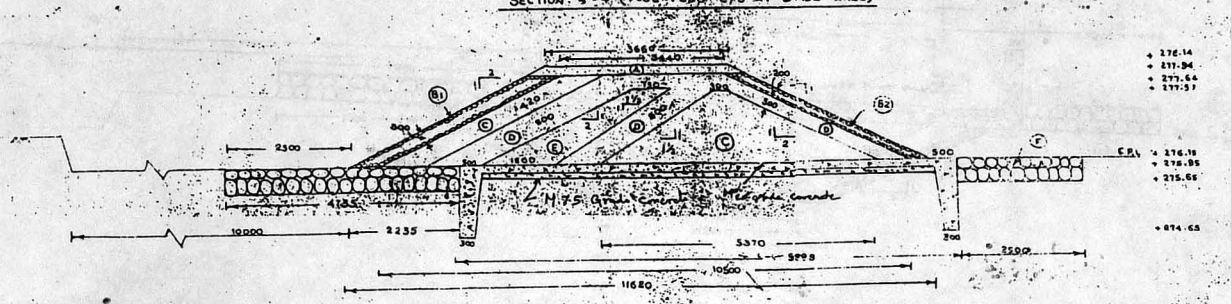
Asst. Exe. Engr., P.W.D.
A.S.P. Sub Dn. I,
Madamukkulam

EXECUTIVE ENGINEER, P.W.D. WRO.
AMARAVATHI BASIN DIVISION,
KARUR - 639 001.

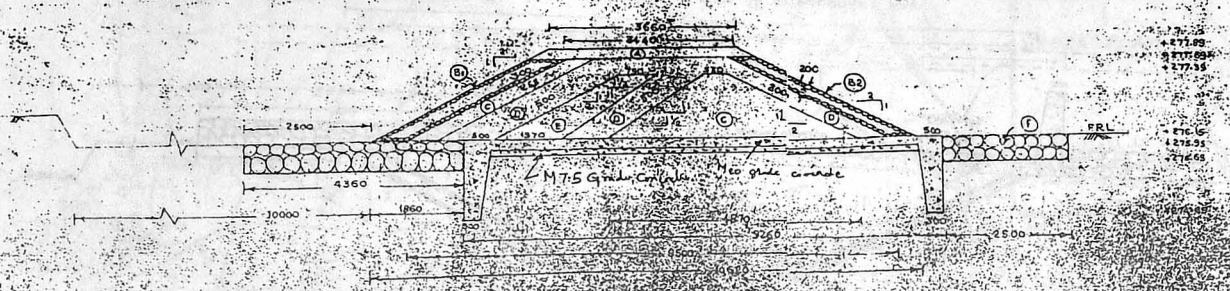
ASSISTANT ENGINEER, P.W.D.
A.S.P. SUB DIVISION
ADUTHUKULAM-642 113



SECTION: 4 - 4 (FUSE PLUG C/S AT DVIDE WALL)



SECTION: 5 - 5 (C/S BETWEEN DVIDE WALL AND NOTCH II)



SECTION: 6 - 6 (C/S AT NOTCH II)

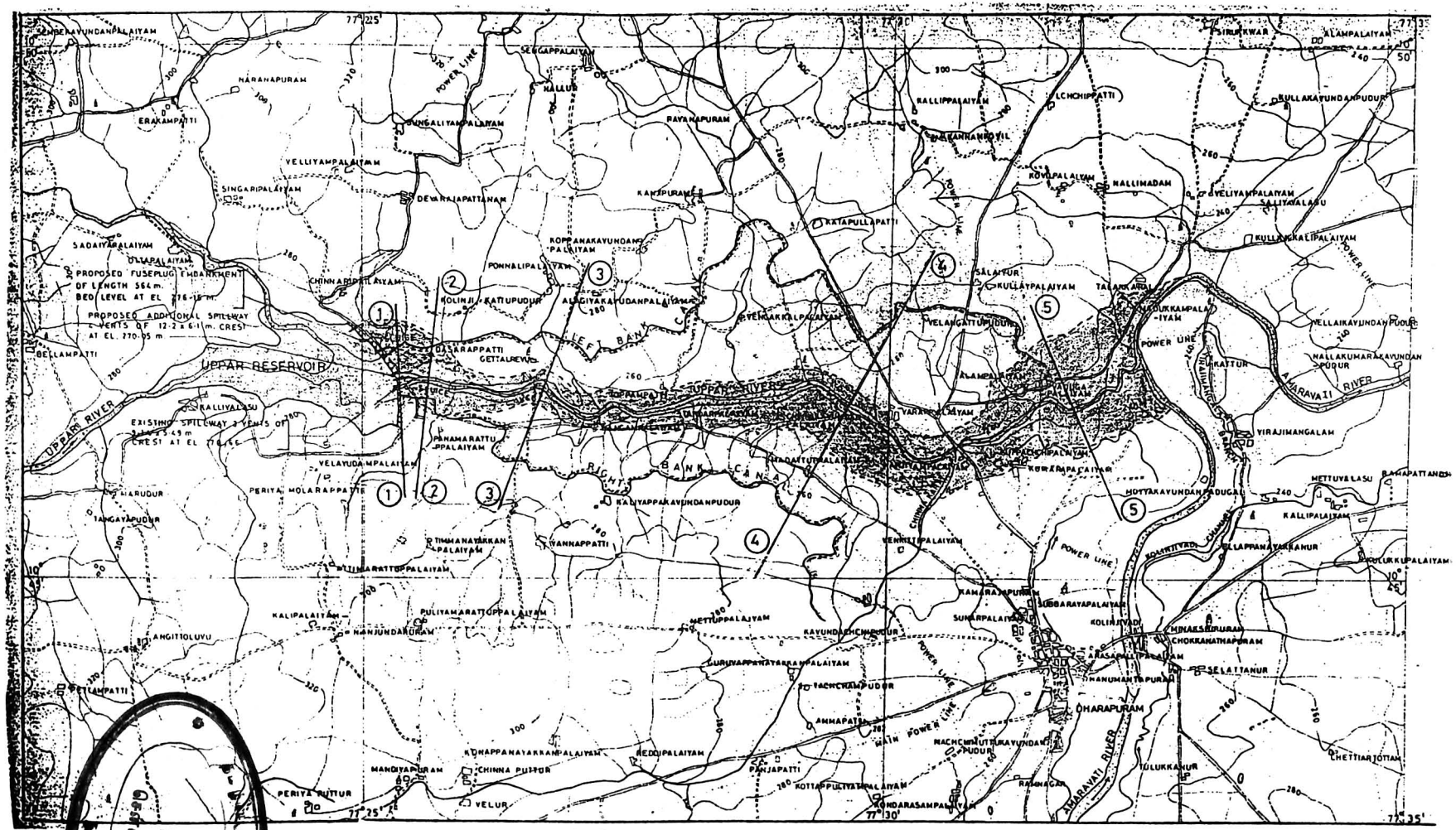
SPECIFICATIONS

- (A) - COMPACTED GRAVEL MATERIAL.
- (B1) - U/S SLOPE PROTECTION 300MM Th BLANKET OF STONE AGGREGATE 40MM SIZE
- (B2) - D/S SIDE PROTECTION 200 MM Th BLANKET OF STONE AGGREGATE.
- (C) - COMPACTED SHELL ZONE
- (D) - COMPACTED FILTER ZONE
- (E) - COMPACTED IMPERVIOUS CORE
- (F) - LOOSE STONE APRON

ALL DIMENSIONS ARE IN 'MM' AND LEVELS ARE IN 'M'.

GOVERNMENT OF TAMILNADU
PUBLIC WORKS DEPARTMENT
PROVIDING FUSE PLUG EMBANKMENT AT LEFT SIDE OF PAPANASAM PERIYAR DISTRICT
CROSS SECTION FOR FUSE PLUG
SCALE 1:50

ASSISTANT ENGINEER, P.W.D.


PROPOSED FUSEPLUG EMBANKMENT OF LENGTH 564 m. BED LEVEL AT EL 276·15 m
PROPOSED ADDITIONAL SPILLWAY 2 VENTS OF 12·2 x 6·1 m. CREST AT EL. 270·05 m
UPPAR RESERVOIR
EXISTING SPILLWAY 9 VENTS OF 15·24 x 5·49 m CREST AT EL 270·05 m
LEFT BANK CANAL
RIGHT BANK CANAL
UPPAR RIVER
AMARAVATI RIVER
POWER LINE
SEMBAKAYUNDANPALAIYAM
NARANAPURAM
ERAKAMPATTI
SEGGAPPALAIYAM
NALLUR
RAYANAPURAM
KALLIPPALAIYAM
LCHCHIPPATTI
SULLAKAYUNDANPUDUR
VELLIYAMPALAIYAM
SINGARIPALAIYAM
DEVARAJAPATTANAM
KANJPURAM
ROYALPALAIYAM
NALLIMADAM
SADAIYANPALAIYAM
ULLAPALAIYAM
PONNALIPALAIYAM
KOLINJI-KATTUPUDUR
ALAGIYARAYUDANPALAIYAM
KATAPULLAPATTI
SALAIYUR
KULLAYPALAIYAM
VELANGATTUPUDUR
VELLAIKAYUNDANPUDUR
NALLAKUMARAKAYUNDANPUDUR
KATTUR
VIRAJIMANGALAM
BELLAMPATTI
KALLIYALASU
VELAYUDAMPALAIYAM
PERIYA MOLARAPPATTI
KALIYAPPAKAVUNDANPUDUR
THANNAPPATTI
VENNITTALAIYAM
METTUVALASU
KALLIPALAIYAM
KAMARAJAPURAM
SUBBARAYAPALAIYAM
SUNARPALAIYAM
KOLINJIVADI
SELATTANUR
KALIPALAIYAM
ANGITTOLUVU
NANJUNDAPURAM
METTUPPALAIYAM
KAYUNDANCHIPUDUR
PUTHUR
ANNAPATTI
KONAPPANAYAKKANPALAIYAM
REDDIPALAIYAM
MANDIYAPURAM
CHINNA PUTTUR
PERIYA PUTTUR
VELUR
PANJAPATTI
KOTTAPPULIYAMPALAIYAM
KONDARASAMPALAIYAM
RAMNAGAR
THETTIARJOTTAM
77°25'
77°30'
77°35'
10°50'
10°45'