HIS MAJESTY'S GOVERNMENT OF NEPAL
MINISTRY OF WATER RESOURCES
DEPARTMENT OF IRRIGATION, HYDROLOGY AND METEOROLOGY
KANKAI DEVELOPMENT BOARD

KANKAI DIVERSION STRUCTURE REMEDIAL WORKS PROJECT

COMPLETION REPORT

AUGUST 1985

NIPPON KOEI CO., LTD.
CONSULTING ENGINEERS
TOKYO, JAPAN

PREFACE

This report is prepared under APPENDIX-A, 3D.2 of the Contract for Engineering Services for Kankai Diversion Structure Remedial Works Project (the Project) made between the Department of Irrigation, Hydrology and Meteorology HMGN and Nippon Koei Co., Ltd., dated 8 April, 1984.

This report contains descriptions in the completed features and works' details for the construction of the stilling basin and associated works which have been commenced from the beginning of March 1984 and then completed by the middle of July 1985.

The objective of the Project, which is located at the eastern end of the Terai plain in Nepal, is to prevent the possible failure of the Diversion Weir of the Kankai Irrigation Project resulting from its undermining during a high flood.

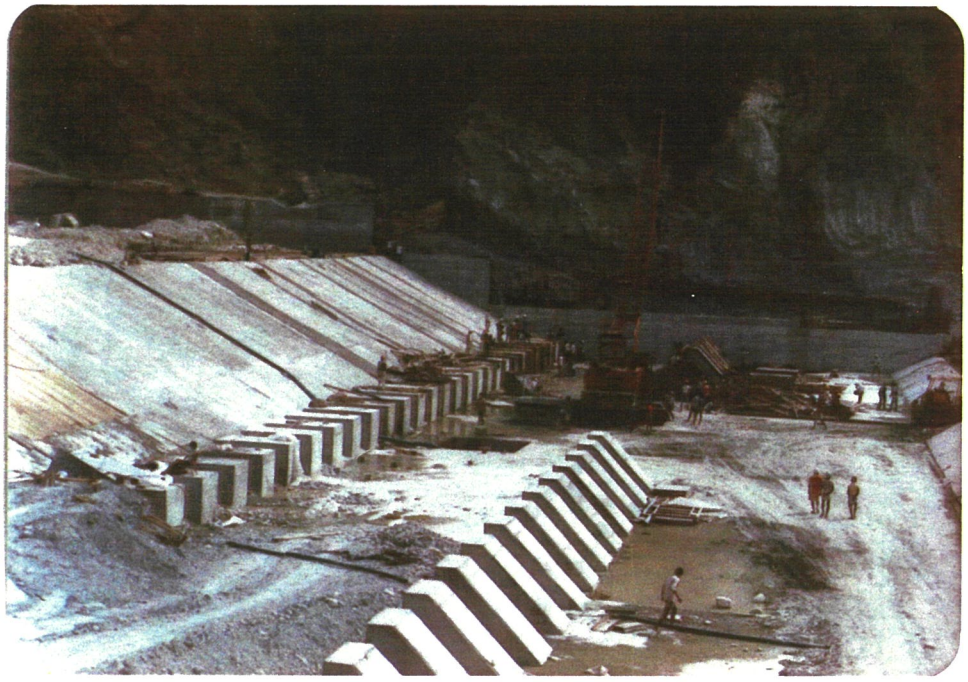
The realization of the Project has been supported by the finance from Asian Development Bank for the civil works, procurement of sheet piles and vehicles and consulting services as well as by the government own finance.

The stilling basin constructed in the Project started its function for controlling hydraulic energy of floods flowing over the diversion weir from the beginning of the rainy season of 1985. The successful completion of the Project on time was a result of harmonic cooperation among the Executing Agency, the Consultant and the Contractor as well as an encouragement of Asian Development Bank extended to the parties concerned.

The nature of the Project was a structural work done at the place deeply below the river bed with controlling sub-soil water and was to be implemented within a short period. It is therefore hoped that this report will be useful as a reference for the implementation of similar works in the future.

Finally it is noted that this report doesn't give a final feature regarding the project cost because the whole payment including price increase for the specified construction materials payable to the Contractor was not concluded yet. The following part of this report are tentatively given here as the conditions up to 30 June 1985 and the revised ones will be presented when those be finalized accordingly.

Section 1.4 Financial Arrangement and Project Cost
Chapter VIII CONSTRUCTION COST AND PAYMENT



PARTIES CONCERNED

EXECUTING AGENCY	HIS MAJESTY'S GOVERNMENT OF NEPAL MINISTRY OF WATER RESOURCES DEPARTMENT OF IRRIGATION, HYDROLOGY AND METEOROLOGY
FINANCE SOURCE OF FOREIGN COMPONENT	ASIAN DEVELOPMENT BANK
ENGINEERING CONSULTANTS	NIPPON KOEI CO., LTD., JAPAN
CIVIL WORK CONTRACTOR	KOREA DEVELOPMENT CORPORATION, KOREA
SUPPLIERS	
STEEL SHEET PILES	KANEMATSU GOSHO LTD., JAPAN
VEHICLES	UNITED TRADERS SYNDICATE (P) LTD., NEPAL

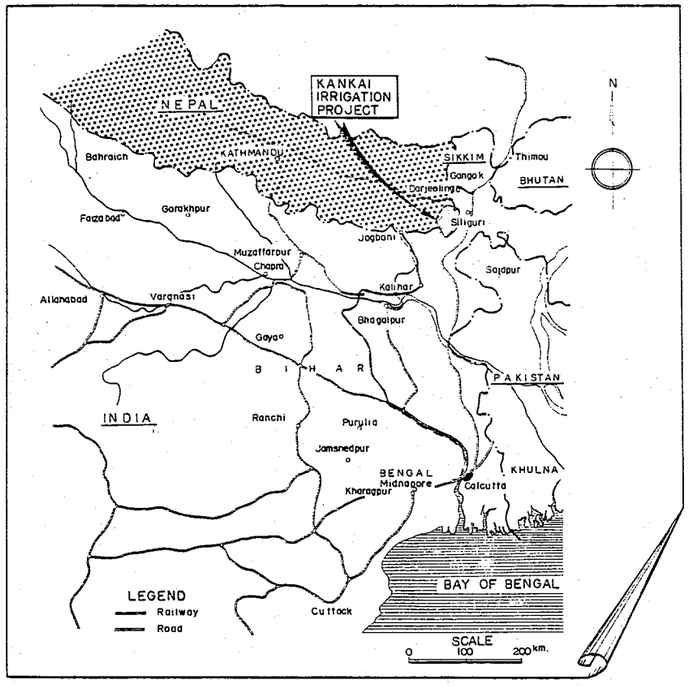
PROJECT COST

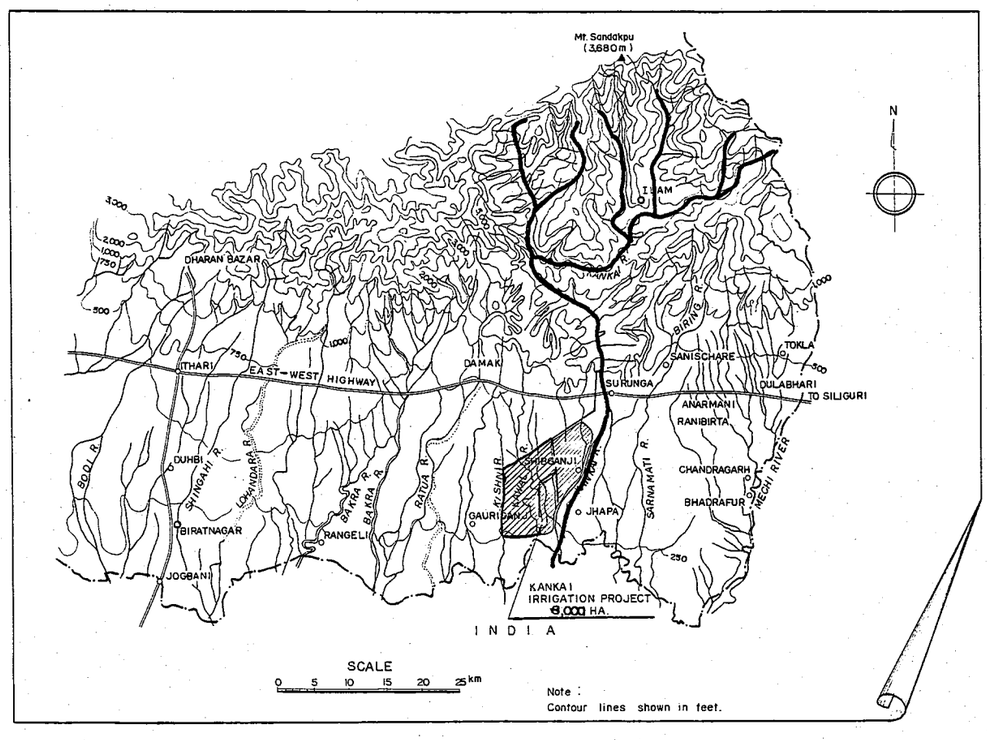
(AS OF 30 JUNE 1985)

TOTAL Rs. 49,904,000

FC : Rs. 36,103,000 (US$2,364,640 equiv.)

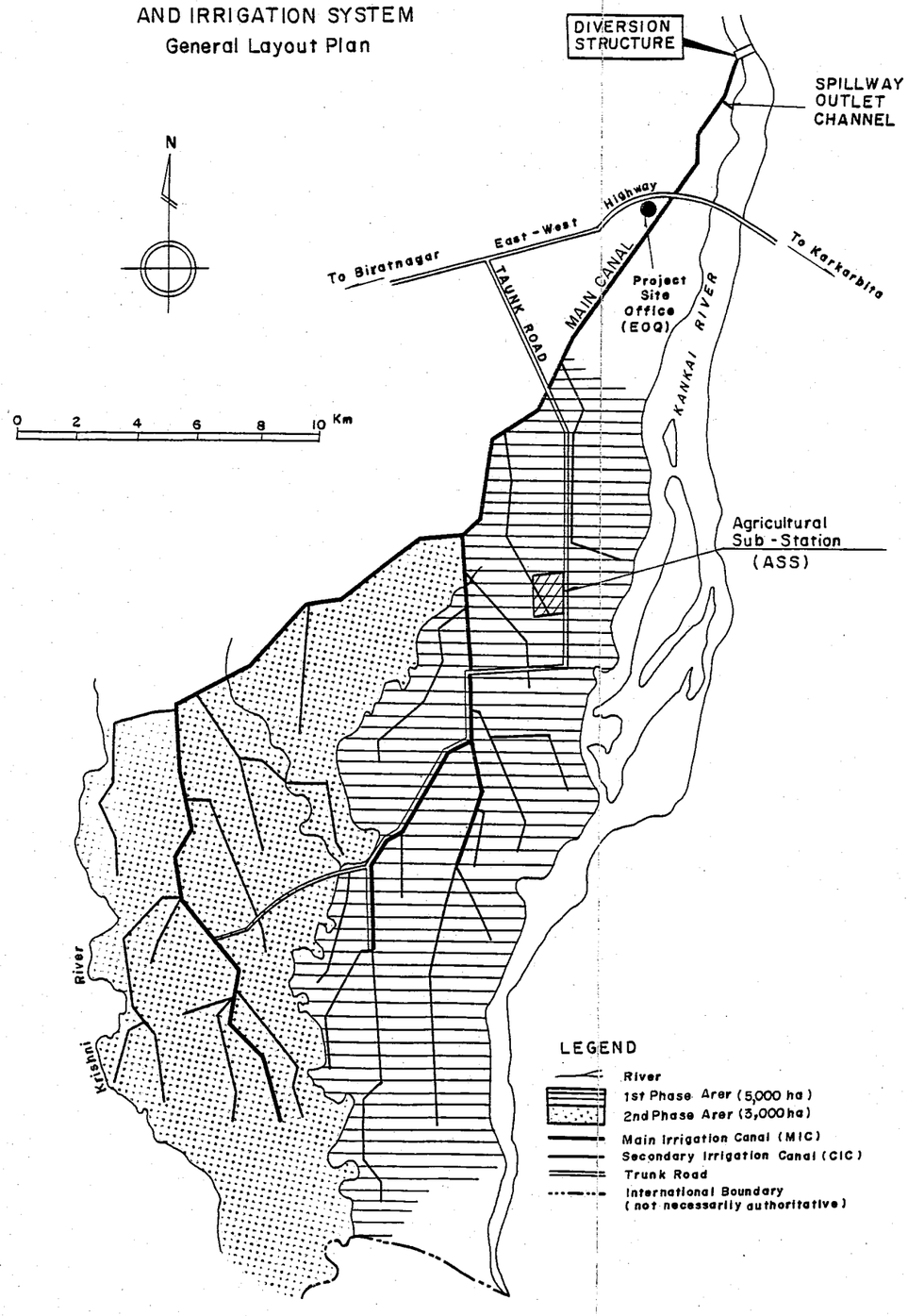
LC : RS. 13,801,000



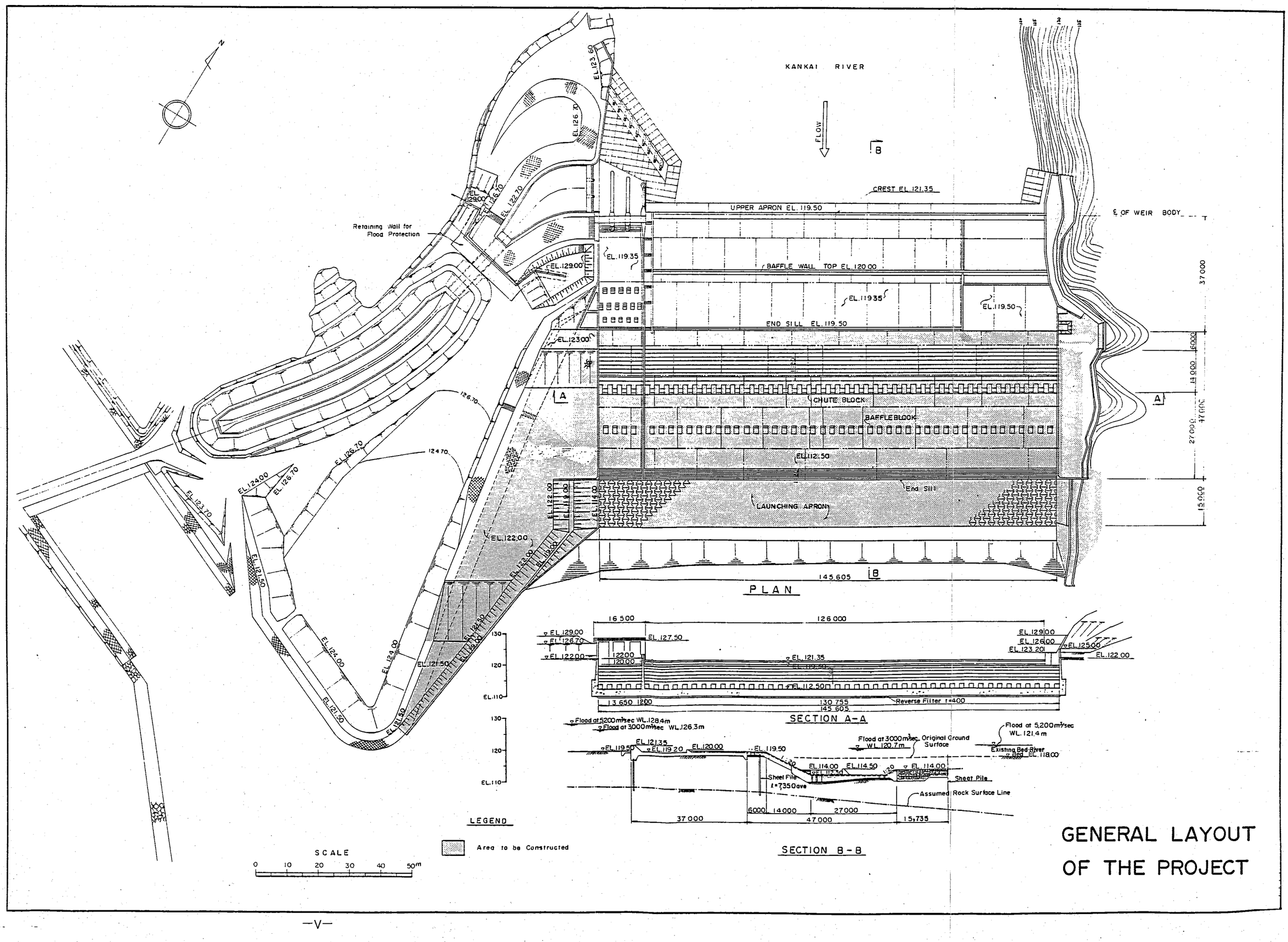


KANKAI DIVERSION STRUCTURE AND IRRIGATION SYSTEM

General Layout Plan



LOCATION MAP



GENERAL LAYOUT OF THE PROJECT

ABBREVIATIONS

Organization and Others

HMGN	:	His Majesty's Government of Nepal
ADB	:	Asian Development Bank
MWR	:	Ministry of Water Resources
DIHM	:	Department of Irrigation Hydrology and Meteorology
KDB	:	Kankai Development Board
KIP	:	Kankai Irrigation Project
The Project	:	Kankai Diversion Structure Remedial Works Project
NK	:	Nippon Koei Co., Ltd., Consultant
KDC	:	Korea Development Corporation, Civil Contractor
EOQ	:	Engineer's Quarters and Offices, KIP's Colony
ASS	:	Agricultural Sub-Station, KIP
USBR	:	United States Bureau of Reclamation
SFRC	:	Steel Fiber Reinforced Concrete

MEASUREMENT

mm	:	millimeter
cm	:	centimeter
m	:	meter
km	:	kilometer
sq.m	:	square centimeter
ha	:	hectare
sq.km	:	square kilometer
l	:	liter
cu.m	:	cubic meter
kg	:	kilogram
mt	:	metric ton
cumsec	:	cubic meter per second
l/s	:	liter per second
%	:	percent
pc or pcs	:	piece or pieces
El.	:	elevation in meter above mean sea level
nos	:	numbers
kw	:	kilowatt
kwh	:	kilowatt hour
Rs	:	Nepalese Rupees
SDR	:	Special Drawing Rights, IMF
US$	:	US dollar

KANKAI DIVERSION STRUCTURE REMEDIAL WORKS PROJECT COMPLETION REPORT

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I. SUMMARY

1.1 Background and Purpose of Project

The KIP aims at an irrigated agricultural development covering a net area of 8,000 ha situated at the eastern edge of the Terai Plain. With a financial aid of ADB provided from 1971, the KIP comprized a diversion weir with an intake on the Kankai river, an irrigation and drainage system for 5,000 ha and an agricultural research substation completed by 1978 and a subsequent extension of the KIP irrigation and drainage facilities for an additional 3,000 ha being constructed.

The diversion weir, completed in 1977, consists of an ogee-type weir with a length of 126 m and a height of 1.85 m, and three scouring sluice gates with a total width of 13.5 m. At the downstream of the weir, a concrete apron with a length of 33.65 m and concrete blocks with a total length of 28 m were constructed for energy dissipation and river bed protection.

Since completion of the diversion weir, river bed at the downstrream of the launching apron has been lowered and many blocks of the apron have been sinking into the river bed. Subsequently, scour in the river bed has been accelerated and the river bed has been lowered by about 2 m from the original bed. After this damage, additional supply of concrete blocks under repair work and less of blocks by floods have been repeated.

A review mission from ADB visited the KIP in March 1983 and investigated the conditions of the diversion weir. The mission raised an alarm for a possible failure of the diversion weir resulting from its undermining during high flood and strongly urged to take a certain remedial step immediately

Through further investigation and study intensively made by DIHM, ADB and its staff consultant and NK, the construction of deeply depressed stilling basin at the immediate downstream of the existing weir apron including other associated works was proposed as the Kankai Diversion Structural Remedial Works Project. Meanwhile it was concluded to make a loan for the Project from ADB to HMGN at the middle of December 1983.

1.2 Project

1.2.1 Location and Topography

The KIP having an irrigable area of 8,000 ha in net, located in Jhapa District in the Terai plain of the Eastern Region of Nepal, stretches south of the East-West Highway to the Indian border. Both the east and west ends of the KIP area are bordered by the Krishini River and the Kankai River respectively. The area is generally flat and descending from the north to the south with an approximate slope of 1/800.

The Project site is of the diversion weir for KIP located at the debouching point of the Kankai river from the hills to the Terai plain, about 3 km north of the East-west Highway bridge. The Kankai river having about 150 m wide fans suddenly to about 700 m at the immediate downstream of the diversion weir.

1.2.2 Meteo-hydrological Condition

The project area has a sub-tropical climate having two distinct seasons, the rainy season from May through to October during which the monsoon brings more than 90% of the annual rainfall and the dry season from November to April. The annual rainfall recorded at EOQ during the past 10 years ranges from 1,570 mm to 3,780 mm. The average monthly (10 years, data) and other rainfall and other meteorological data are given in 1.2.1.

The Kankai river, classified as a medium sized river in Nepal, originates from the Mahabharat mountain range to the north of the town Illam in the Mechi Zone. The catchment area at the diversion weir for KIP is about 1,190 sq. km. A yearly run-off pattern is simple. The discharge begins to increase in May with the onset of the rainy season, reaches to the peak in July and August and keeps to decrease till the end of the dry season. It is the lowest in April.

Hydrological data on average monthly run-off and the past annual maximum flood discharges are given in Tables 1.2.2 and 1.2.3.

Table 1.2.1 Metecrological Data at Project Site

Station : EOQ & ASS

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Rainfall (mm)	9.2	11.3	17.1	61.1	194.0	435.8	775.4	370.6	428.1	74.4	31.4	3.7
Temperature (°C)												
Max.	24.7	27.0	30.4	31.4	30.0	31.2	31.3	32.1	31.5	30.6	29.5	27.0
Min.	9.6	11.5	15.7	21.6	22.7	24.7	25.1	25.3	24.2	20.1	15.8	10.8
Mean	17.2	19.3	23.1	26.5	26.4	28.0	28.2	28.7	27.9	25.4	22.7	18.8
Humidity (%)	87.0	79.9	67.2	68.8	74.6	84.2	85.2	83.4	83.4	79.8	76.7	77.2

Table 1.2.2 Average Run-off of the Kankai River

Unit : m^3/sec

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Run-off	13.0	10.0	8.2	7.5	11.7	27.5	153.0	158.0	124.0	40.0	27.6	17.1

Table 1.2.3 Annual Maximum Flood

Unit : m^3/sec

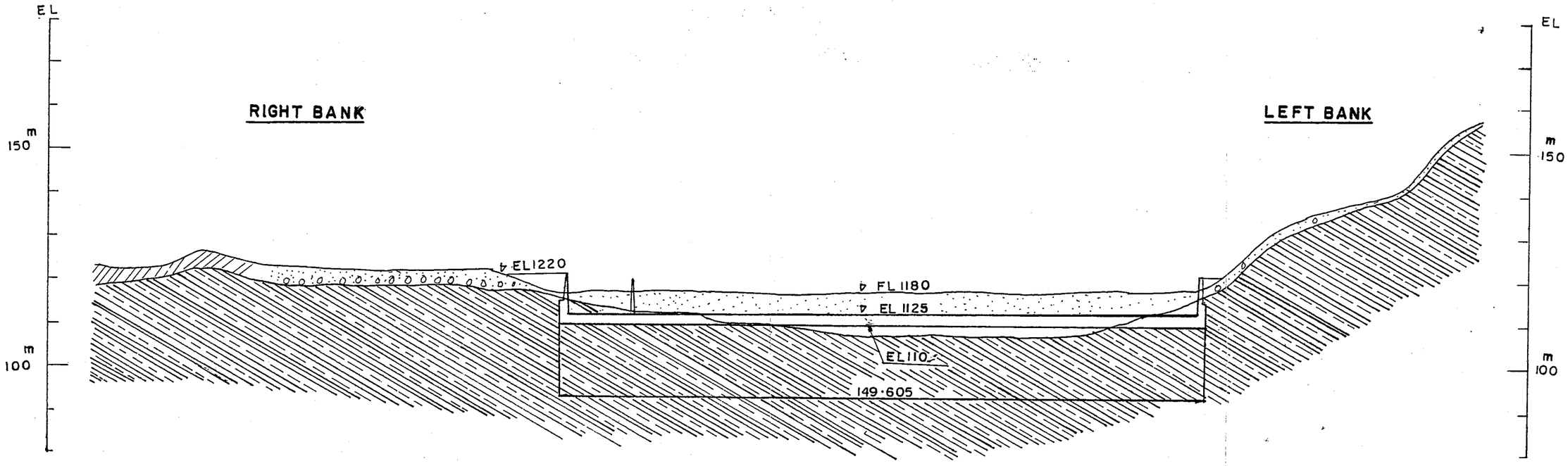
Year	Discharge
1980	400
1981	1800
1982	400
1983	1000
1984	600

1.2.3 Geological Features

The geology of the project site is composed of the "Siwalik Formation" which belongs to the Pilo-Pleistocene Age namely Upper Tertiary to Lower Quarternary. The formation below the thick sand and gravel layer of about 12 m deep at the river center consists of alternation of shale, sandstone, siltstone and sandy shale having many foldings and minor faults. These rocks are highly weathered and decomposed, and down to sand or clay states at some places. The layer of sand and gravel are well compacted.

The transversal geological section of the Kankai river at the project site is shown in Fig. 1.2.1.

FIG 1-2-1 GEOLOGICAL SECTION OF STILLING BASIN



---RIVER GRAVEL AND SAND (MAINLY MICA, CUARTZ, FELDSPART, GARNET SAND)

---TALUS DEPOSIT

---LOW TERTACE

---WEATHERED AND DECOMPOSED UP TO SURFACE SOIL ZONE

---BASEROCK, MAINLY SHALE (HARD AND SOFT) AND SOME SANDSTONE, SILTSTONE MUSDSTONE, SANDYSHALE ETC SOMITIMES WEATHERED HIGHLY AND DECOMPOSED UP TO CLAYEY STATE UPPER. AND MIDDLE SIWALIKS (UPPER PLIOCENE TO PLEISTOCENE) GENERALLY SOFT(RELATIVELY HARD TO VERY SOFT

SCALE

0 50m

1.2.4 Diversion Weir and Scouring Problem

The original design of the Kankai diversion weir was made so as to be safe against the design flood of 3,000 cumsec under the original river bed condition of EL. 119.5 m before the degradation of downstream river bed took place. The hydraulic calculation of the original design is shown in detail in the NK's report "Additional Technical Note on Urgent Implementation of Remedial Works for Kankai Diversion Weir, July 1983.

After the completion of the diversion weir in 1977, the river bed degradation throughout the reaches downstream from the weir occurred rapidly and reached 2 m deep with a speed and a magnitude in depth being beyond general forecast, although somewhat degradation for a long time range had been considered at the design of the weir as have been observed in the similar cases in Japan. The river bed degradation was caused basically by trapping of sedimentation load in the upstream pocket of the weir.

The degradation of the downstream river bed accordingly lowered the tail water table resulting that high velocity supercritical flow occurs throughout the length of the launching apron without the formation of hydraulic jump on the weirs solid apron when the discharge exceeded 500 cumsec. This has been causing the local scouring at the tail of the launching apron and subsequently resulting wash-away of concrete blocks from the tail of the launching apron.

1.2.5 Features of Project

The Project consists of the construction of a depressed stilling basin and other associated works. The detailed description of the Project features, and the quantities of major works and construction materials are as follows:

(1) Construction of stilling basin and associated works

Stilling basin: As a means to provide adequate depth of tailwater for the formation of hydraulic jump to dissipate the hydraulic energy, the launching apron was removed and in its place, a depressed concrete stilling basin was constructed at the immediate downstream of the existing diversion weir. The stilling basin consists of a chute slab with chute blocks, a floor slab with baffle blocks and endsill and side walls. The floor slab level of the basin is at El. 112.50 m and thus be 7.0 m below the top of the endsill of existing weir apron slab (El. 119.50 m).

The general dimensions of the stilling basin are given below:

(i) Elevation of nap crest El. 119.50 m

(ii) Elevation of floor slab El. 112.50 m

(iii)	Vertical height of chute	7 m
(iv)	Horizontal length of the chute	14.0 m
(v)	Length of basin floor slab	27.0 m
(vi)	Width of stilling basin	145.605 m
(vii)	Max. thickness of concrete at chute slab	2.50 m
(viii)	Max. thickness of concrete at basin floor slab	2.30 m
(ix)	Top elevation of side walls	El. 122.00 m
(x)	Top elevation of guide wall	El. 120.50 m
(xi)	Height of chute block	1.5 m
(xii)	Height of baffle block	2.0 m
(xiii)	Height of endsill	1.5 m

Steel fiber reinforced concrete (SFRC) was applied to the overlay on the stilling basin with a thickness of 15 cm and to the entire bodies of chute blocks, baffle blocks and endsill to control abrasion of concrete surface by heavy sediment load (boulder) carried by flood flows.

Downstream river bed protection: The river bed protection downstream of the stilling basin end, having dimensions of about 16 m long, 145.6 m wide and 3 m to 2 m high, is composed of precast concrete blocks of such shape as interlocking with each other.

Heightening and extending the left bank training wall of the weir: The left bank wall was heightened and extended downstream to cope with the extremely high flood discharge of 5,200 cumsecs to prevent the erosion of the weathered rock and consequent slides of the left bank, as shown below:

	Previous	Improved
Elevation of training wall top	El.123.20	El.129.0
Length of training wall	51 m	140 m

Increasing the freeboard at the canal intake: The available freeboard at the previous canal intake embankment against the design flood discharge of 3,000 cumsecs was 0.6 m. In order to protect the canal from flood intrusion over the embankment, the embankment was raised by 2.3 m from El.126.7 m to El.129.0 m.

Heightening the scouring sluice gates: The tops of the original scouring sluice gates were at the same elevation as the weir crest. For the reason that the top of the gates should be normally higher than the weir crest to allow a reasonable discharge flowing over the weir with the gates closed,

three units of scouring sluice gates having net span of 3.50 m wide were raised by 0.5 m from 1.85 m high to 2.35 m high.

(2) Quantities of major works and consturction materials

Major works:

Excavation	60,500	cu.m
Backfill and embankment	12,000	"
Steel sheet piling	354	mt (7,375 m)
Concrete for basin slab	11,000	cu.m
Concrete for walls	1,400	"
SFRC	2,545	"
Precast concrete blocks	2,800	"
Miscellaneous concrete	1,100	"
Form for concrete	8,400	sq.m
Reinforcement bar	227	mt
Wet rubble masonry	1,100	sq.m

Major construction materials

Cement	5,000	mt
Reinforcement bars	227	"
Steel sheet piles	354	"
Structural steel	1.7	"
Plywood for shuttering (4' x 8' x 12 mm)	500	sheets
Coarse aggregates	22,000	cu.m
Diesel oil	450,000	l

1.3 Progress of project

The progress of the Project from the investigation to the completion of the construction is summarized hereunder. (The detailed chronological description of main events are given in Annex-1.)

Year 1983

March : - An ADB Review Mission urged to implement a remedial work for the protection of the Kankai diversion weir against a possible its failure by undermining during high flood.

April : - NK's senior hydraulic/river engineering specialist and other staff carried out a site investigation and prepared a finding report.

June : - NK submitted a study report to DIHM proposing a gradually depressed stilling basin.
- The joint discussion held in Kathmandu with attendances of DIHM, ADB and its staff Consultant and NK resulted that it would be need to construct a suddenly depressed stilling basin.

August : - ADB conducted an appraisal of the Project and Memorandum of Understanding (MOU) was exchanged between ADB Mission and HMGN.
- NK assisted DIHM in preparing a prequalification document for the civil works and tender documents for supply of steel sheet piles and the civil works.

September: - Notices of sheet piles procurement and prequalifi- cation of tenderers for the civil works were advertized and closed this month.
- NK submitted two reports on 1) evaluation of qualification of tenderers for the Project and 2) evaluation of bids for supply of steel sheet piles for the Project to DIHM.
- NK started hydraulic model test and preparation of tender document for civil work.

October : - NK started the detailed design of the stilling basin.
- DIHM issued tender documents for the civil works to three qualified tenderers.

November: - The contract for the supply of steel sheet piles was concluded.

- Tenders for the civil works were closed

December :
- NK submitted a evaluation report on tenders for the civil works to DIHM recommending to select KDC, and it was accepted by DIHM.
- NK submitted two reports on 1) hydraulic model test and 2) detailed design of the Project.
- Loan agreement for the Project was signed between HMGN and ADB.
- ADB and NK discussed the results of the hydraulic model test and the detailed design in Tokyo.

Year 1984

January :
- The Contract for the civil works was awarded to KDC with concurrence by ADB, and the letter of intent was issued to KDC.
- NK finalized the detailed design of the Project based on the results of discussion with ADB.
- KDC started a site mobilization.

February :
- The Contract for the civil works was signed between DIHM and KDC.

March :
- An order of commencement of the Works was issued to KDC.
- Steel sheet piles of 440 mt were delivered to the site.
- KDC started the construction.

April :
- ADB progress review mission inspected the progress situation and discussed the delay in progress with the Project, NK and KDC.
- KDC delivered the major construction equipment to the site and subsequently started driving steel sheet piles on 15 th, being 1.5 months behind the schedule.

May :
- The sheet pilling was successfully completed on 13 th, being 2 days earlier than the mandate completion date.

June through October :
- Precast concrete blocks for the launching apron and aggregates for concrete and filter were produced throughout the rainy season.

November :
- KDC started the coffering work for the river diversion and

subsequently the removal of the concrete blocks of the existing launching apron.

- an ADB progress review mission inspected the situation of delay in progress and strongly urged DIHM, NK to take some remedial steps by the first week of December 1984 in order to recoup the serious delay.

December :
- Every effort to recoup the delay in progress was made by the said three parties and consequently equipment and construction materials were brought to the full-force conditions by 7th of this month.
- KDC started the foundation excavation of the river bed for the stilling basin slab.
- KDC started the concrete placing for the stilling basin slab at the deepest portion.

Year 1985

January :
- The foundation excavation and concrete placing for the stilling basin slab were carried out in full swing.

February :
- The stilling basin slab in the right-half area was completed.
- KDC started the SFRC placing.

March :
- An ADB progress review mission inspected the site and stressed the every effort to be taken by DIHM, NK and KDC for the completion of stilling basin before mandating date of 15 May 1985.
- Guidewall and right-side wall were completed.
- With diverting the river flow to the right bank through the scouring sluice gates, the entire foundation excavation was basically completed.
- KDC started the installation of precast concrete blocks for the launching apron.

April :
- The entire stilling basin slab was completed.
- chute blocks were completed.

May :
- The appurtenant structures to the stilling basin slab such as baffle blocks, endsill and SFRC overlay on the slab were completed.
- The installation of the Concrete blocks for the launching apron

was completed. Thus the mandatory works to be completed on or before 15 May 1985 under the Contract were successfully completed on 8 th.

- The left-side wall was completed.

June : - The remaining associated works were completed except minor work items

1.4 Financial Arrangement and Project Cost

1.4.1 Financial Arrangement

Finance for the implementation of the Project was provided in two sources from ADB for foreign currency component and from the national budget for local currency component.

The loan from the special fund of ADB was concluded dated 19 December, 1985 with its Loan Number 659NEP(SF). the amount of loan was SDR 3,304,000 (US$3,500,000) and its allocation for the respective categories is given below:

Unit: SDR 1,000 (US$1,000 equiv.)

	Category	Amount	Allocated
I.	Civil Works	2,159	(2,280)
II.	Construction Materials	269	(285)
III.	Consultants' Services	263	(279)
IV.	Local Expenditures Civil Works	283	(300)
V.	Service Charge during Construction	38	(40)
VI.	Unallocated	292	(314)
	Total	3,304	(3,500)

While, the local currency component was provided by the HMGN's budget every year on the basis of the scheduled expenditure estimated in accordance with the progress of the works.

The loan from ADB covered a part of local currency expenditure for the civil works as allocated to the loan category IV amounting SDR 283,000 (US$300,000 equiv.) in such a manner as disbursing by ADB to HMGN amount of 9% of each payment made by HMGN to the civil work contractor.

1.4.2 Project Cost

The total expenditure spent for the implementation of the Project amounted to Rs. 49,904,000 as of 30 June, 1985 consisting of Rs. 36,103,000 (about US$2,364,640 equiv.) in foreign component and Rs. 13,801,000 in local component. Out of the latter local component amounting Rs. 13,801,000, the amount of Rs. 1,170,000 was disbursed in foreign currency from the loan of ADB.

The summary of the Project cost as of 30 June, 1985 is given below:

(Unit: Rs. 1,000)

Description	Total	F.C.	L.C
1. Supply of steel sheet piles (Final)	2,560	2,248	312
2. Supply of vehicles (Final)	462	450	12
3. Contract for civil work including price escalation (Not final)	41,671	28,670	13,001
4. Consulting services (To be final)	4,788	4,735	53
5. Executing agencies' administrative expenditure (Final)	423	-	423
Total	49,904	36,103	13,801

II DESIGN OF STILLING BASIN

2.1 Preliminary Design and Hydraulic Model Test

In response to a request of DIHM. NK investigated the project site, reviewed previous reports and data and discussed with DIHM authorities concerned in early April 1983. NK further carried out the following survey in cooperation with the KIP staffs:

(1) Additional transversal cross section of the Kankai River, which had been done annually since 1977, down to the Kankai Bridge of East-West Highway.

(2) Sieve analysis of river bed materials, and

(3) Reviewing the past floods data

Based on the results of these activities, NK prepared a study report in June 1983 proposing to construct a stilling basin gradually depressed by sloping apron at the immediate downstream of the diversion weir.

ADB dispatched a staff Consultant to Nepal in early June 1983 and carried out the site investigation jointly with DIHM and NK. Technical discussions were held among DIHM, ADB and NK and reached a conclusion that it would be urgent need to construct a suddenly depressed type of stilling basin at the immediate downstream of the diversion weir. The basic concept of the stilling basin confirmed at the discussion were as follows:

(1) Dissipate completely flow kinetic energy by hydraulic jump within the solid stilling basin at the floods of 3,000 cumsec or less, and

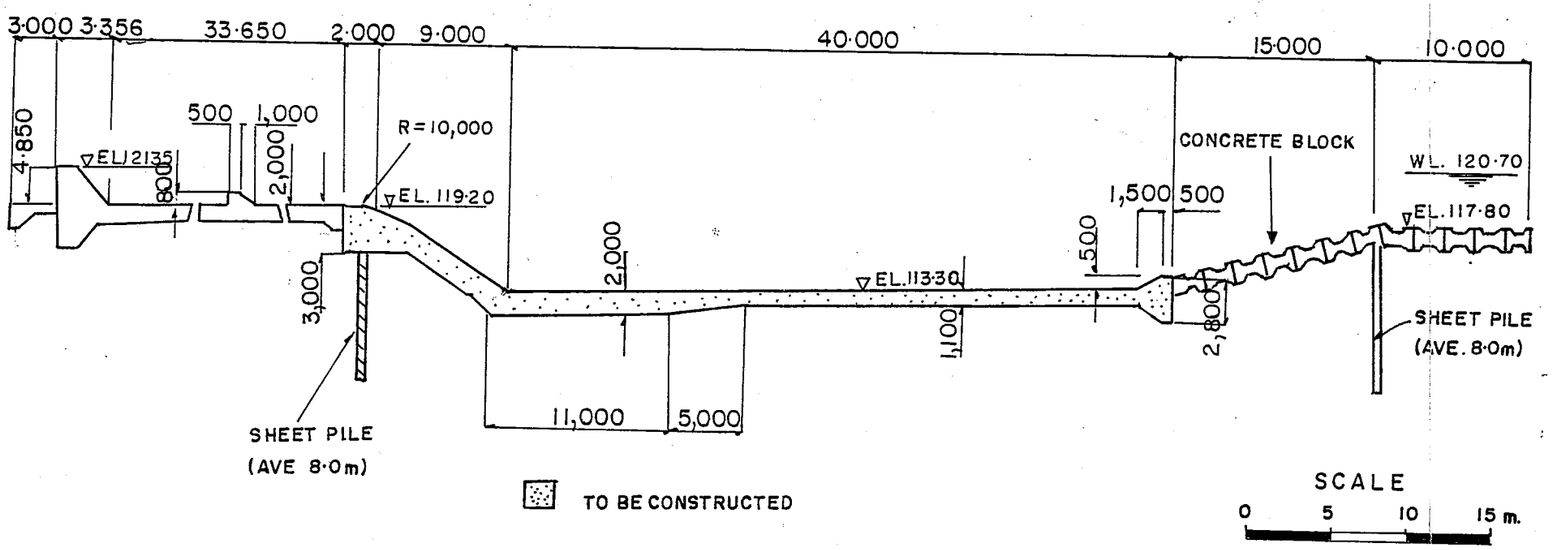
(2) Minimize the damage at downstream river bed even against the extremely high flood of 5,200 cumsec.

A preliminary design of stilling basin and a implementation schedule for the Project, which were to be implemented for about 2 years mobilizing from July 1983 to completing in May 1985, prepared at this stage are shown in Fig. 2.1.1.

NK carried out the hydraulic model test at NK's laboratory in Japan during a period of two months from the end of September to the end of November 1983. A section model of the stilling basin with a model scale of 1/25 was built in a test flume with a width of 0.6 m, a depth of 0.8 m and a length of 20 m as shown in Fig. 2.1.2.

The tests were conducted for various types of stilling basin by changing

FIG.2-1-1 PRELIMINARY DESIGN OF STILLING BASIN AND IMPLEMENTATION SCHEDULE



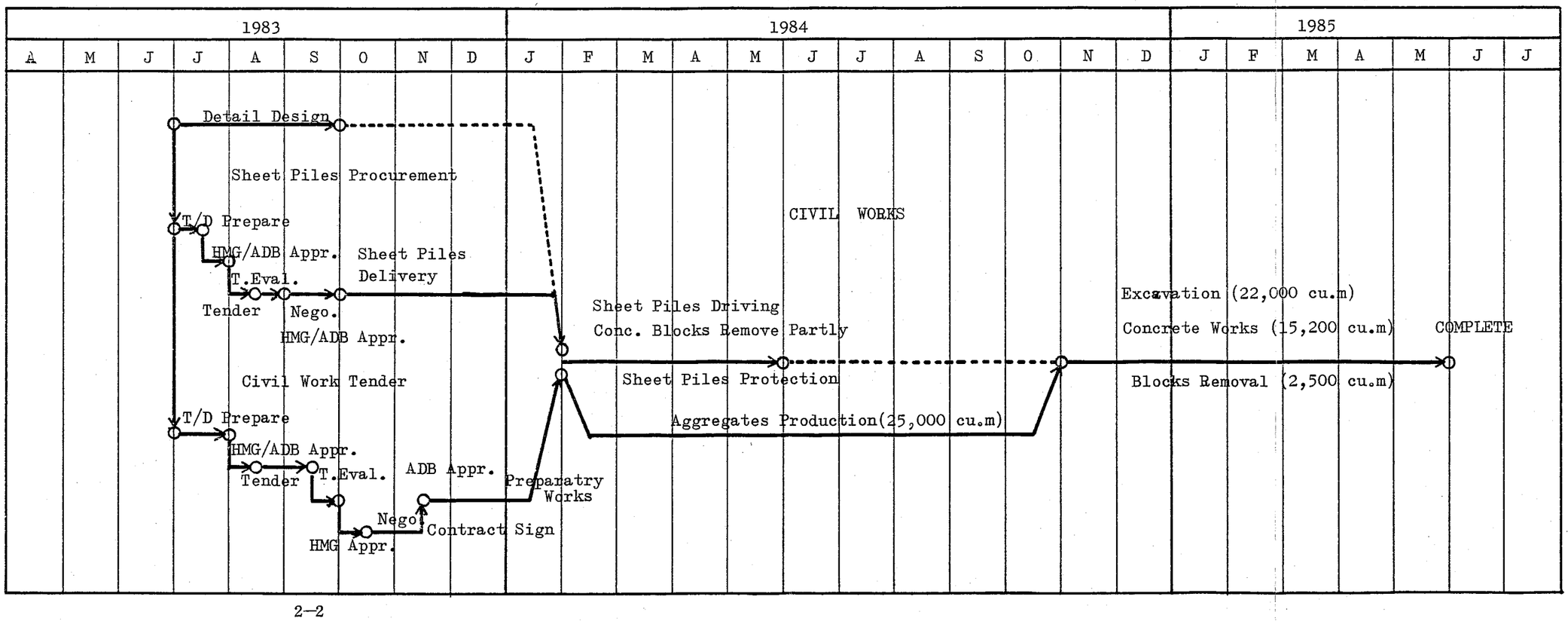
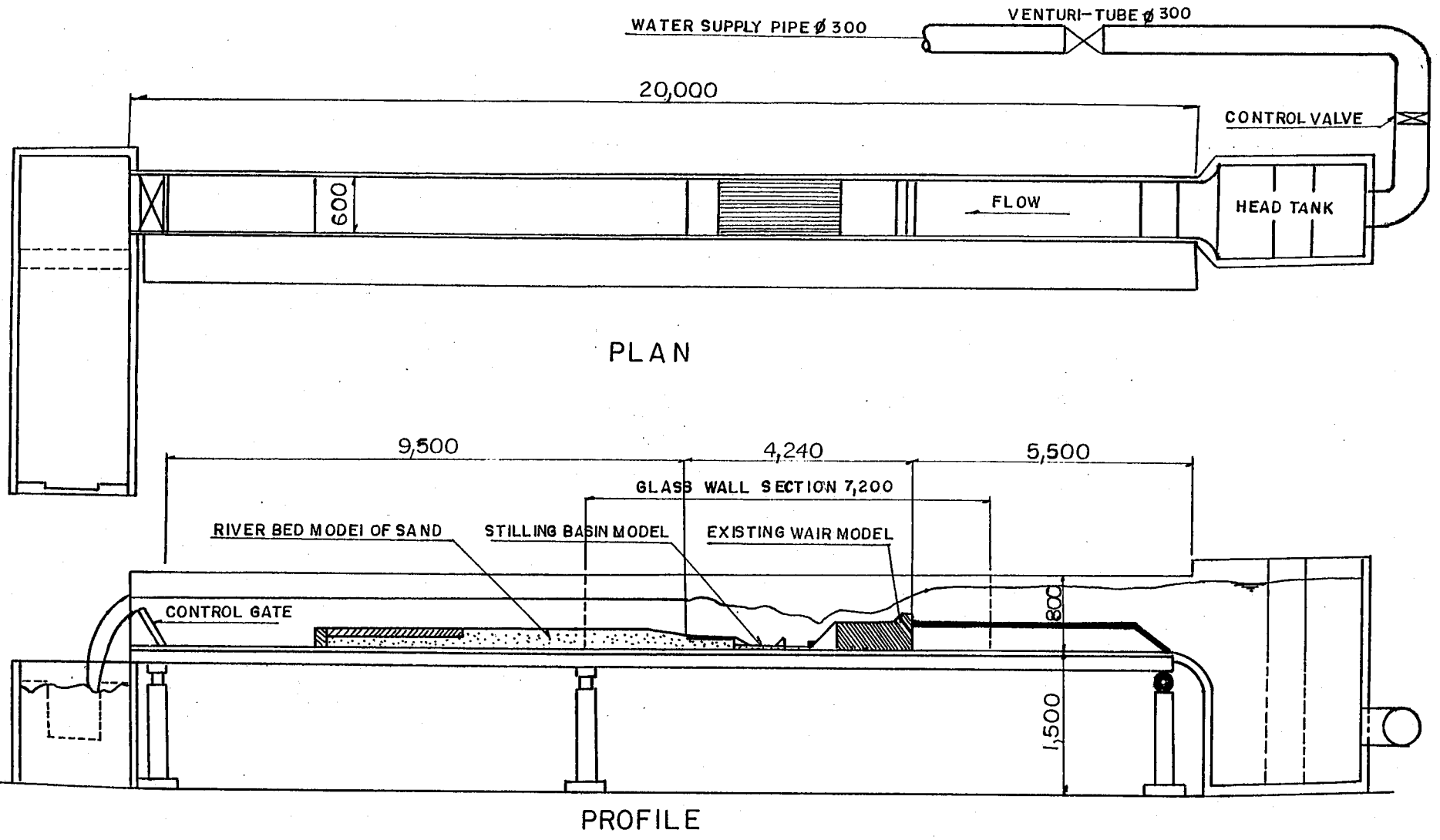


FIG. 2.1.2 FACILITIES OF HYDRAULIC MODEL TEST



basin depth and length with or without providing chute or/and baffle blocks. In the course of the test, a technical discussion was held with ADB's staff consultant. The report on the hydraulic model test submitted at the beginning of December 1983 recommended a stilling basin slightly modified from the Stilling Basin III of USBR having chute and baffle blocks in the basin. The features of the recommended stilling basin was as follows:

Depth of stilling basin (Fall height)	5.8 m
Apron elevation of stilling basin	El. 113.4 m
Apron length	27 m
Chute block	1.5 m high x 1.5 m wide
Baffle block	2.0 m high x 1.5 m wide
End sill	2.0 m high

NK made the detailed design of stilling basin and other associated works based on the results of hydraulic model test. The most focal point in the detailed design was to estimate the tail water stage at each anticipated flood. This was obtained through repeated computer simulations based on the past data of river cross sections recorded from 1977 and a few actual water stage records at the high floods. Another essential point was assessment of up-lift pressure working on the stilling basin, by which thickness of concrete slab was determined. This was estimated by creep length theory.

The summary of major points in the detailed design was given as follows:

(1) The principal features of the stilling basin was those as given in the above with having the maximum 2.5 m thick of slab basin concrete.

(2) The entire surface of stilling basin slab were coated by SFRC with an thickness of 30 cm for minimizing damages of surface abrasion and the both chute and baffle blocks were entirely constructed by SFRC.

(3) Both banks of the stilling basin were protected by concrete walls having enough height to cater the extremely high flood of 5,200 cumsec.

(4) River bed at the tail of stilling basin was protected from scouring during floods by providing the interlocking type concrete blocks and deep cut-off wall of steel sheet piles.

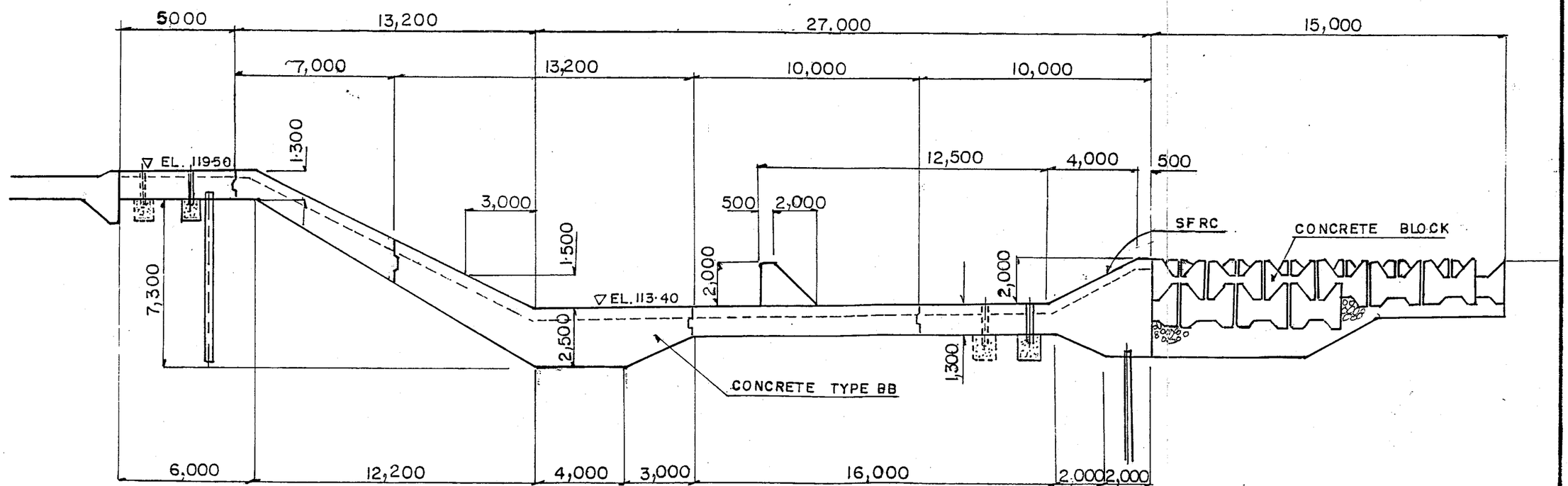
(5) Construction of stilling basin would be carried out during a period of two dry seasons from the year of 1983/84 to 1984/85 and would be

compelted by the end of June 1985.

(6) Construction cost of stilling basin and associated works was estimated at Rs. 54,160,000 or US$ 3.71 x 106 million equivalent.

The basic design of stilling basin prepared at this stage is shown in Fig. 2.1.3. NK submitted a report on detailed design at the end of December 1983.

FIG. 2.1.3 BASIC DESIGN OF STILLING BASIN



SCALE

0 2 4 6 8 10 m.

2.2 Finalization of Design

2.2.1 Comments to Design

An ADB Mission visited Tokyo at the end of December 1983. Having discussion with the Mission, an additional hydraulic model test was carried out for an alternative basin of which floor level was further deepened by 0.9 m from El. 113.40 m of the original design to El. 112.50 m. This was aiming to assess further safety of the stilling basin and downstream river bed against the extremely high flood of 5,200 cumsec.

An intensive discussion was subsequently held between the Mission and NK. As a result of discussion, both confirmed to employ the alternate stilling basin (basin floor level at El. 112.50 m) subject to the civil work cost being within the budget. In addition, the following major comments to the design were given by the ADB mission.

(1) The height of end sill would be determined by further hydraulic model test varying it 1.0 m, 1.5 m and 2.0 m, though 1.5 m high seemed best.

(2) An underdrainage system beneath the stilling basin slab should be provided, so that the thickness of concrete slab could be decreased by releasing up-lift pressure through the system.

(3) SFRC coating on the basin slab would be decreased to 15 cm and it would be placed over the entire existing diversion weir apron.

(4) Deep cut-off wall by steel sheet pile at the end sill of the basin would be eliminated and the sheet pile wall would be moved in downstream direction away from end sill to ensure the foundation excavation in dry condition.

(5) A cut-off wall would be provided in the additional embankment to be constructed at the canal intake.

Further some comments to design were raised at the site visit of an ADB Progress Review Mission in November 1984 as follows:

(1) End sill would be constructed entirely by SFRC

(2) The alignment of underdrainage system was further reviewed and finalized.

(3) Cut-off wall at the end sill would be further deepened by 1 m.

(4) The top portion of baffle wall on the existing diversion weir apron would be removed.

(5) Sheet pile wall driven in the downstream of the stilling basin would be salvaged.

Further minor design revision were confirmed at the site visit of an ADB Progress Review Mission in November 1984. The major points of design revisions at this stage were as follows:

(1) End sill would be constructed entirely by SFRC.

(2) The alignment of underdrainage system was further reviewed and finalized.

(3) Cut-off wall at the end sill would be further deepened by 1 m.

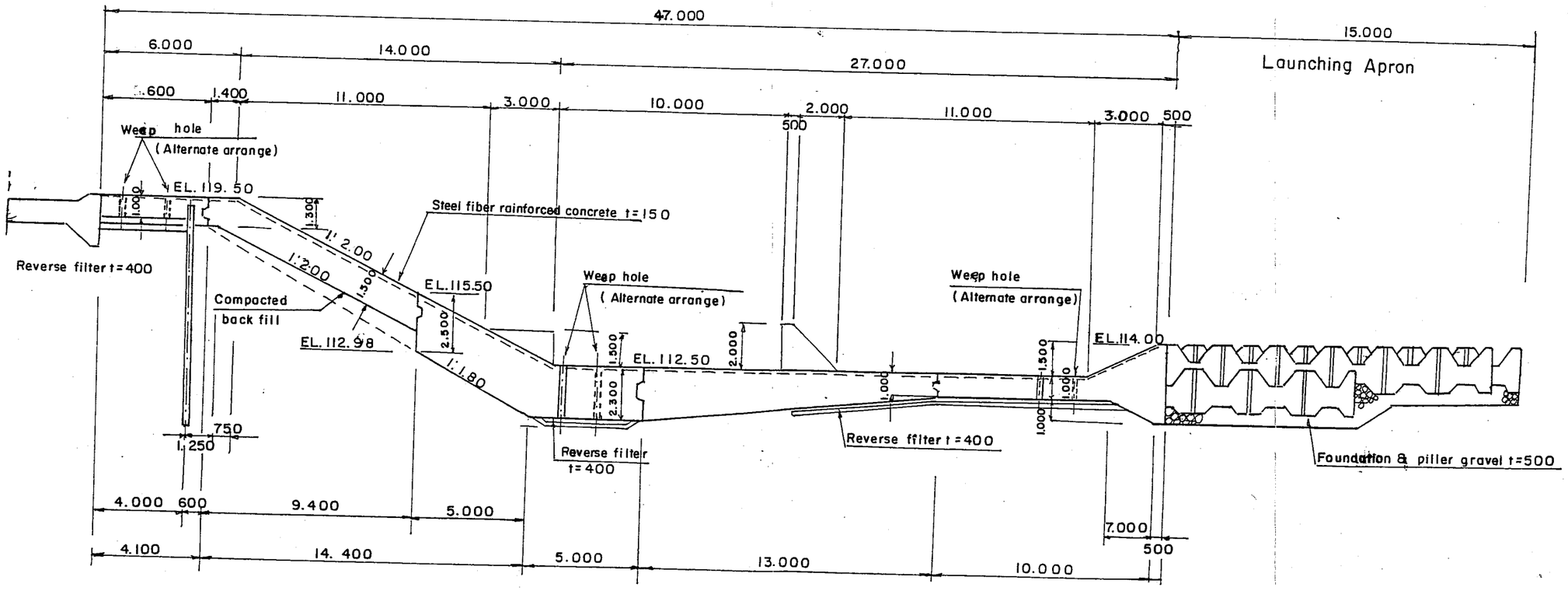
(4) The top portion of baffle wall on the existing diversion weir apron would be removed.

(5) Sheet pile wall driven in the downstream of the stilling basin would be salvaged.

2.2.2 Final Design

NK modified the detailed design based on the discussion with the ADB mission as well as an additional hydraulic model test which resulted in the appropriate height of the end sill of 1.5 m. The final design of stilling basin is shown in Fig. 2.2.1. The flow conditions of the final design of stilling basin with varying the discharge of 3,000 cumsec, 4,000 cumsec and 5,200 cumsec are shown in Fig. 2.2.2 and Photo.

FIG. 2.2.1 FINAL DESIGN OF STILLING BASIN



Scale :-

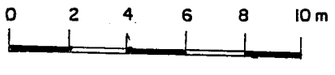
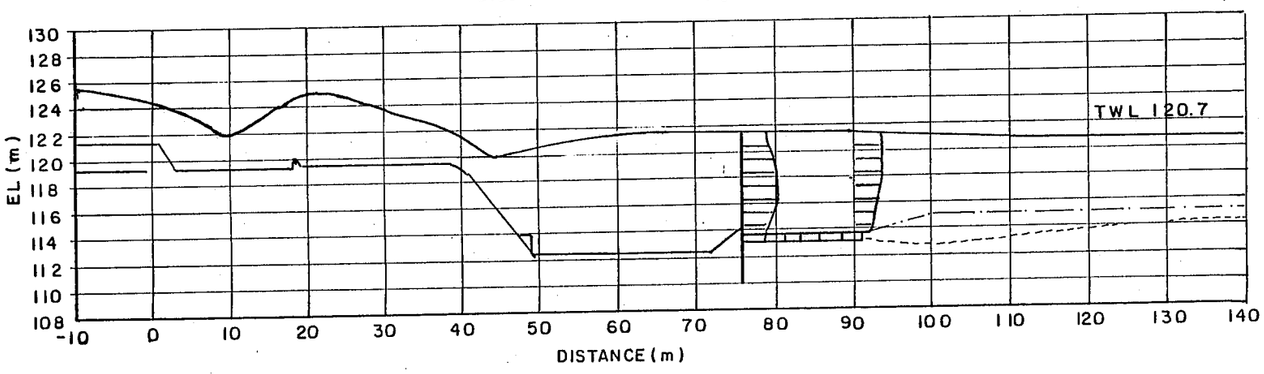


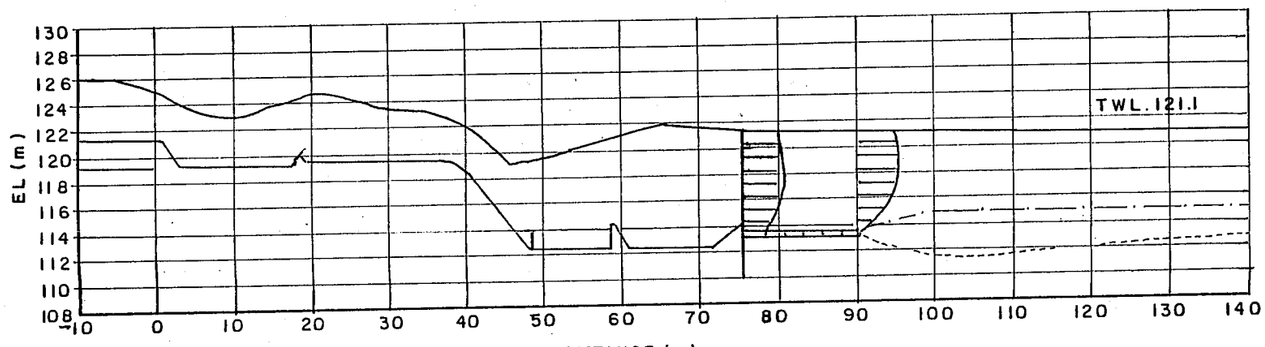
FIG: 2.2.2 HYDRAULIC CONDITIONS AT FINAL DESIGN OF STILLING BASIN

Q = 3,000 To 5,200 m^3/sec ***

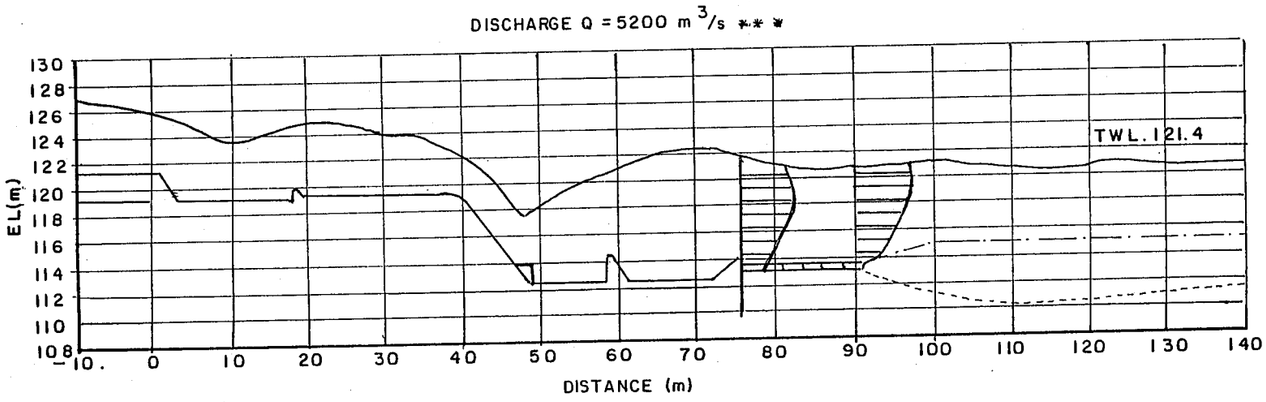
DISCHARGE Q = 3000 m^3/s



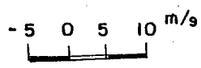
DISCHARGE Q = 4000 m^3/s ***

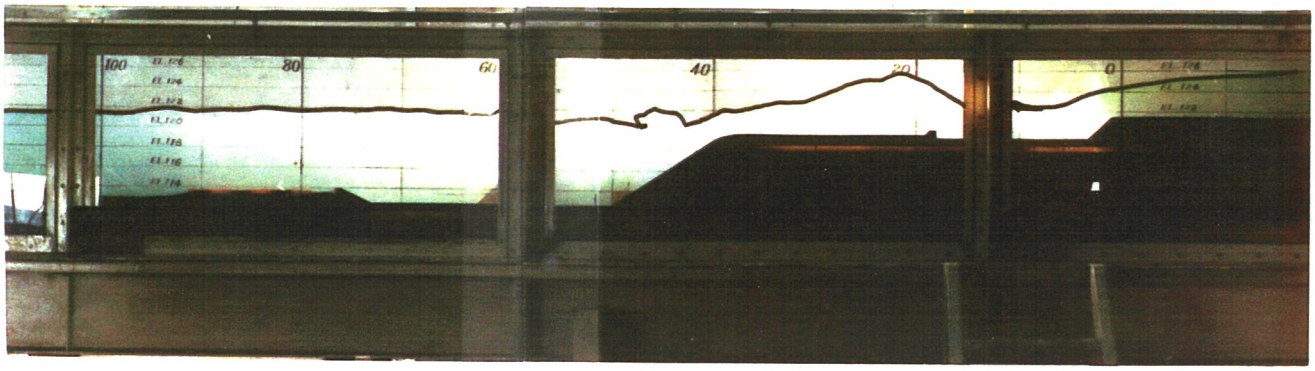


DISCHARGE Q = 5200 m^3/s ***

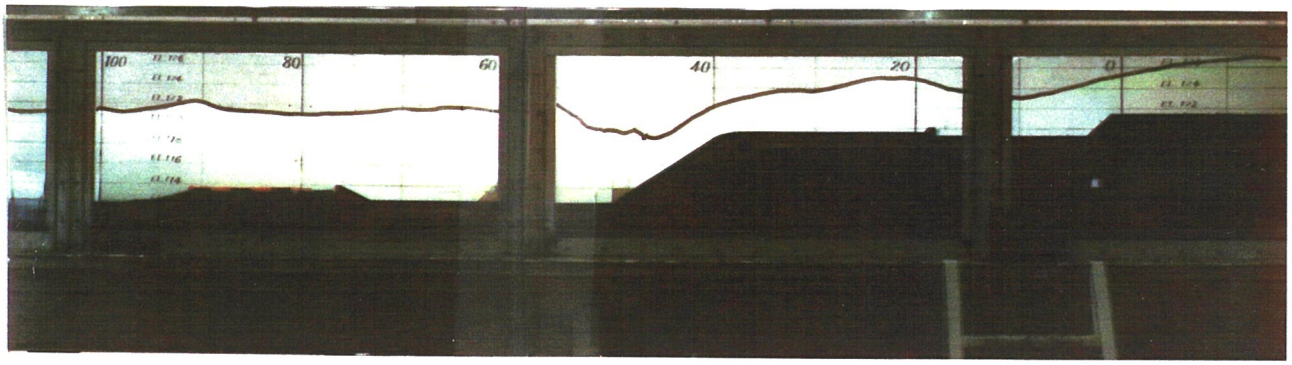


Velocity Scale

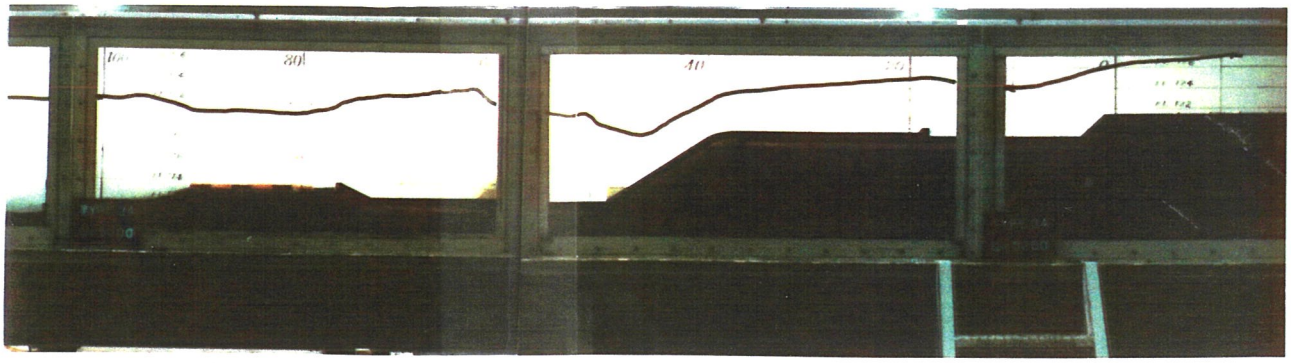




Q=3,000 cumsec



Q=4,000 cumsec



Q=5,200 cumsec

The final design of the works actually constructed are described hereunder with referring to the "as-built drawings" attached to this report.

(1) Design principle of stilling basin slab

In order to ensure the stability of stilling basin against up-lift pressure and to minimize the civil work cost, the following design principles were employed for the design of the stilling basin slab.

a) Reverse filter with weep holes was provided beneath stilling basin slab for reducing the up-lift pressure.

b) Safety factor against up-lift pressure in determining the thickness of concrete slab could be reasonably reduced to 20% from 30% in Japanese design criteria, which was applied to the original design of stilling basin, judging from the facts that (i) the critical condition in safety of stilling basin against up-lift pressure might appear just after the completion of stilling basin and filter drains and weep holes were considered to be fully functioning at this time, (ii) under the normal conditions, the stilling basin would be filled with water and river bed materials which were expected to act as a counterweight against up-lift pressure, and (iii) such an extreme large degradation of river bed as reaching to the level of stilling basin floor (El. 118.0 m of present river bed level to EL. 112.5 m of basin floor) might not be considered judging from the depth of stilling basin and present river bed slope.

(2) Design of stilling basin

(See "as-built drawings" Nos. ABD/RW-002 to 03)

The stability of the stilling basin including the existing weir was examined by the creep length theory of seepage using the both Bligh's method and Lane's method. The examinations were made for two cases of hydraulic conditions, one was the condition just after the completion of the stilling basin and the other at the flood of 5,200 cumsec.

With the result of the stability analysis of the stilling basin, the structual section of the basin slab having concrete thickness of 2.3 m in max. and 1.0 m in mini. was determined under the conditions that underdrainage and weep hole be provided as shown in Fig. 2.2.1.

The major dimensions of the stilling basin are as follows:

Depth of stilling basin : 6.7 m
Apron elevation of stilling basin: EL. 112.5 m

Apron length	:	27 m
Width of stilling basin	:	145.605 m
Max. thickness of slab concrete	:	2.3 m
Min. thickness of slab concrete	:	1.0 m
Chute block	:	1.5 m high x 1.5 m wide
Baffle block	:	2.0 m high x 1.5 m wide
End sill	:	1.5 m high

(3) Underdrainage system

(See "as-built drawing" No. ABD/RW-009)

As shown in Fig. 2.2.1, the underdrainage system was designed initially to be consisting of the filter gravel layers with a thickness of 40 cm provided at three places, beneath (i) the upper flat slab, (ii) the upstream end of the basin floor and (iii) the downstream portion of the basin floor between baffle block and endsill, and weep holes provided at each filter gravel layer.

With further comments and discussions, the underdrainage system was finally designed to be provided under the entire flat portion of the stilling basin slab. This consisted of the gravel filter layer of 40 cm thick and underdrain pipe network. The weep holes located at the downstream end of the basin slab were deleted in order to prevent the transfer of higher water pressure after the hydraulic jump through the underdrainage system to the upstream end of the basin slab where uplift acting the basin slab be critical.

The drain pipe was of perforated PVC one with an inside diameter of 100 mm. The pipe network was provided with about 5 m x 5 m mesh on the pervious foundation (sand and gravel) and about 10 m x 10 m one on the impervious foundation (weathered rock).

In addition to the underdrainage system of the stilling basin, weep holes were provided in the existing weir apron at between the weir crest and the baffle wall in order to relief the uplift pressure as much as possible. Though this weep hole was initially proposed to have a diameter of 50 mm and to be installed with a space of 2 m long, the diameter of 38 mm (1.5") with a space of 1.25 m long was actually applied due to unavailability of adequate equipment.

The further details of the underdrainage system are mentioned in the subsequent sub-sections 5.5.4 and 5.7.6.

(4) Arrangement of sheet pile walls

(See "as-built drawing" No. ABD/RW-004)

As agreed through the discussion with the ADB mission made in December 1983, a deep cut-off wall of sheet piles provided at the basin endsill in the basic design was eliminated from the final design. This was based on the facts obtained from the additional hydraulic model test that (i) flow condition at a discharge of 5,200 cumsec at the downstream end of the stilling basin became more stable due to deepening the basin floor by 90 cm from EL. 113.40 m to EL. 112.50 m and (ii) a ground roller (or back eddy) phenomenon was formed at the immediate downstream of the launching apron in such a way as compensating the local scour by pulling the bed materials back towards the downstream end of the launching apron.

The arrangement in location of sheet pile walls were finally designed at 2 transversal lines of about 150 m long in the river, one was at the immediate downstream of the existing weir apron's endsill and the other about 58 m downstream from the upper line (or downstream end of anticipated launching apron of the stilling basin), and one longitudinal line of about 58 m long connecting the above 2 lines in the center of the river.

These sheet piles were intended to be salvaged after the completion of the stilling basin except the whole upper transversal line and a part of the longitudinal one.

(5) SFRC

(See "as-built drawings" Nos. ABD/RW-005 and 006)

The thickness of SFRC overlay over the entire surface of the stilling basin was initially chosen to be 30 cm on the safer side, since the past experiences in Japan and USA showed its range from 10 cm to 40 cm applied to the hydraulic structures for the prevention of abrasion. In order to minimize the civil work cost, the thickness of SFRC overlay was reduced to 15 cm in the final design on the basis that placing of such thin concrete on the old concrete was possible according to the past experiences of SFRC works to the similar hydraulic structures and road pavement. SFRC overlay with the same thickness was provided on the almost entire surface of the existing weir's apron, too.

The both chute and baffle blocks on the stilling basin were entirely to be constructed by SFRC as initially intended. The endsill of the stilling basin was also designed as the SFRC structure entirely.

(6) Concrete walls

(See "as-built drawings" Nos. ABD/RW-005 and 006)

The following three concrete vertical walls were designed in the stilling basin.

(i) Guide wall
(ii) Right-side wall
(iii) Left-side wall

(i) Guide wall

The guide wall was designed for the purposes of diverting the river flow through the existing scouring sluice during the construction of left-half of the stilling basin slab and avoiding the unnecessary turblence of flood flow due to the difference of the unit discharge at between scouring sluice part and fixed weir part. The guide wall consisted of an additional guide wall of 27.5 m long constructed on the existing one of the weir with height of 0.5 m to 2.2 m and a wall of 47 m long constructed on the stilling basin slab with height ranging from 2.5 m to 8.0 m. The guide wall was structurally designed as the cantilever supported by the stilling basin slab.

(ii) Right-side and left-side walls

The top elevation of the both side walls of the stilling basin was decided based on the results of hydraulic model tests, in such a way as giving freeboard of 1.0 m high against the design flood discharge of 3,000 cumsec and 0.6 m high against the maximum recorded flood discharge of 5,200 cumsec.

The right-side wall consisted of three types of wall from the upstream, a hollow cylinder type wall with height ranging from 7.5 m to 5.8 m (top EL. 126.70 m to EL. 123.00 m), a L-type retaining wall of 3.5 m high to 9.5 m high (top EL. 123.00 m to EL.122.00 m), and a wing wall of 11.5 m high (top EL. 122.00 m).

The left-side wall also cosisted of three types of wall from the upstream, a mass concrete wall having a heitht of 3.7 m (top EL. 123.20 m), a L-type retaining wall of 3.7 m high to 9.5 m high (Top EL. 123.20 m to EL. 122.00 m), and the same wing wall as the right side.

(7) Launching apron

(See "as-built drawling" No. ABD/RW-007)

The launching apron was designed to be provided at the immediate

downstream of the stilling basin giving an area of longitudinal length of about 16 m and 144.8 m in width. The launching apron was composed of interlocking type concrete blocks of about 830 in number, each having weight of about 8.0 mt being stable during a flood of 5,200 cumsec.

The launching apron consisted of two parts, one is of the double layers of precast concrete blocks in the upper-half of the launching apron of about 8.5 m in length and the other single layer of blocks in the lower-half of about 6.5 m in length.

(8) Additional embankment at the canal intake

(See "as-built drawing" No. ABD/RW-008)

An additional embankment in combination with a retaining wall was designed on the existing canal intake embankment in order to cater the maximum recorded flood of 5,200 cumsec with keeping freeboard of 0.6 m high. The height and top elevation of the both embankment and the retaining wall were 2.3 m and EL. 129.0 m respectively. The retaining wall was deeply penetrated into the embankment as the cut-off wall against seepage erosion along the contract between the fill and concrete. The slope of embankment facing the upstream of the river was protected by wet-rubble masonry. Hand rails were provided on the top of the embankment.

(9) Protection of river bank

(See "as-built drawings" Nos. ABD/RW-006 and 008)

The protection works of the river bank were provided for the both right and left banks.

Right bank: A guide bank of which slope was paved by wet rubble masonry was provided at the downstream of the stilling basin as a transition to natural river bank. The height and top elevation ranged from 8.0 m to 2.5 m and from EL. 122.0 m to EL. 121.5 m respectively.

Left bank: The protection works in the left bank were provided from the upstream of the existing diversion weir through the downstream of the launching apron of the stilling basin, having the following two works:

(i) Slope protection of side hill by concrete and wet rubble masonry, and

(ii) Gully protection dam.

A gully protection dam was provided at the debouching point of the left side steep stream located near to the endsill of the existing weir apron. The inclined type concrete wall with a slope of about 7% was provided on the slope of left side hill upstream from the gully protection dam to the upstream end of the existing concrete wall. The height and top elevation of the inclined wall ranged from 5.5 m to 1.8 m and from EL. 129.0 m to EL. 125.0 m respectively.

The wet rubble masonry wall having heights of 2 m to 3 m was provided on the slope of hill downstream from the gully protection dam to the left wing wall of the stilling basin. A further slope protection wall made by concrete and wet rubble masonry, ranging its height from 8.0 m to 4.0 m, was provided beyond the wing wall downstream over 34 m long.

(10) Raising height of scouring sluice gates

The tops of the scouring sluice gates are at the same elevation as that of the weir crest. For avoiding unnecessary continuous overflow over the gates particularly during the flood season, the tops of the gates are to be raised somewhat higher than the weir crest and it was designed at 0.5 meter high.

2.3 Design Criteria

2.3.1 Hydraulic Design of Stilling Basin

(1) Design flood discharge

Floods to be taken for the design of the stilling basin and associated structures were given as follows:

a) 3,000 cumsec, design discharge for the existing diversion weir, was employed as the design flood for designing the stilling basin, and

b) 5,200 cumsec, assessed maximum recorded flood, was taken into consideration in such a way as that the stilling basin and associated structures should stand with allowing certain scouring within acceptable limits but not any damages to the main body of the stilling basin.

(2) Headwater stage-discharge curve

The headwater stage-discharge curve was obtained by a empirical formula under the condition that all the flood discharges flow only over the fixed weir, as given below:

Discharge (cumsec)	Stage (EL. m)
1,000	123.7
2,000	125.2
3,000	126.3
4,000	127.3
5,000	128.4
6,000	129.2

(3) Tailwater stage-discharge curve

a) Available data: The following data were used for the estimation of tailwater stage-discharge curve:

(i) Results of river profile and cross section survey carried out since 1977,

(ii) Flood discharge and tailwater elevation measured in August 1981, which were 1,000 cumsec and EL. 119.8 m respectively, and

(iii) Flood discharge and tailwater elevation measured in July 1983,

which were 1,000 cumsec and EL. 119.75 m.

b) Procedure for calculation

The tailwater stage-discharge curve was prepared through the following procedure:

(i) Estimation of roughness coefficient (n) for the Manning formula, and

(ii) Calculation of water surface elevation from the Kankai Bridge on East-West Highway about 3 km downstream from the weir to the tail of diversion weir for various discharges using the Manning's formula.

The tailwater-discharge curve was estimated as below:

Discharge (cumsec)	Stage (EL. m)
500	119.20
1,000	119.70
2,000	120.30
3,000	120.70
5,000	121.30
5,200	121.40

(4) Basic design of stilling basin for hydraulic model test

A standard type of stilling basin for the basis of hydraulic model test was designed theoretically under the design discharge of 3,000 cumsec and corresponded tail water stage. This standard type consisted of a chute and horizontal apron, on which the hydraulic energy be dissipated by hydraulic jump without aid of appurtenant energy dissipators. The principal features of the standard type of the stilling basin were as follows:

Design discharge	:	Q = 3,000 cumsec
Unit discharge	:	q = 23.8 cumsec/m
Tailwater stage	:	EL. 120.70 m
Elevation of horizontal apron surface	:	EL. 112.90 m
Tailwater depth (Conjugate depth)	:	7.8 m
Apron length	:	43.0 m

(5) Design of concrete block for launching apron

A concrete block for launching apron was designed so as to be safe against wash-away force under the flood discharge of 5,200 cumsec. The safety of a concrete block of interlocking type was examined by the following formula:

$$1.3 \quad F < R$$

where, F : Drag force by flood flow

$$F = C_D \cdot W_o \cdot \varepsilon \cdot A \cdot \frac{V^2}{2g}$$

C_D: Drag coefficient ($C_D = 1.0$)

W_o: Unit weight of water ($W_o = 1.2$ ton/m^3 */)

*/ Sediment load in water is taken into account.

ε : Coefficient due to interlocking effect ($\varepsilon = 0.35$)

A : Upstream area of each concrete block

The most prevailing type of concrete block in Japan was employed. From the above formula, concrete block having about 8 mt in weight was selected.

2.3.2 Permanent Structural Works

(1) Thickness of stilling basin slab

The determination of concrete thickness of stilling basin slab was made based on the criteria that (a) reverse filter with a underdrain pipe network and weep holes should be provided beneath stilling basin slab in order to reduce up-lift pressure and accordingly (b) a safety factor against up-lift pressure in determining the thickness of concrete slab should be 20% though about 30% guided in the Japanese design criteria.

(2) Conditions and criteria of structural calculation

a) Load

Dead load and surcharge load

Reinforced conorete	2.40 t/cu.m
Plain concrete	2.30 "
Soil, wet	1.80 "
Soil, saturated	2.00 "
Soil, submerged	1.00 "
Surcharge load	1.00 t/sq.m

Earth pressure

Rankin's formula is used for the structural design. No cohesion of soil is taken into consideration in calculation of earth pressure and no friction angle between wall and soil is also considered. Earth pressure is calculated as below.

$$Pv = \frac{1}{2} \cdot r.K.H2$$

where, Pv: Earth pressure (t/m)

r: Unit weight of soil (t/cu.m)

H: Height from the ground surface (m)

K: Coefficient of earth pressure

$$K = \text{Tan}2\ (450 - \frac{\phi}{2})$$

ϕ - Internal friction angle (degree)

Hydrostatic pressure

Hydrostatic pressure acting on a plane surface is calculated by the following formula.

$$Pw = \frac{1}{2} \cdot rw \cdot H^{z}$$

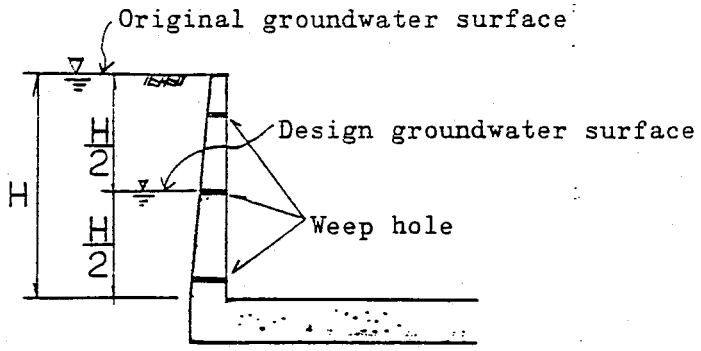
$$= \frac{1}{2} H^{z}$$

where, Pw Total hydrostatic pressure (t/m)

rw: Unit weight of water (= 1.0 t/cu.m)

H: Water depth (m)

Due to the effective for installation of weep holes, the hydrostatic pressure acting on the wall is reduced as follows.



b) Stress Calculation

Stress in concrete and reinforcing bar of concrete members is calculated by following equations.

$$c = \frac{M'}{b.d2} \cdot C$$

$$s = \frac{M'}{b.d2} S.M$$

$$c = \frac{Q}{b.d} \cdot Z$$

$$M' = M + N.u$$

where, c: compressive stress of concrete (kg/sq.m)

s: tensile stress in reinforcing bar (kg/sq.m)

c: shear stress in concrete (kg/sq.m)

M: applied bending moment (t.m)

N: applied axial load (t)

Q: applied shear force (t)

b: width of compression face of member (cm)

d: distance from extreme compression fiber to centroid of tension reinforcement (cm)

u: distance from acting point of "N" to centroid of tension reinforcement (cm) ("N" is assumed to act on centroid of gross concrete section)

n: modular ratio (= Es/Ec = 15)

c,s,z: coefficients

The coefficients "C", "S", "Z" are given in the report "Structural Calculation for Stilling Basin of Kankai Diversion Structure" submitted by NK through letter No. NKP/RE-31/84 dated 18 March 1984.

Requirement of reinforcement bars are obtained from the following.

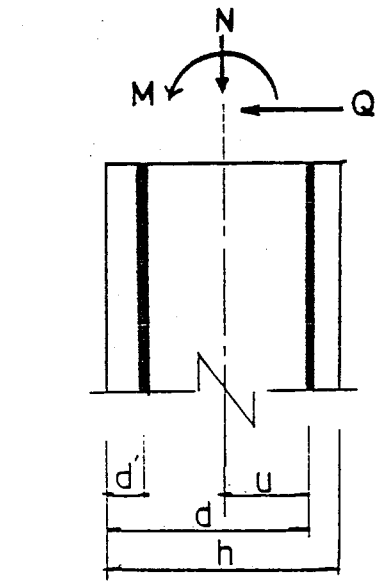
h: overall thickness of member (cm)

de: distance from extreme compression fiber to centroid of compression reinforcement (cm)

f: lower length of "N" measured from centroid of tension reinforcement for producting total amount M' (cm)

P: ratio of tension reinforcement area to effective concrete area (= As'/b.d)

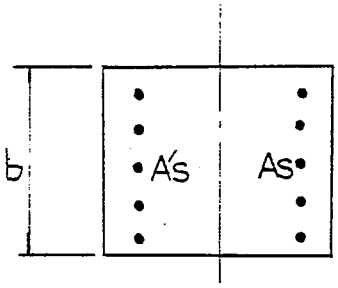
As , As' : area of tension and compression reinforcement, respectively



$$f = \frac{M}{N} + u$$

$$M' = M + U \cdot u$$

$$P = \frac{As}{b \cdot d}$$



c) Allowable Stress

The allowable stress of the materials in normal condition short term condition is decided as follows.

Allowable Stress

Material	Allowable stress (kg/sq.m)	
	Normal	Short term
1) Concrete		
- Compressive (σca)	70	87.5
- Shearing (σca)	8	10
2) Reinforcement bar (SD24)		
- Tensile (σsa)	1,600	2,000
- Bond (σoa)	14	17.5
3) Bearing capacity of foundation (qa)		
- Soil	15	18.8
- Soft rock	30	37.5

d) Stability Requirement

To assure safety against i) overturning ii) sliding and iii) bearing stress of foundation, stability analysis are made on the intake site and stilling basin structure. Explanations of stability calculation on each case are shown below.

Overturning

$$Fs = \frac{MR}{MD} \quad \text{and} \quad e \geq \frac{B}{6}$$

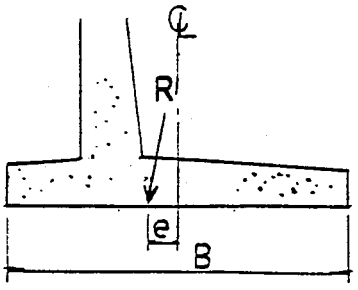
where, Fs: required safety factor

MR: total resisting moment (t.m)

Md: total reversing moment (t.m)

e: eccentric distance from axis of structure (m)

B: width of foundation (m)



Sliding

$$Fs = \frac{\sum V.f}{\sum H}$$

where, V: total vertical forces (ton)

H: total horizontal forces (ton)

f: coefficient of friction (f = 0.7)

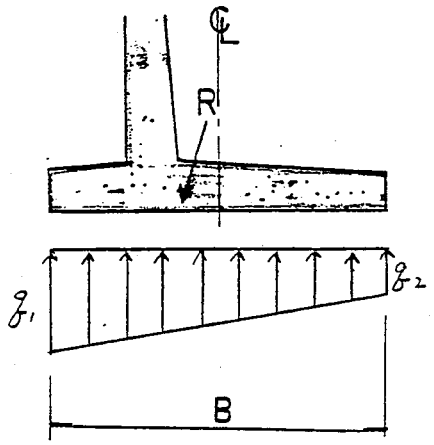
Bearing stress of foundation

$$q\frac{1}{2} = \frac{V}{B.L}\left(1 + \frac{6.e}{B}\right)$$

where, $q\frac{1}{2}$: bearing stress (t/sq.m)

B.L: width and length of structure (m)

e: eccentric distance (m)



Allowable minimum safety factor

Allowance minimum safety factor in normal and short term condition is shown below.

Case	Normal	Short term
Overturning	1.5	1.2
Sliding	1.2	1.0
Bearing capacity (t/m2)		
- Soil	15	18.8
- Soft rock	30	37.5

2.3.3 Temporary Work

(1) River diversion during construction

Major temporary work for the Project was a river diversion work during the construction. Though the river diversion work should be done under the responsibility of the Contractor, the Contractor has been strongly guided to facilitate the proper river diversion work by the Engineer with the following Engineer's estimate.

a) Data on floods occurred in the dry season
Table 2.3.1 shows the yearly maximum discharge occurred in the dry season from November to May recorded at the project site.

b) Design discharge of the river diversion
Probable flood with an occurrence of once in 5 years by the Gumbel method .....82.7 cumsec.
Past maximum flood occurred in the dry season ..... 150 cumsec.

The design discharge of the river diversion including coffering work was employed at 150 cumsecs taking the lack of data from the year of 1970/71 to 1976/77 and the importance of the Project into considerations.

Table 2.3.1 Flood in the Dry Season

Year	Max. Discharge (m^3/S)	Month
1964/65	66.8	May
1965/66	58.6	Nov
1966/67	29.0	Mar
1967/68	30.0	Nov and Feb
1968/69	42.6	May
1969/70	40.0	Nov and May
1970/71 to 1976/77	-NA-	-NA-
1977/78	40	Feb
1978/79	25	Feb
1979/80	150	Dec
1980/81	30	Nov
1981/82	60	May
1982/83	30	Nov

Data Source : 1) Data from 1964 to 1970 by Feasibility Report on Kankai Irrigation Project prepared 1972

2) Data from 1977 to 1983 by measured data by Kankai Project Site Office

(2) Pump requirement for dewatering

The maximum dewatering quantity was assessed by the following formula under the condition that effect of sheet pile walls be little expected.

$$Q = 4\,k\,r_o\,(H - ho)$$

where: Q : Inflow into the excavation area and amount to be removed

k : Coefficient of permeability

H : Depth from groundwater table to impervious layer (EL. 118 - EE. 103 = 15 meters)

ho: Depth from excavated bottom to impervious layer (EL. 110 - EL. 103 = 7 meters)

r_o: Radius of excavation area (o max. = 50 meters)

Coefficient of permeability (k) was estimated by the following Terzagi's formula:

$$k = 800 \times \frac{\mu_{10}}{\mu_t} \cdot \left(\frac{\lambda - 0.13}{\sqrt[3]{1 - \lambda}}\right)^2 de^2$$

where μ_{10}: Viscosity of water at 10° C (0.0131)

μ_t : Viscosity of water at t C, 20 = 0.01009

λ : Porosity, estimated at 30%

de : 10% grain size of river bed material de = 0.027 cm

From the above formula, the maximum dewatering quantity was assessed at Q = 0.45 cumsec (or 27 cum per minutes).

2.4 Contract Documents

2.4.1 Supply of Steel Sheet Piles

A contract document for supply of steel sheet piles was prepared by employing a standard type of contract documents prevaling in Nepal subject to the eligibility requirements of ADB. the major features of the contract documents were as follows:

Bid bond : not less than 2%

Performance : 5%

Payment Schedule :

1) 90% both the FOB price and the price for insurance, freight and inland transport of goods after the shipping with necessary documents, and

2) Remaining 10% after issuing the Final Acceptance Certificate

Liquidated damage :

1% of the FOB price of goods for delay in each week and not exceeding 10% in total

2.4.2 Civil Work Contract

A contract document for civil work was prepared by employing a standard type of contract documents prevailing in Nepal, too, with containing some special conditions taking the urgency and tightness of construction schedule of the Project into consideration. The major features of the contract document were as follows:

(1) General Condition of Contract : Employed FIDIC 3rd Edition with adding conditions of particular application.

(2) The Engineer : Project Manager of Executing Agency Side

(3) Bid bond : not less than 2%

(4) Performance bond : 10%

(5) Advance payments : There were two kinds of advance payment, one was for mobilization and the other for construction materials, made to the contractor in the following manners:

a) Advance payment for mobilization in an amount not exceeding 20% of the accepted tender price on the following basis:

S.No.	Activity	Percentage of the accepted tender price
		(%)
1.	Signing of the Contract agreement and delivery of Performance Bond and against Bank Guarantee	3.0
2.	Delivery of sheet piling equipment to the site	5.0
3.	Delivery of dewatering equipment to the site	4.0
4.	Delivery of excavation equipment to the site	4.0
5.	Delivery of concreting equipment to the site	4.0
	Total	20.0

b) Advance payment for any materials for permanent work delivered by the Contractor on the site but not incorporated in such work up to 70% of the value. The amount of both advance payment was repaid to the Employer on the progress basis in the manner of reducing from each monthly payment.

(6) Payment : The payment was made to the Contractor both in Nepalese and foreign currencies in the proportions proposed by the Contractor subject to the acceptance by the Engineer.

(7) Price Escalation : Price escalation was considered only for the construction materials such as cement, reinforcement steel, petrol and diesel fuel. The net increase or decrease in the Contract price due to increase or decrease in the cost of the above materials on the basis of the quantities certified by the Engineer as having been incorporated in the works. As for the petrol and diesel fuel, the quantities used for vehicles engaged in transporting any labour, plant, equipment or materials to or from the site were excluded from the consideration for the price escalation.

(8) Taxations : Contract tax, sales tax and custom duties required for the project works were exempted from the Contractor subject to condition that the Contractor should pay these taxes and such amount should be reimbursed separately to the Contractor by the Employer. While payment of other taxes

should be the responsibility of the Contract.

(9) Date of completion and Liquidated Damages/Bonus:

The works were divided into three stages each having different date of completion as follows:

Stage	Description	Date of Completion
1.	Installation of sheet piles	15 May 1984
2.	Stilling basin and downstream river bed protection	15 May 1985
3.	Remaining works	30 June 1985

Liquidated damages for delay were imposed to the Contractor when the Contractor failed to complete any stage of the works as designated above and the contractor should pay to the Employer as liquidated damages a sum as stated in the following table for each calender day beyond the date of completion.

Stage	Description	Liquidated Damages per day of delay (Rs)	Maximum Amount of Liquidated Damages (Rs)
1.	Installation of sheet piles	50,000	1,000,000
2.	Construction of Stilling basin and downstream river bed protection	100,000	3,000,000
3.	Remaining works	1,000	100,000
	Total		4,100,000

While, bonuses were paid to the Contractor when the Contractor completed stage 1 and stage 2 of the works earlier than the designated date of completion. The Employer would pay to the Contractor as Bonus the sum stated in the following table for each calender day ahead to the date of completion.

Stage	Description	Bonus per day of early completion (Rs)	Maximum amount of Bonus (Rs)
1.	Installation of sheet piles	25,000	500,000
2.	Construction of stilling basin and downstream river bed protection	50,000	1,000,000
	Total		1,500,000

III IMPLEMENTATION

3.1 Executive Organization

The implementation of the Project was administrated and managed by the following organization.

(1) Executing Agency

The Department of Irrigation, Hydrology and Meteorology (DIHM) was the Executing Agency responsible for the Project. It is under the Ministry of Water Resources (MWR) and is headed by a Director General.

(2) Kankai Development Board

Under the direct control of DIHM, Kankai Development Board (KDB) is a representative to execute the Project. The chairman of the KDB is the Secretary of the MWR and board members are appointed from the other HMG's departments and agencies concerned to the KIP. The Project Manager of KIP is also a member and secretary of KDB. KDB is a policy making body relating to all the activities of the KIP and also provided necessary assistance and guidance for the successful and timely completion of the Project.

(3) Kankai Irrigation Project Office

The Kanaki Irrigation Project Office at the site, established for the purpose of KIP, was responsible for the day-to-day execution of the works. This office in particular prepared and issued tender documents, issued procurement invitations, evaluated bids supervised the construction and maintained proper records of expenditure and progress on the Project.

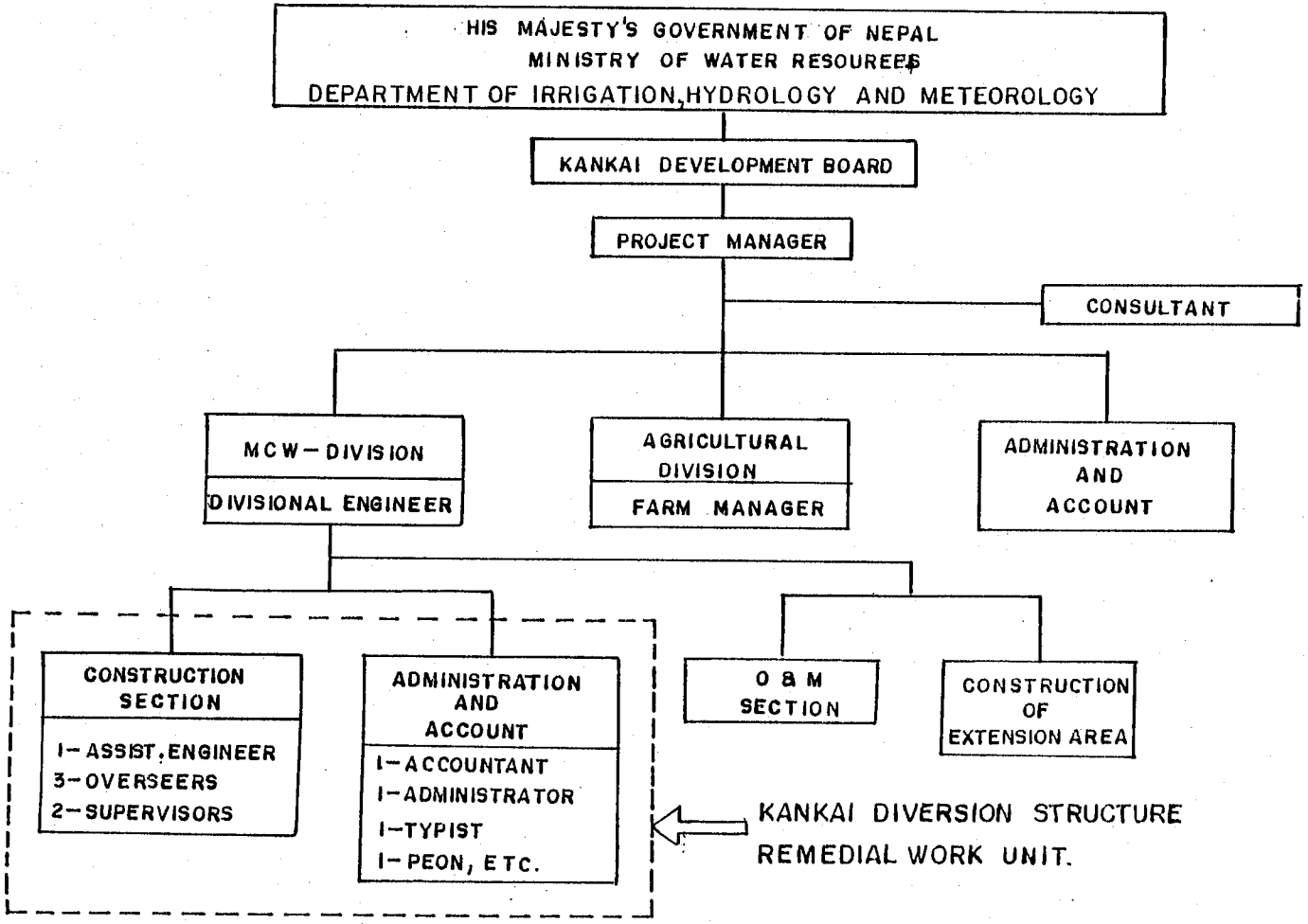
KIP office is headed by a Project Manager and had a particular unit for the Project under a Divisional Engineer. This unit had a Site Engineer, three overseas and other necessary supporting staffs.

(4) Consultant

The execution of the Project was assisted by the Consultant in such a manner as assisting the Project Manager, who was designated as "the Engineer" on the Civil Contract, in procuring the steel sheet piles and civil contractor, in executing the supervisory works, in monitering and maintaining the progress, in preparation of various reports, in dealing with contractual matters and in issuing the various certificates to the Contractor.

The above mentioned executive organization is shown in Fig. 3.1.1.

FIG. 3-1-1 CHART OF EXECUTIVE ORGANIZATION



3.2 Loan Arrangement

In response to HMGN's application to ADB for a loan for the implementation of the Project, ADB agreed to make the loan to HMGN form the ADB's special Funds resources after an appraisal study for the Project had been done by ADB. The total amount of the loan was SDR. 3,304,000 (US$ 3.5 million equiv.) which would be used as the foreign exchange for the civil works, procurement of steel sheet piles and vehicles and consultants' services and as a supplement for the local expenditure. The loan agreement was concluded on 19 December 1983 in the implementation of the Project, HMGN was allowed to take advance actions before the loan agreement be valid subject to approval by ADB.

In order to enable the Executing Agency to meet the tight schedule of the Project, ADB approved on 5 September 1983 the following advance actions to be taken before the loan agreement in respect of the Project be valid:

(1) Procurement of steel sheet piles through international shopping to ensure delivery at site no later than the second week of January 1984.

(2) Award of civil works contract through international competitive bidding by mid-December 1983 to ensure that the Contractor would be ready to commence the sheet piling work by 1 February 1984, and

(3) Contractual arrangements with the consultants to ensure timely accomplishment of the design, procurement of steel sheet piles and the award of civil works contract.

3.3 Selection of Engineering Consultant

Nippon Koei Co., Ltd. (NK), which have been engaged in KIP Project Consultant since its beginning, was selected as the Engineering Consultant for the Project on negotiation basis taking NK's full awareness and continuing examination of the Diversion Structure problem into consideration.

Consultants services were required for carrying out hydraulic model test, preparation of detailed design and construction drawing and to assist the Executing Agency in the project implementation involving preparation of prequalification and tender documents for Civil Works Contract, preparation of bid documents for procurement of steel sheet piles, evaluation of tenders/quotations, award of contracts, supervision of the construction work, monitering of the construction progress and other activities relating to the contract administration. The man-months required for the detailed design and

assistance in respect of the Project implementation was 26 man-months in total as given below:

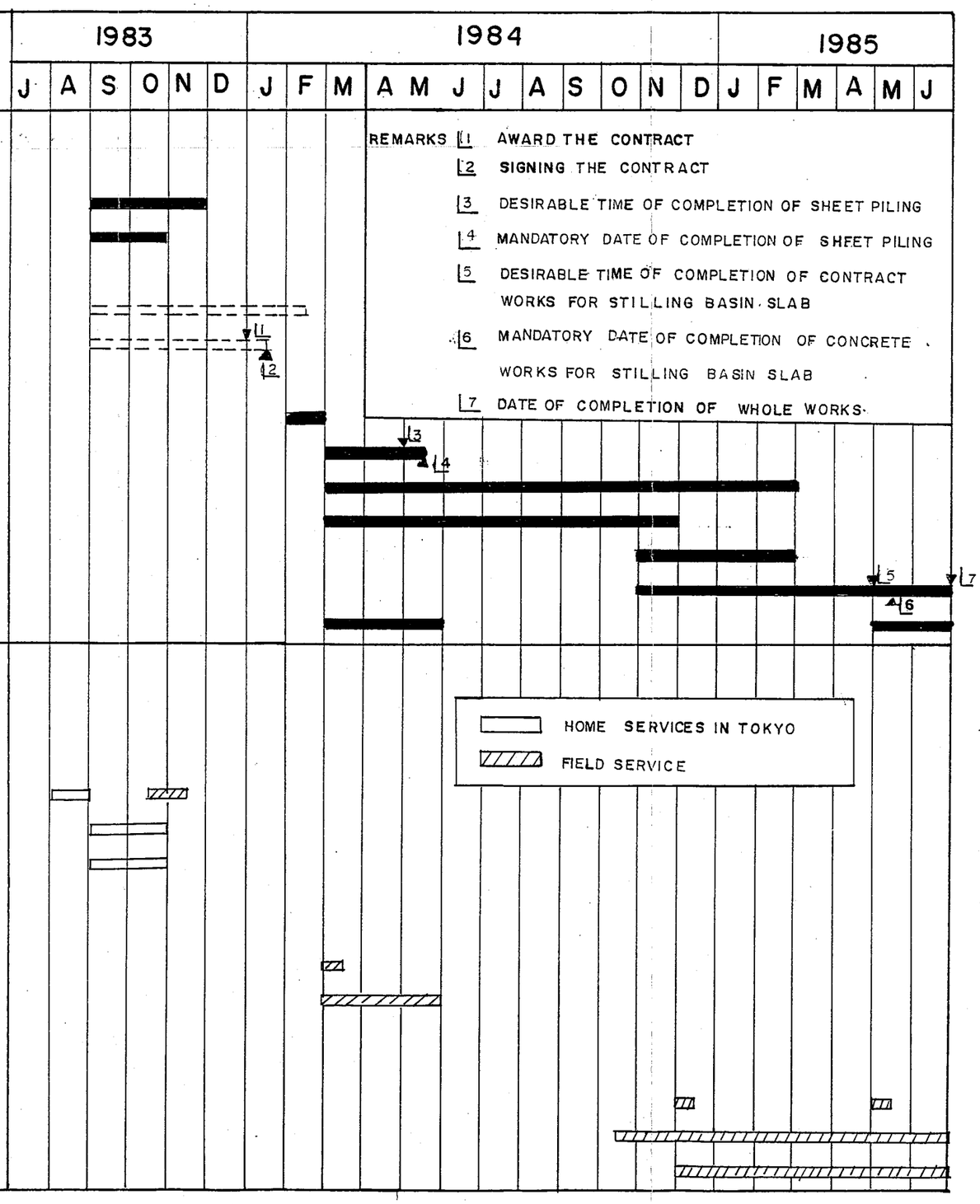
Detailed Design	:	5.0 man-months
Assistance in respect of Advance Procurement Action	:	1.0 "
Assistance in respect of the work relating to sheet pile installation	:	3.5 "
Assistance in respect of remaining project implementation work	:	16.5 "
Total	:	26.0 man-months

The distribution of the above man-months schedule is shown in Fig. 3.3.1.

The Contract for the Engineering Services with NK was concluded and signed on 8 April 1984.

FIG · 3·3·1 ASSIGNMENT SCHEDULE OF CONSULTING SERVICES

DESCRIPTION
PROPOSED IMPLEMENTATION SCHEDULE
1 DETAILLED DESIGN & HYDRAULIC MODEL TEST
1-1 DETAILED DESIGN
1-2 HYDRAULIC MODEL TEST
2 PROCUREMENT
2-1 SHEET PILE
2-2 CIVIL WORKS
3 CUNSTRUCTION
3-1 PREPARATORY WORKS
3-2 SHEET PILING
3-3 PRECAST CONCRETE BLOCKS
3-4 PRODUCING AGGREGATES
3-5 CLEARING & EXCAVATION
3-6 CONCRETE WORKS
3-7 MISCELLANEOUS WORKS



PROPOSED ASSIGNMENT SCHEDULE OF CONSULTING SERVICE

1 DETAILED DESIGN AND ASSISTANCE IN RESPECT OF PROUCRUMENT ACTION (6 M/M)

- 1-1 CHIEF ENIGINEER (2 M/M)
- 1-2 DESIGN ENGINEER(A) (2 M/M)
- 1-3 DESIGN ENGINEER(B) (2 M/M)

2 ASSISTANCE IN RESPECT OF THE WORK RELATING TO SHEET PILE INSTALLATION (3.5 M/M)

- 2-1 CHIEF ENGINEER (0.5M/M)
- 2-2 CONSTRUCTION ENGINEER (3 M/M)

3 ASSISTANCE IN RESPECT OF REMAINING PROJECT IMPLEMENTATION WORK (16·5M/M)

- 3-1 CHIEF ENGINEER (1M/M)
- 3-2 CONSTRUCTION ENGINEER (A) (8·5 M/M)
- 3-3 CONSTRUCTION ENGINEER (B) (7M/M)

3.4 Procurement of Steel Sheet Piles

Steel sheet pile was proposed to be used for a river diversion and care of water during the construction of the Project in such a manner as providing it to the Contractor from the Executing Agency. The procurement of steel sheet piles was done as the advance action through international shopping by the Executing Agency.

A notice of invitation for bids for supply was advertized on "the Rising Nepal", English newspaper in Nepal, on 7 September 1983. The submission of the bids were closed on 25 September 1983. By the closing date, bids were received from nine (9) suppliers and all were accepted as valid.

A proposed type of steel sheet pile was U-shaped one and the bid was initially made for the supply of 400 mt with a specification of Type-I sheet pile (400 mm (W) x 75 mm (H) x 8 mm (T) or nearest equivalent). However, the result of study and detailed design being carried out by NK in Tokyo recommended to change the type of piles from Type-I to Type-II (400 mm (W) x 100 mm (H) x 10.5 mm (T) for the reason of harder soil foundation anticipated more than 20 in N-value with containing certain amount of boulders in it.

The above recommendation was accepted and the further quotations for Type-II piles were immediately inquired to three (3) lowest bidderers among nine ones. The fresh quotations were collected from the bidderers by 25 October 1983. Kanematsu-Gosho Ltd. was selected as the successful supplier of increased quantities of steel sheet pile of 440 mt and the contract was made on 7 November 1983 with an amount of .

US$ 149,865.40 (439,488 mt) plus RS. 312,476

Although the delivery of sheet piles to the site was delayed for about three weeks due to the change of its specification from Type I to Type II after closing bids, sheet piles were on site within the first week of March 1984. The following shows a record of supply of Japanese made steel sheet piles after the contract until the delivery to the site:

Date of shipping from Japan	:	27 December 1983
Date of arrival at Calcutta port	:	16 February 1984
Delivery to the site	:	5 and 6 March 1984 by 17 Nos. truck trailers without any missing

3.5 Prequalification of Civil Contractors

Prequalification of civil contractors was made for the purpose to select a civil contractor from among only possible contractors having sure and sufficient ability in engineering, construction plant and equipment available and finance, so that a risk to fail in completing within the construction schedule would be avoided.

A notice of the prequalification was advertized on "the Rising Nepal" on 7 September 1983. By the closing data for submission of document on 25 September 1983, applications for the prequalification were received from the eight (8) firms, comprising one (1) from Nepal, four (4) from India and three (3) from Korea.

The evaluation of prequalification documents was made by NK with applying very strict evaluation criteria taking into account a nature of the Project. The applicants were evaluated on the following status with score adopted in the evaluation:

		Score
1)	Engineering capability and experience	50
2)	Construction Plants own hand	50
	2)-(a) Availability of sheet piling equipment	(30)
	2)-(b) Other construction plant and equipment	(20)
3)	Financial standing	40
4)	Company records	10
	Total	150

The passable score in the prequalification was defined at as high as more than eighty (80) % or 120 points of the total full mark.

The most importance was given to the availability of the Contractor's own construction plant and equipment, particularly placed on whether the sheet piling equipment could be mobilized immediately after the contract be made and be delivered to the site within 1.5 months by the end of January 1984. The applicant who didn't have their own sheet piling equipment or didn't have recognized sources to sent it was marked "zero" and not qualified accordingly.

Out of eight (8) applicants, the following three (3) Contractors were finally selected as qualified for participating in the tendering for the civil works of the Project:

1) Korea Development Corporation (Korea)
2) Sambu Construction Co., Ltd. (Korea)
3) Sankyong General Construction Limited (Korea)

The result of prequalification was submitted to DIHM by NK on 30 September 1983.

3.6 Tender for Civil Works

DIHM transmitted tender documents to the aforementioned three (3) qualified contractors on 12 October 1983. By the tender closing time 12:00 hours local time on 28 November 1983, two (2) tenders were received from the following two qualified tenderers from Korea:

1) Korea Development Corporation (KDC)
2) Sambu Construction Co., Ltd. (Sambu)

After the tenders were opened publicly at the office of KDB in Kathmandu on that day in the presence of representative of DIHM, NK and tenderers, NK started immediately the evaluation of tenders. Both tenders were legally valid and a focal point in evaluation of tenders was the amount of tender price. The detailed assessment of the lowest tender offered by KDC, quoting Rs. 44.7 million against the Engineer's Estimate of Rs. 45.9 million, was carefully made and NK resulted to recommend DIHM to give the first priority of award of the Contract to KDC. NK submitted a tender evaluation report on 5 December 1983.

The record of subsequent actions for contract conclusion was shown as follows:

Acceptance of KDC's tender by DIHM and sending documents to ADB for concurrence	:	9 December 1983
ADB's concurrence for the Contract with KDC was given to DIHM	:	6 January 1984
Issuance of letter of Intent to KDC	:	13 January 1984
Contract signed	:	28 February 1984
Issuance of Order of Commencement of works to KDC	:	1 March 1984

3.7 Construction Schedule and Progress

3.7.1 General

The project was required to be completed during the shortest period of time which covered only two (2) dry seasons from the year of 1983/84 through 1984/85. The construction schedule was largely divided into two (2) stages the first stage was steel sheet piling to be done for 2.5 months from the beginning of March 1984 to completing up to mandating date on 15 May 1984, and the second was the construction of stilling basin with associated works for 8 months from November 1984 to June 1985 with setting up particular mandating completion date of the construction of stilling basin slab and downstream river bed protection on or before 15 May 1985.

Though the mobilization of piling equipment was seriousely delayed for about 1.5 months behind the schedule, the sheet piling work was carried out within very short period of about one (1) month and successfully completed on 13 May 1984, two days earlier than the mandating date on 15 May 1984.

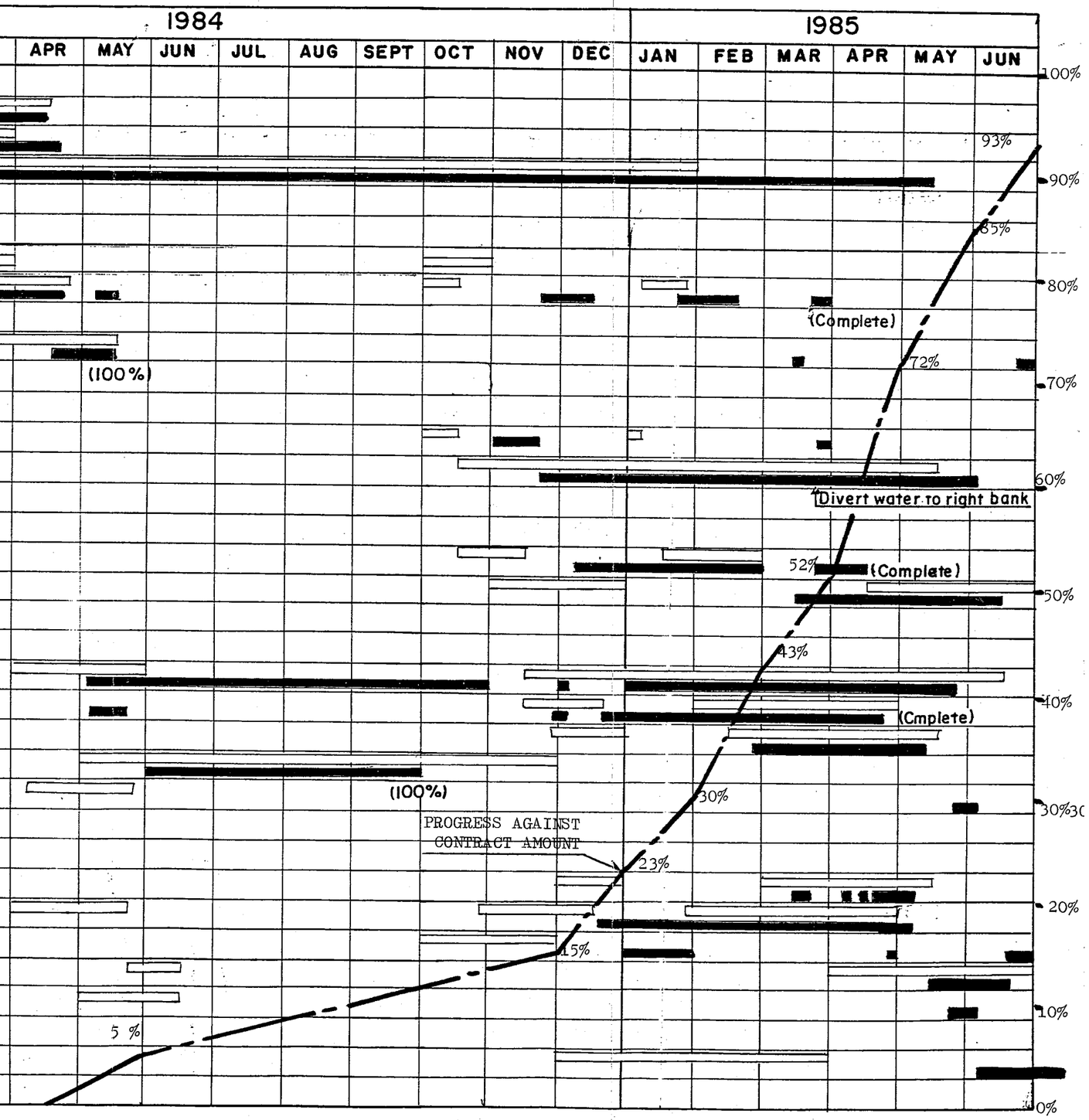
During the bridging period of the rainy season from the first stage to the second one, preparatory works such as production of concrete aggregates and of precast concrete blocks for the launching apron were done, and the latter was completed during this period.

The second stage was actively commenced from the beginning of December 1984, being also delayed for about one (1) month behind the schedule due mainly to insufficient mobilization such as delay in delivery of construction materials and shortage of construction equipment as well as the spareparts. However the delay in progress has been gradually recovered by the Contractor's own efforts to strengthen the work force with having such an aid as providing construction equipment by the Executing Agency and the construction of stilling basin slab and the downstream river bed protection were successfully completed on 8 May 1985, seven (7) days earlier than the mandating date on 15 May 1985. The remaining miscellaneous works were also completed by the middle of July,1985

The overall construction schedule construction schedule and the actual progress are shown in Fig. 3.7.1.

FIG 3.7.1 OVERALL CONSTRUCTION SCHDULE & PROGRESS

DESCRIPTION	UNIT	Q'TY
1. PREPARATORY WORKS.		
Delivery of Construction Plant	–	–
Temporary Facilities	–	–
Aggregates Production.	m3	32,000
2. CLEARING WORKS.		
Site Clearing.	ha	–
Removal of Exist. Conc. Blocks	m3	4,000
3. DRIVING STEEL SHEET PILES	ton	353
4. RIVER DIVERSION & CARE OF WATER		
Coffering	–	–
Diversion & Care of Water.	–	–
5. EARTH WORKS.		
Excavation in River Bed	m3	56,000
Backfill.	m3	5,300
6 CONCRETE WORKS		
Side Walls (Conc Type. A)	m3	1,400
Basin, Slab (Conc Type. BB)	m3	11,000
Steel Fiber Conc (Conc Type AA+Fiber)	m3	2,540
Precast Conc Block (Conc Type B)	m3	2,800
Inclined Wall (Type BB)	m3	290
7. MISCELLANEOUS WORK		
Conc. Block Installation.	Nos	881
Gravel Foundtion & Filter Lay	m3	3,350
Flood Dike	m3	6,700
Wet Rubble Masonry	m2	1,100
Add Embank at Intake	m3	930
8. RAISE SCOURING SLUICE GATES	–	–



PROGRAM LINE
ACTUAL PROGRESS LINE

3.7.2 Contractor's Mobilization

KDC dispatched a crew to the Project site and started the construction of camp including offices, store house and staff quarters from 23 January 1984. The Contractor's major site facilities including electricity supply system and fencing around the camp were completed by the end of April 1984.

KDC had a depot of the major construction plant and equipment in Bangladesh from which they intended to import almost all the major equipment to be used for the Project including the sheet piling equipment to Nepal through India directly by land, not by sea from Chittagong through Calcutta as an usual route in order to squeeze the time for transportation.

All the plant and equipment were assembled at the Bangladesh/India border by 2 February 1984. Meanwhile, KDC was trying to obtain a permission for the transit of equipment through the Indian teritory by land from the Government of India. However it took very long time to obtain the permission, and this resulted the long delay in custom clearance from Bangladesh to India. The major equipment imported from Bangladesh depot including piling ones were finally delivered to the site, starting from 9 April and up to 13 April 1984, which was about 1.5 months behind the schedule.

The delivery of major construction materials imported from Korea was quickly done at the initial stage. Cement of 500 tons necessary for the first dry season was delivered to the site by the beginning of March 1984, and other materials such as reinforcement bars of about 180 tons and ply wood of 500 sheet were available on the site in April 1984.

3.7.3 Steel Sheet Piling Work

The most critical work on the time schedule, a key to successful completion of the Project in time, was a steel sheet piling work by which the sub-surface water in the excavation area would be controlled. The piling work was to be started on the schedule from the beginning of March 1984, but it was actually done from 15 April 1984 with lag for 1.5 month behind the schedule. The piling work was smoothly carried out and successfully completed on 13 May 1984, two (2) days earlier than mandating date of completion on 15 May 1984. The construction time was squeezed to only one (1) month from the anticipated 2.5 months due mainly to use of proper piling equipment and piling practice by very superior operator available as well as the Contractor's exterme effort. The payable quantity of piling work was about 322 mt in total or about 6,700 m long.

3.7.4 Preparatory Works in the Rainy Season

The major works to be done in the rainy season of the year 1984 were preparatory ones such as production of precast concrete block for the launching apron and production of aggregates.

KDC started to produce the precast concrete blocks from June 1984 and completed to produce for 4 months a required quantity by the end of September 1984. The total quantity of concrete blocks produced was 882 pcs in total or about 2,800 cu.m in concrete volume.

The production of aggregate was started from the middle of May 1984 in the Kankai river bed fairly downstream from the stilling basin and was to be completed by the end of 1984. However, the production was in slow progress as low as only 30% at the end of the rainy season (end of October 1984) and 58% at the end of 1984 due mainly to lower density of coarse aggregates in the river bed materials in the downstream area and heavy rainfalls in the rainy season.

The preparation of the working drawings and a detailed construction schedule were also prepared by KDC in this rainy season.

3.7.5 Construction of Stilling Basin and Associated Works

November 1984:

In the construction schedule prepared before the rainy season of 1984, a river diversion with coffering work was to be completed at the beginning of November 1984 and subsequently the concrete placing for the stilling basin slab at the deepest portion was to be commenced from the middle of this month. However, the force of construction equipment was very short due to insufficient number of equipment with the major those in out-of-order conditions. No fresh cements had been delivered to the site yet, too. These brought on the delay in the progress of the entire work about 4 weeks behind the schedule at the end of this month.

This delay, corresponding to about 15% of the construction period in the second dry season at this stage was very significant one which might result in the failure to complete the stilling basin slab before the flood season because the conditions of sub-soil water and base rocks of the both banks were unknown factors for the progress of the foundation excavation in the river bed.

An ADB progress review mission visited the site in the later this month. Reviewing the current situation of the progress, the Mission advised the concerned three parties, e.g., the Engineer (DIHM), the Consultant and the Contractor that the following action had to be taken immediately to remedy the delay in progress within the first week of December 1985:

(a) Cement for a 15 days requirement (500 metric tons) had to be delivered to the site.

(b) A delivery schedule for the remaining cement, reinforcement bars, plywood, steel fibres and any other outstanding materials had to be prepared.

(c) A report on the arrangement for cement storage had to be submitted.

(d) The construction equipment as per the Tender proposal had to be delivered.

(e) Sufficient skilled Korean foremen had to be at site.

(f) The production schedule for concrete aggregate and filter/drain materials had to be submitted.

(g) A realistic revised construction schedules had to be prepared. One schedule might allow for workable contingency provision which would allow deferment of part of the construction until 1985, providing the deferment in no way would endanger the stability of the partially completed works.

In addition, the Mission suggested that all the actions mentioned above had to be certified by the Engineer (Project Manager) and the Consultant, and this certificate accompanied by copies of the above items (b), (c), (f) and (g) sent to Manila such that they were received by the Bank no later than 10 December 1984.

The coffering work was started from 5 November and the flow of the Kankai river was diverted to its left-half on 20 November. Following the river diversion, the removal of existing concrete blocks provided at the downstream of the weir was started. The progress of the civil works up to the end of this month was 15% including sheet piles driving.

December 1984:

Upon the Mission's suggestion, the Executing Agency and the Consultant took immediate actions including supplying the HMGN's construction equipment to the Contractor and successfully fulfilled the requirement.

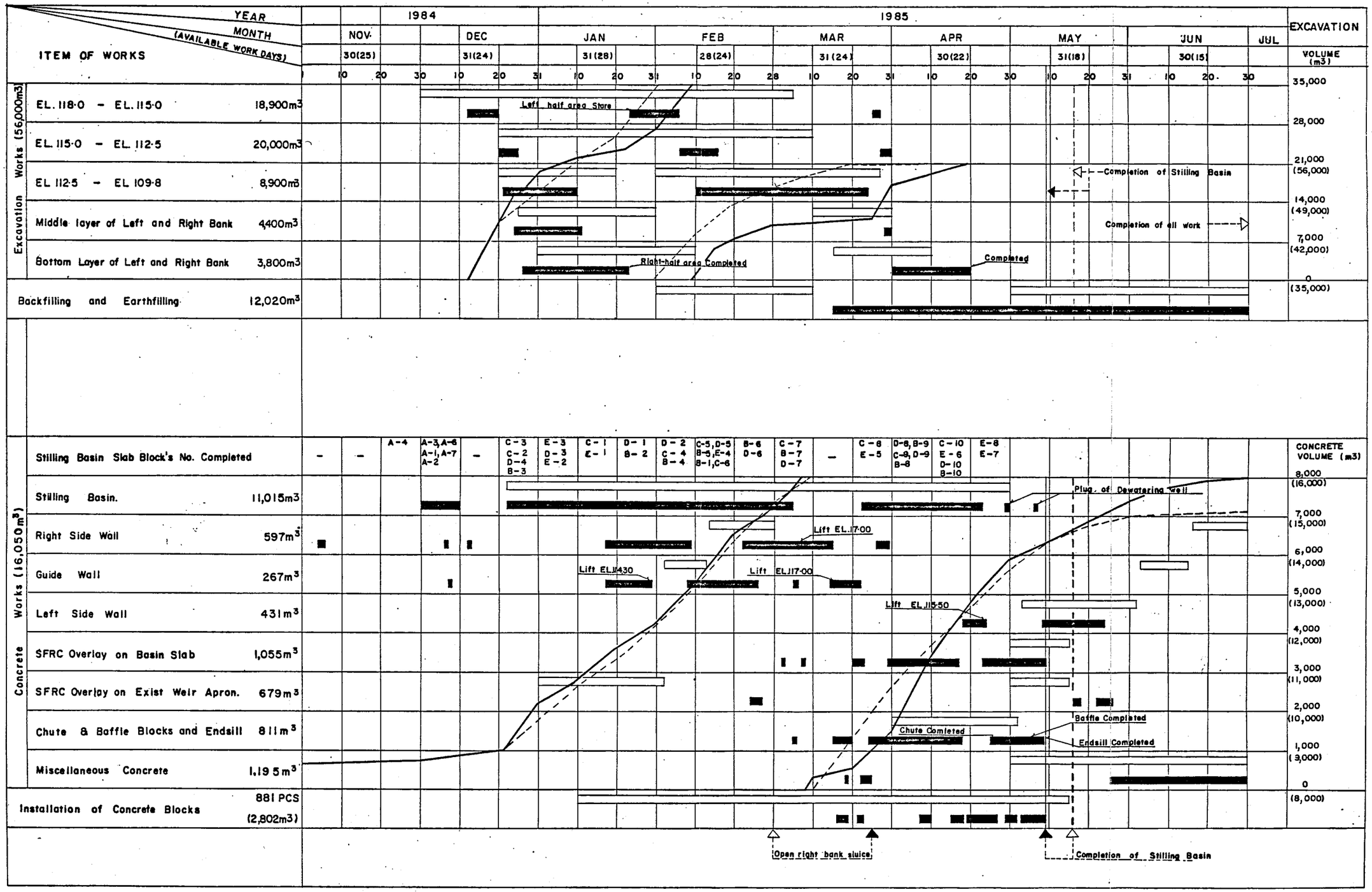
With strengthening the mobilization made by KDC, three Bulldozers including two hired from KIP and cements of 1,100 tons were delivered to the site at the beginning of this month. The foundation excavation in the river bed was started from 12 December and the concrete placing for the stilling basin slab at the deepest portion was started from 22 December.

In order to recoup the delay in the entire progress as well as to accomplish the construction of the Project within the time schedule, the construction plan and schedule was thoroughly reviewed by NK. Taking the KDC's current force and anticipated one to be reinforced into the account, a revised construction schedule as shown in Fig. 3.7.2 was prepared. The main remedial step to recover the progress stressed in the revised construction plan was that the foundation excavation in the left-half area should be started as early as possible without waiting for the river diversion to the right bank through scouring sluice by constructing a diversion channel at the left corner of the left bank along the foot of hill.

KDC was guided to conform the revised plan and schedule together with giving them a strong advise to increase the both forces of construction equipment and manpower.

The progress of civil works up to the end of this month was 22.5%.

FIG.3.7.2 CONSTRUCTION SCHEDULE AND PROGRESS FOR THE SECOND DRY SEASON (SCHEDULE REVISED ON 20DECEMBER 1984)



LEGEND

- : Work Schedule.
- : Actual progress.
- : Target day to be achieved
- : Actual day achieved.
- : Progress Scheduled.
- : Actual progress.

January 1985:

The sheet pile walls surrounding the excavation area were well functioning to check seepage water from outside. The foundation excavation and subsequent concrete works for stilling basin slabs were smoothly carried out under the dry condition with an aid of intermittent operation of a submersible pump. By the end of this month, one third of the stilling basin slab in area was completed. The concrete placing for guide wall was started in this month.

A concrete lined diversion channel was constructed at the left corner of the Kankai river along the foot of hill and the river flow was diverted into this channel on 23 January. With this, the area covering 80% of the entire foundation excavation area was unwatered. The excavation in the left-half area was commenced from 24 January.

The progress of civil works up to the end of this month was 30%.

February 1985:

With reinforcing the fresh construction equipment such as a shovel Dozer (1.8 m3) and a Backhoe (0.7 m3) delivered to the site at the beginning of this month, the foundation excavation had been done in full swing and it for the area covering 80% of stilling basin slab was completed by the end of this month.

The concrete placing for the stilling basin slab had been continued in good progress and those for the right-half area was completed on 19 February. The construction of slab in the left-half area was subsequently started. The progress of basin slab at the end of this month was ahead of the schedule (Fig. 3.7.2) for about two weeks.

While, the progress of the construction of guide and right-side walls was lagging behind the schedule for about two weeks due to the scarcity of carpenters for the form work and to devoting KDC's major forces to the slab construction.

The progress of civil works up to the end of this month was 43%.

March 1985:

Since the river diversion to the right bank, which had been scheduled on 1 March by opening the scouring sluice gates, was seriously delayed, the stress was placed on the construction of guide and right-side walls as well as the miscellaneous related works to diverting the river flow. It was finally

diverted to the right bank on 25 March through scouring sluice gates and subsequently downstream channel made between guide and right-side walls.

The progress of concrete works particularly for the stilling basin slab was depressed this month for the reason mentioned above. The works of SFRC such as chute blocks, baffle blocks, endsill and overlay on the stilling basin slab were started from this month. The installation of precast concrete blocks for the launching apron was started, too.

Immediately after diverting the river flow to the right bank, the foundation excavation for the remaining portion of the left bank was carried out in full swing and major excavation for the entire area was completed by the end of this month.

The progress of civil works up to the end of this month was 52%.

April 1985:

With completion of major foundation excavation, the progress of concrete works had been sharply rising from the beginning of this month. The concrete placing for the stilling basin slab was basically completed on 23 April and others such as SFRC and left-side wall were also in good progress.

Precast concrete blocks installed by the end of this month covered an area of 75% of the launching apron.

The progress of civil works up to the end of this month was 72%.

May 1985:

With completion of stilling basin slab in April 1985, the remaining major concrete works such as baffle blocks, endsill and SFRC coating on the slab have been smoothly carried out and completed by 8 May. The installation of precast concrete blocks of launching apron including laying filter gravels was also finished on the same day. Thus, all the mandatory works to be completed on or before 15 May 1985 under the Contract were successfully completed on 8 May, seven days ahead of the above mandating date.

The construction of left-side wall and SFRC coating on the existing weir's apron were also completed on 23 and 25 May respectively. The slope protection wall at the left bank is in progress.

The minor works such as river bed protection, backfilling and embankment are also in progress. However those works have been largely hampered by the

abnormally heavy rainfall in the second-half of this month.

The progress of civil works up to the end of this month was 85%.

June 1985:

Following the previous month, the heavy rainfall continued in the beginning of this month and thereby all the coffer banks were washed away on 4 June by a heavy flood.

The remaining works such as slope protection of left-side hill with gully protection dam, wet rubble masonry work and additional embankment at the canal intake were carried out this month. KDC also started an additional work to construct the outlet structure of escape channel from the existing setting basin.

However, the whole works could not be completed by the end of June 1985 which is the date of completion of the Project under the Contract due mainly to the unexpected weather conditions particularly in the later period of the last May. The following works were brought forward for completion in July 1985.

(i) Sod facing in the right-side guide bank

(ii) Sod facing and hand rail for the additional embankment at the canal intake

(iii) Raising the height of scouring sluice gates, and

(iv) Outlet structure of escape channel. (additional work)

The progress of civil works up to the end of this month was about 90%.

3.7.6 Actual Working Days

The Contract period was 16 months from March 1984 to June 1985, out of which the construction period actually workable was 10 months over the two dry seasons, one was 3 months from March to May 1984 and the other November 1984 to May 1985. The total calender days during the above 10 months were 304 days. The anticipated workable days were estimated at 235 days in total taking into account the religious holidays, pay days and the past rainfall records.

As shown in Table 3.7.1, the actual workable days were 289 days, out of which only 15 days were unworkable. The reasons for which works were stopped were Contractor's rest for 9 days and weather conditions for 6 days. No normal weekly holidays or national holidays except particular cases were considered in the light of a requirement of the Project which should be completed before flood season of 1985 without fail.

The rainfall data recorded at EOQ during the Contract period are given in Table 3.7.2.

Table 3.7.1 Actual Working Days (Dry Season Period)

	Calendar day	Anticipated Workable day	Actual Working day	Reason for work stoppage		
				Total	General holiday	Weather
1984/Mar.	31	24	30	1	1	-
Apr.	30	22	28	2	1	1
May	31	24	31	-	-	-
Nov.	30	25	29	1	1	-
Dec.	31	24	31	-	-	-
1985/Jan.	31	28	29	2	2	-
Feb.	28	24	27	1	1	-
Mar.	31	24	30	1	1	-
Apr.	30	22	29	1	1	-
May.	31	18	25	6	1	5
Total	304	235	289	15	9	6

Table 3.7.2 DAILY RAINFALL RECORD

Rainfall Records during Construction Period

Name of Station KIP, EOQ Lat. ° ' Long. ° '

Station No. _____ Alt. . m. For the Year : 1984

	Jan mm	Feb mm	Mar mm	Apr mm	May mm	June mm	July mm	Aug mm	Sep mm	Oct mm	Nov mm	Dec mm
1							10.5	16.7				
2							0.3	8.9	1.0			
3							7.0	6.7	16.0			
4							27.5	2.3	2.2			
5						7.5		2.2	15.8			
6						12.7	15.0		121.0	39.8		
7						109.2	14.0		80.2			
8					1.4	83.9	49.2	10.0				
9					0.2	14.2	26.9	0.7	0.6			
10					68.4	118.9	69.9		130.7			
11					1.2	105.3	51.0					
12		0.3			1.9	7.0	56.5		9.0			
13							75.0	17.5	5.0			
14					3.1	12.0	0.3		4.4	0.3		
15					4.4	38.2	3.5	0.3	2.3	4.0		
16	20.0					83.5	8.5	2.6	437.0			
17	13.6					7.0	96.2	33.0	155.0			
18							10.0	1.5	24.0	0.6		
19							2.0	7.2	134.5	98.0		
20		15.3				97.4		35.0	29.5	26.6		
21		7.0				1.0		30.4		17.5		
22				32.0	14.7			18.5	12.5			
23						39.0	126.3	10.0	1.0			
24						0.2	119.4	2.8				
25						37.4	8.0	27.5				
26						21.6	75.0	3.2				
27			17.2				14.0	3.0				
28				30.5	8.2		38.0	3.0				
29				8.5	34.5	7.0	109.0	5.5				
30					2.2	8.5	3.7	8.0				
31							35.2					
Total	33.6	22.6	17.2	71.0	140.2	811.5	1051.1	257.5	1181.7	186.8		
No. of Days	2	3	1	3	11	20	27	24	19	7		

Max. Daily Rainfall . mm (/) Annual Rainfall 3,773.2 mm

Max. 2- day Consecutive Rainfall . mm Total Rainy Days 117 days

Max. 3- day " . mm

Table 3.7.2 DAILY RAINFALL RECORD

Rainfall Records during Construction Period

Name of Station KIP, EOQ Lat. ° ' Long. ° '

Station No. _____ Alt. . m. For the Year : 1985

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
1						45.0						
2						40.0						
3					13.5	128.0						
4						38.0						
5					15.0	2.1						
6		1.5	7.5									
7					23.0							
8						21.0						
9		2.0										
10												
11					25.5							
12					54.5							
13												
14						0.5						
15					5.0	13.0						
16		18.5				9.0						
17						1.0						
18					52.0	26.0						
19					29.0	10.0						
20					69.0	0.5						
21					48.0							
22				8.5		29.0						
23						0.5						
24						1.5						
25			1.5			30.0						
26					1.0	5.0						
27			3.5		11.5							
28			18.0			8.0						
29					31.0	7.5						
30					14.0	8.0						
31					56.0							
Total	-	22.0	23.5	8.5	448.0	440.0						
No. of Days	-	3	4	1	15	21						

Max. Daily Rainfall . mm (/) Annual Rainfall _____ mm

Max. 2-day Consecutive Rainfall . mm Total Rainy Days _____ days

Max. 3-day " . mm

IV CONSTRUCTION

4.1 Contractor's Facilities

4.1.1 Offices, Stores, Workshop and Quarters

After the issuance of the Letter of Intent to KDC by DIHM dated 13 January 1984, KDC started the construction of a camp including offices, store house and staff quarters at the Project site from 23 January 1984. By the end of April 1984, a site office, a Korean staff quarter, a local staff quarter, a workshop and a cement warehouse having 500 mt storing capacity with all the electricity supply system and fencing around the above buildings. With the progress of the work, cement warehouses and local staff quarters were increased and expanded.

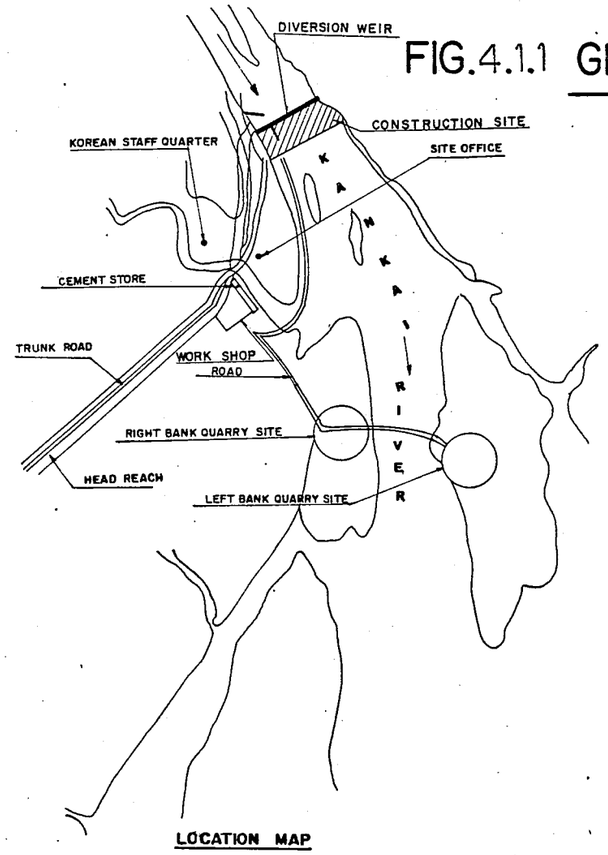
Numbers and size of the above facilities are tabulated in Table 4.1.1 and those layout are shown in Fig. 4.1.1.

4—1

Table 4.1.1 List of Contractor's Office, Stores, Workshop and Quarters

	Number (Unit)	Area (m^2)
Office	2	117
Cement Store	3	1,113
Spareparts Store	2	51
Workshop	2	146
Korean Staff Quarter	1	235
Local Staff Quarter	1	91
Labour Quarter	1	164
Laboratory Room	1	20
Generator House	1	59
Total		1,996

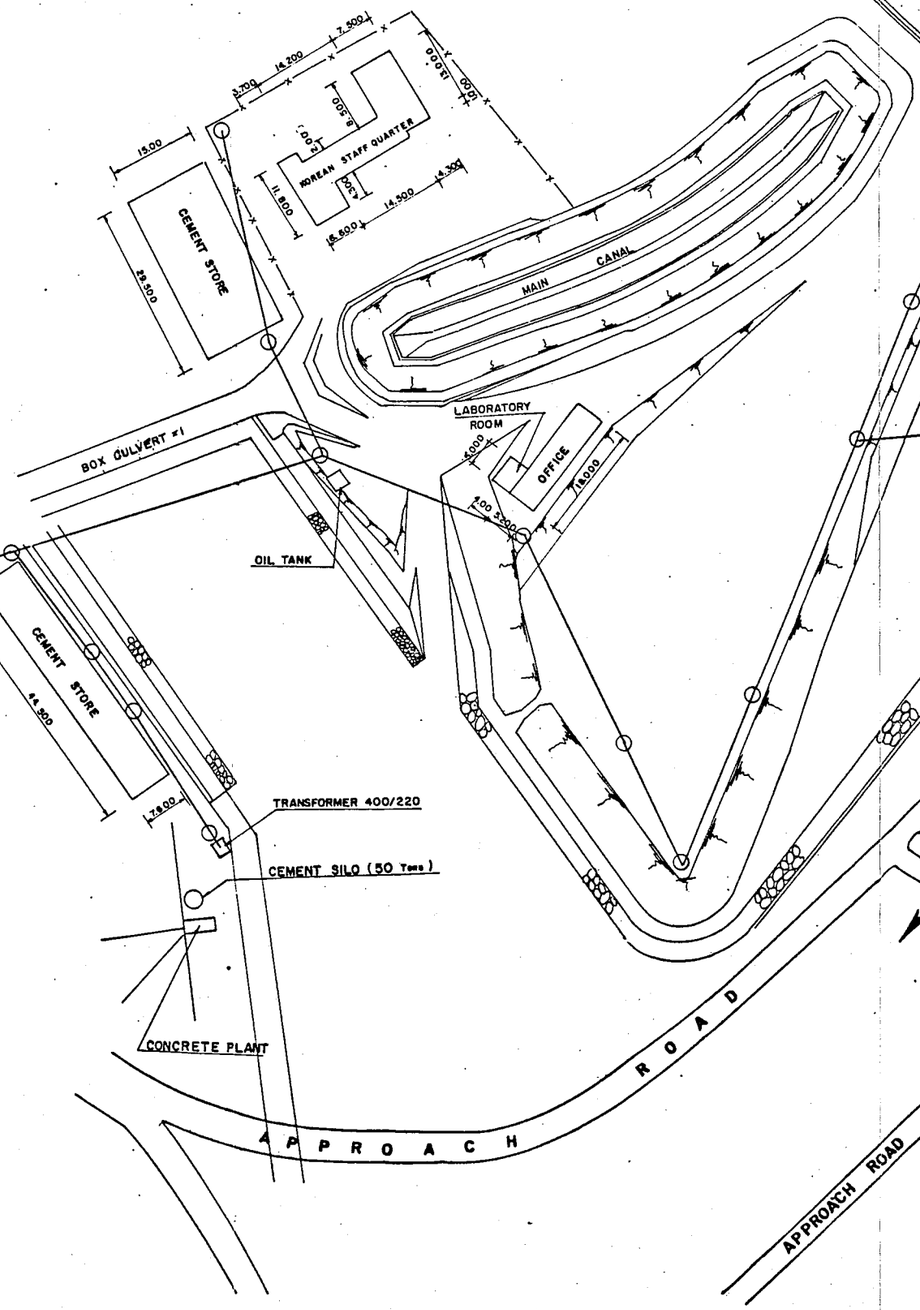
FIG.4.1.1 GENERAL LAYOUT OF CONTRACTOR'S FACILITIES

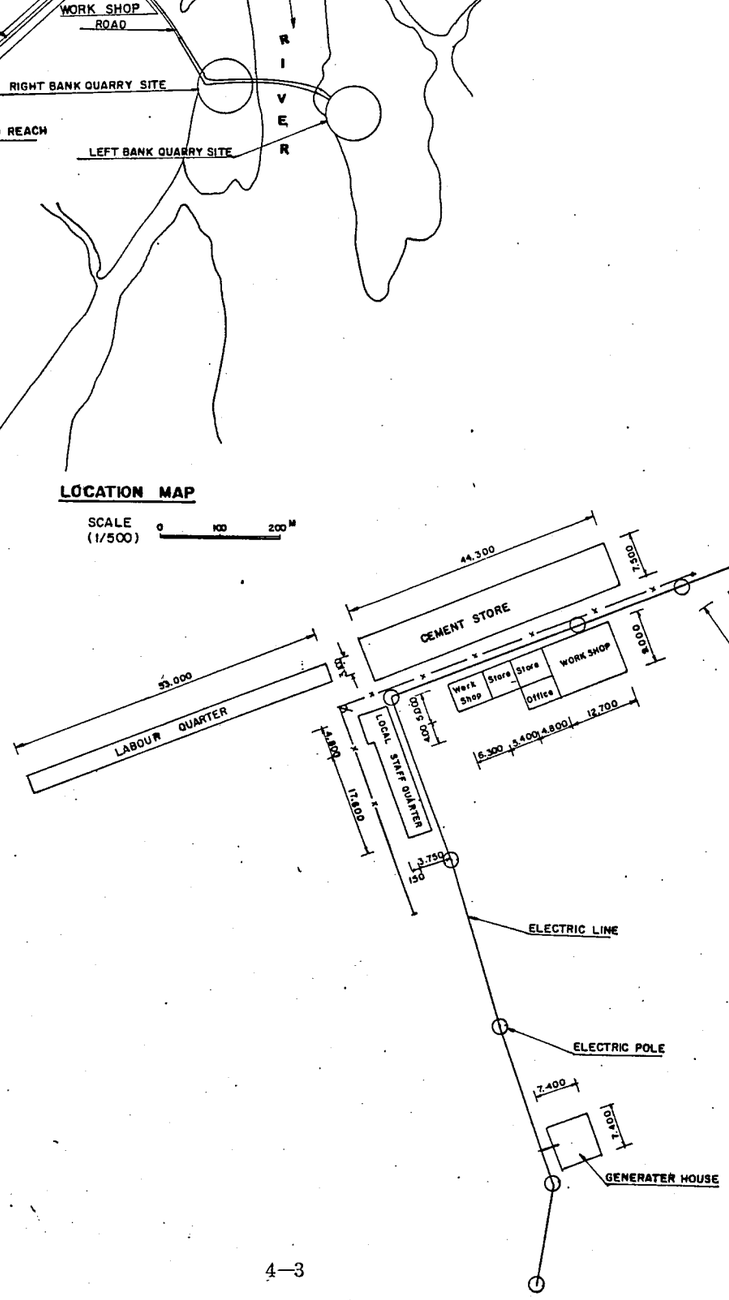


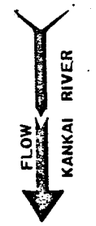
LOCATION MAP

SCALE (1/500) 0 100 200 M

KANKAI IRRIGATION WEIR SITE







SCALE (1/500)

0 10 20 30 40 50 M

4.1.2 Quarry Sites and Screen Plants

Quarries for aggregates for concrete and filter materials were situated at two (2) different places, one was located at the right bank about 500 m downstream from the stilling basin slab and the other at the left bank about 600 m downstream as shown in Fig. 4.1.1. The production of aggregates at the left bank was carried out only in the rainy season from 5 July 1984 to 15 October 1984 by setting a screen plant at the relatively higher place in elevation where operation was not hampered by floods. KDC provided two screen plants which could produce coarse and fine aggregates of about 60 mt per hour at the maximum.

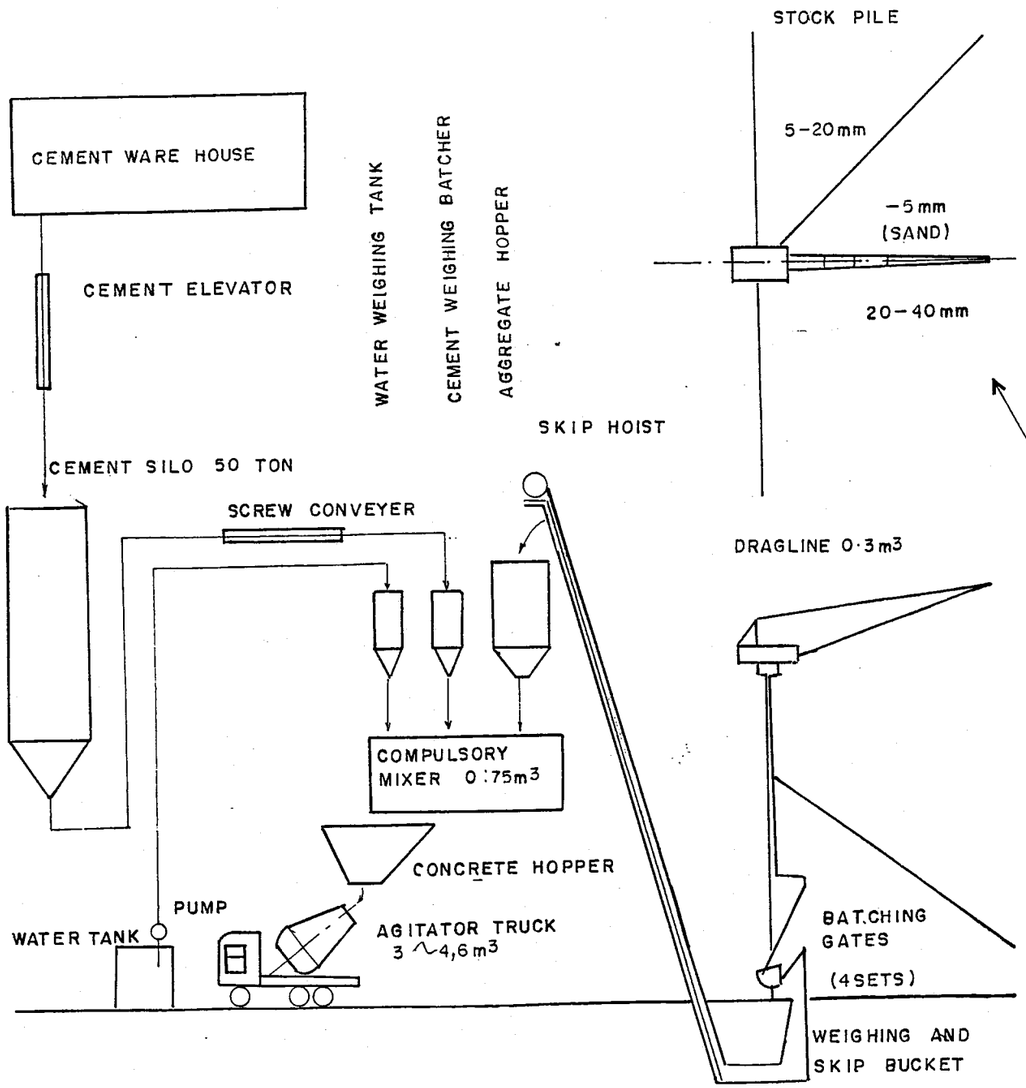
4.1.3 Concrete Plant

KDC delivered a concrete plant to the site on 6 June 1984. The plant was assembled at the site with a technical aid of the manufacturer's engineer and was in operation from 23 July 1984. The plant was situated at the right bank within the KDC's store and workshop yard about 300 m downstream from the stilling basin as shown in Fig. 4.1.1.

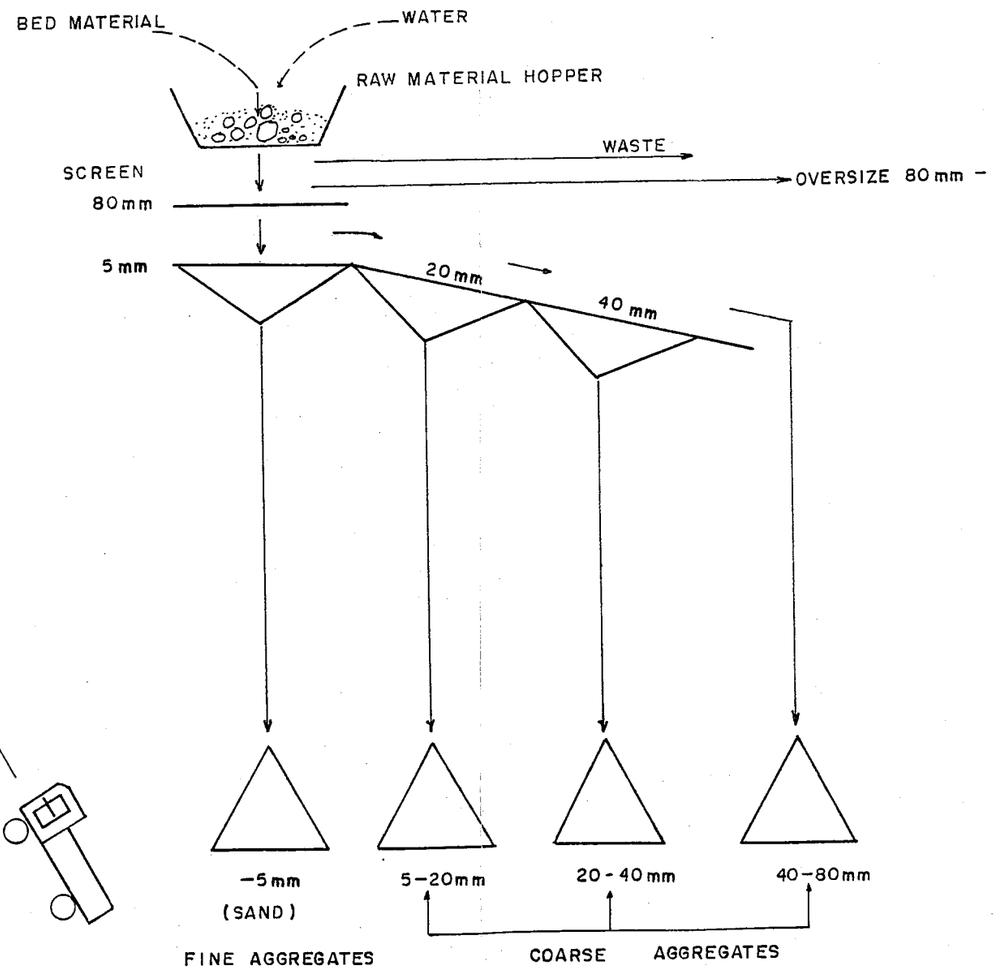
The plant was of compulsory mixing type having a maximum capacity of concrete production at 40 cu.m per hour. The plant was equipped with a automatic weighing devices of cement, aggregates and water and with a cement silo having 50 mt capacity. Cement was poured by manually and stored into the silo by bucket elevator. The stock pile of coarse and fine aggregates was situated adjacent to the plant and divided into three compartment upon the size of aggregates, i.e., 5 ton 20 mm, 20 to 40 mm and fine one. Transport of produced concrete to the site was done mainly by Concrete Transit Mixer and sometimes by Dump Truck. The flow sheet from the aggregates production to the concrete production through the concrete plant is shown in Fig. 4.1.2.

FIG. 4.1.2 FLOW CHART FROM AGGREGATE PRODUCTION TO CONCRETE PLACING

CONCRETE PRODUCTION



AGGREGATES PRODUCTION

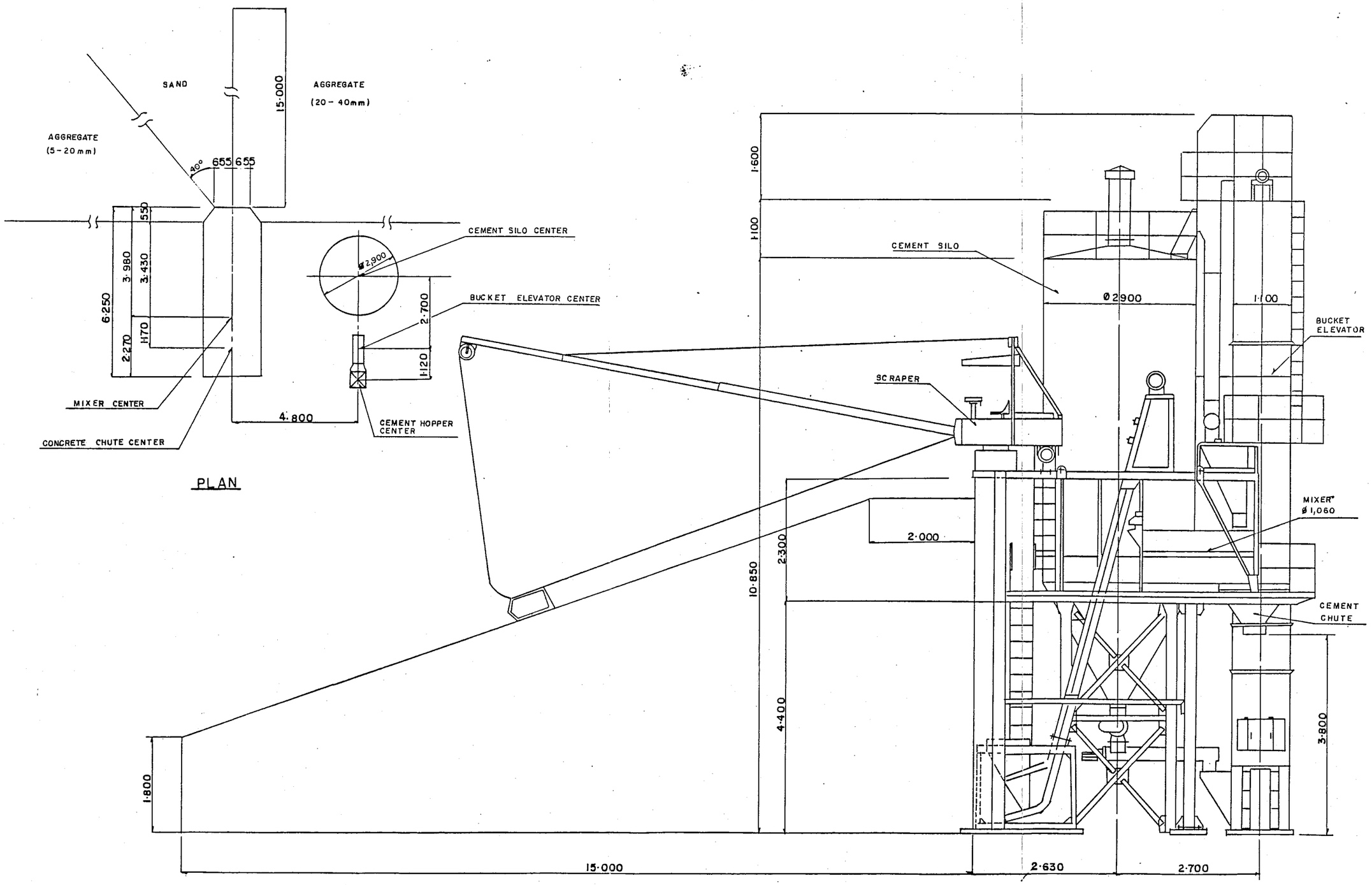


The features of concrete plant are given as follows:

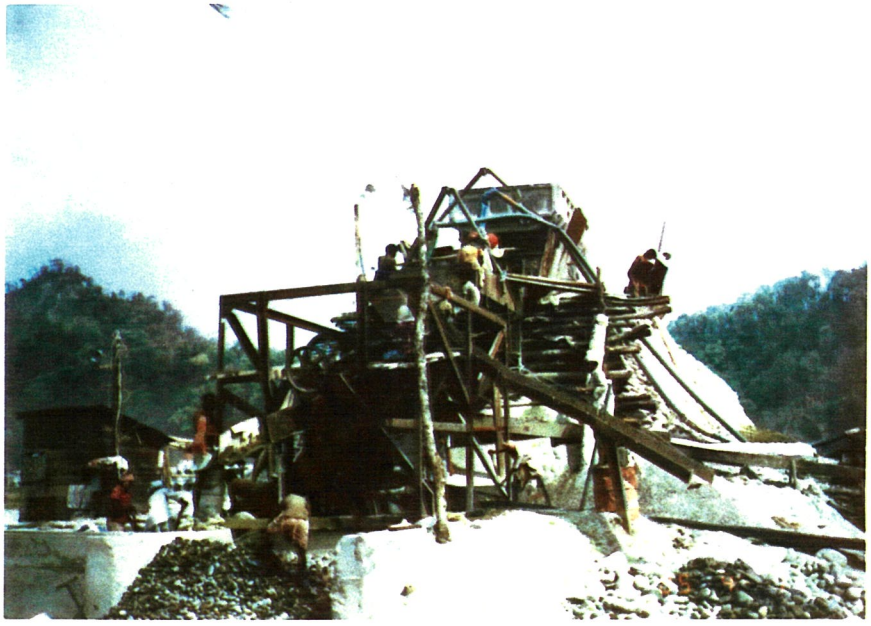
a.	Model	KYC, DS-75 H
b.	Mixer	
	dry material capacity	1,125 cu.m
	drive motor	30 kW
	compacted concrete output per batch	0.75 cu.m
c.	Water supply	25 cu.m/hour max.
d.	Number of batching gates for aggregates	4
e.	Skip hoist	7.5 kW
f.	Aggregate weighting batcher with pre-setting system	
	weighting range	2,000 kg
	effective volume	1,125 cu.m
g.	Cement weighting batcher with pre-setting system	
	weighting range	500 kg
	effective volume	0.4 cu.m
h.	Boom drag-line scraper for aggregates	
	reach of boom	10 m
	capacity of bucket	0.4 cu.m
	hoist motor	7.5 kW
	scraping capacity at dry condition	50 cu.m/hr max.
i.	Air compressor	1.5 kW
j.	Electrical connected load	60 kW
k.	Cement silo	
	store volume	50 mt
	bucket elevator	40 mt/hour and 5.5 kW
l.	Compacted concrete output	40 cu.m/hour max.

The general plan and elevation of the concrete plants are shown in Fig. 4.1.3.

FIG. 4.1.3 CONCRETE PLANT



Concrete Plant



Screen Plant for Aggregate Production

4.1.4 Power Supply System

Power supply for the construction use in the site including for the Contractor's office and quarter was fed by own diesel generator of alternate operation out of two units of 240 kVA ones, which were situated at the Contractor's store and workshop yards. Distribution of power was made through temporary overhead distribution line. The location of generators and layout of distribution line are shown in Fig. 4.1.1.

While the power supply for EOQ was made by a KDC's diesel generator of 73 kVA through existing internal overhead distribution lines of the KIP's colony on the contract basis per kilowatt -hour. The above generator was installed in the KIP's generator house separately from the KDC's camp.

4.1.5 Access Roads

An existing operation road provided along KIP's head reach canal and main canal for a distance of about 3 km long was used as the trunk access road to the Project site from the East-West Highway. This road was of 5 m wide with sand and gravel topped.

Access roads connecting the quarry sites, concrete plant, stilling basin and other facilities in the construction site were situated on the river bed of the Kankai river. These roads were maintained by Bulldozers. The layout of access roads in the construction site is shown in Fig. 4.1.1.

As for the access roads within the stilling basin area, the detailed description and locations which have been changed time to time upon the progress of excavation and concrete works are given in the subsequent sub-section 4.5.1 and in Fig. 4.5.1 respectively.

4.2 Steel Sheet Piling Work

4.2.1 Removal of Existing Concrete Blocks

The total area of launching apron where the concrete blocks were placed and to be removed was about 4,500 sq.m (150 m x 30 m). The removal of concrete blocks were carried out at this stage only for ones along sheet piles line to be driven with about 5 m wide or about 1,000 sq.m (150 m x 5 m and 30 m x 5 m) in area.

The removal of concrete blocks was started from 15 March 1984 and completed on 10 May 1984 amounting to about 1,000 cu.m or about 450 pcs of blocks.

All the reinforcement bars articulating the concrete blocks were cut by acetylene/oxygen gas. The concrete blocks then were thrusted up by a Bulldozer (CAT D7) and draged with wire rope by the Bulldozer to a dumping yard about 100 m downstream from the existing weir apron. Sizes and weights of concrete blocks removed were as follows:

Cross-shaped block	:	2m (W) x 2m (W) x 0.75 (H), 2.75 mt
Rectangular solid block:		2m (W) x 1.5m (l) x 0.3m (t) to 1.0m (t), 2.1 mt to 6.9 mt

4.2.2 River Diversion and Care of Water

Since the sheet piling work was started from 15 April 1984, the river water was flowing in the right bank through scouring sluice gates of the diversion weir without providing paticular coffer embankment until 9 May 1984 by which the progress of sheet pilling work was achieved at about 90%. The river flow was temporary diverted to the left bank, flowing over the weir's crest, from 10 May 1984 by constructing very simple coffer dike. It was maintained until the end of May, during which the remaining sheet piles were driven by 13 May 1984 and the concrete for the upper stilling basin slab was placed.

During the sheet piling work, the works were hampered for two days by small floods which flowed over the weir crest.

No care of water such as pumping the water from the construction yard was necessary at this stage.

4.2.3 Steel Sheet Piling

The purpose of driving steel sheet piles was to place curtain walls in the ground, possibly to be reached to the base rock, in such a way as surrounding an excavation area of the stilling basin so that the excavation would be done safely with controlling the sub-soil water. The locations of curtain walls were planned at 2 transversal lines of about 150 m long in the river, one was at the immediate downstream of the existing weir apron's endsill and the other about 58 m downstream from the upper line, and one longitudinal line of 58 m long connecting the above 2 lines in the center of the river.

In the original construction schedule, the sheet piling work was to be done for 2.5 months from the beginning of March 1984 to 15 May 1984 and this time schedule was estimated according to an actual record of piling work carried out at the construction of the existing diversion weir in the year of 1975/76. This record showed an average daily driving numbers of steel sheet pile (6m to 10m long) of about 15 by using the diesel pile hammer (3 mt capacity). The requirement of piles for the Project was about 900 Nos. so that the required period was estimated at 60 days in net.

The piling work was actually started from 15 April 1984 behind the schedule for about 1.5 months, however it could be completed on 13 May 1984 before anticipated completion date.

The steel sheet pile used for this Project was of U-shaped Type-II (Model Name YSP-II) having dimensions of 400 mm wide, 100 mm height and 10.5 mm thick and unit weight of 48 kg per m. A length of a pile was 12 m.

The pile driving was originally proposed to be done by a diesel pile hammer for avoiding to give the sand foundation of the existing weir unnecessary vibration which might make it loose. However a vibrating hammer was employed for the driving in spite of the above proposal taking the extreme tight schedule, while a very careful observation of influence by the vibration was of course conducted during the whole piling work. The major equipment used for the piling work were as follows:

Vibration hammer, 6.8 ton, 90 kW	:	1 unit
Crawler crane 37 ton	:	1 unit
Diesel Generator 240 kVA	:	1 unit

The time required for driving a pile depended upon the condition of foundation. The foundation was medium to coarse sands including rubbles with high density ranging prevailed sized from 5 cm to 15 cm dia. Under such foundation condition, piling time was only 1 to 2 minutes per pile of about 8m to 12m long. When the piling time was over 5 minutes, it was stopped. Such stop order was decided by the discussion among the Engineer, the site representative of the contractor and the piling operator. The confirmation whether the pile was reached to the rock surface was often made by pulling out the pile and then by observing slimes of weathered rock adhering to the groove of pile.

With the progress of piling, piles gradually inclined along the direction of wall. Wedge piles made by 2 to 3 piles with welding processed were driven to adjust the inclination of piles.

The payment to sheet piling was made to the Contractor on piles weight basis and against only the quantity of piles below the elevations designated by the Engineer as follows:

Upper line	:	El. 119.0 m
Downstream line:		El. 117.0 m
Center line	:	El. 119.0 - 118.0 m

The number of piles driven and length of piles was 895 Nos. and ranging from 2 m to 12.7 m respectively. The payable quantity of piles were 321.9 mt in total or 6,706.3 m in length.

The progress of pilling work is summarized as below:

Month		Apr. 84	May 84	Total
Period		15th - 30th	1st - 13th	-
Actual working days (day)		15	11	26
Actual working hours (hour)		145	89	234
Q'ty of piles	(Nos.)	519	377	895
	(mt)	213.6	108.3	321.9
	(m)	4,452.7	2,253.6	6,706.3
Rate of progress				
Daily	(Nos./day)	34.6	34.3	34.4
"	(mt/day)	14.2	9.8	12.4
"	(m/day)	296.8	204.9	257.9
Hourly	(Nos/hour)	3.6	4.2	3.8
"	(mt/hour)	1.5	1.2	1.4
"	(m/hour)	30.7	25.3	28.7

The detailed records of piling work are given in Table 4.2.1.

The quantity of diesel oil consumed by the Crawler Crane and the Generator is shown as follows:

Month	Working hour (hour)	Crawler Crane		Generator		Total	
		D-oil consume (l)	Hourly rate (l/h)	D-oil consume (l)	Hourly rate (l/g)	D-oil consume (l)	Hourly rate (l/h)
Apr.84	145	1,400	9.66	1.460	10.07	2,860	19.72
May 84	89	800	8.99	1.140	12.81	1.940	21.79
Total	234	2,200	9.40	2,600	11.11	4,800	20.51

The detailed record of piling progress are shown on the As Built Drawing, DRW. No. ABD/RW-004.

Table 4.2.1 Record Steel Sheet Piling

Date	Number	Length (m)	Weight (t)	Hour (Hr)
1984/Apr 15	1	9.3	0.4	3
16	35	359.3	17.2	12
17	40	477.2	22.9	10
18	49	470.1	22.6	11
19	47	410.2	19.7	9
20	37	388.4	18.6	10
21	4	37.4	1.8	10
22	11	84.4	4.1	7
23	56	243.3	11.7	12
24	28	220.9	10.6	8
25	47	419.8	20.2	13
26	35	354.6	17.0	7
27	28	280.2	13.4	7
29	41	304.4	14.6	14
30	60	393.2	18.8	12
Sub-total	519	4,452.7	213.6	145
Mar 1	45	359.3	17.2	11
2	49	499.8	24.1	12
3	36	304.8	14.6	9
4	45	220.6	10.6	10
5	12	69.2	3.3	4
6	12	61.8	3.0	6
7	79	270.2	13.0	13
11	37	237.3	11.4	10
12	57	199.1	9.6	9
13	4	31.5	1.5	5
Sub-total	377	2,253.6	108.3	89
Total	895	6,706.3	321.9	234

(Remark : Payable length)

4.3 Production of Precast Concrete Blocks

Concrete blocks were produced for the launching apron constructed at the tail of the stilling basin slab for a purpose to prevent the local scour during floods. A concrete block was designed so as to be safe against wash-away under the flood discharge of 5,200 cumsec. A type of concrete block to be articulated by a way on interlocking as shown in the As Built Drawing No. ABD/RW-007, which was the standard type being prevailed in Japan for the river bed protection, was employed. The weight of a block was about 8 mt decided based on an evaluation of stability of one block against the said flood discharge. The major features of a block are as follows:

Weight	:	7.88 mt
Concrete Volume	:	3.425 cu.m
Re-bars quantity	:	18.25 kg
Length	:	2.34 m
Height	:	2.01 m

For adjusting the arrangement of concrete blocks, half size of blocks were also produced.

The production was done by precasting method using the steel forms. KDC imported 15 units of self-made steel forms from Korea. KDC started the production of concrete blocks from 18 May 1984 and completed it on 26 September 1984. The total quantity of concrete blocks produced was 882 pcs consisting of full size blocks of 756 pcs and half sized one of 126 pcs and 2,805 cu.m in concrete volume. The monthly production record is shown in Table 4.3.1.

Placing the concrete was done in such a manner as pouring the concrete into the steel from by a 1.0 cu.m bucket and compacting it by electric-driven immersion type vibrators.

4.4 Production of Aggregates

Aggregates used for the filter materials of the drainage system for structures as well as the concrete were produced on the river bed of the kankai river. Two quarry sites were selected, one was located at the right bank about 500 m downstream from the stilling basin and the other at the left bank about 600 m downstream.

The aggregates were graded in size into 5 classification, the sand of 5 mm under, and the gravels of 5-20 mm, 20-40 mm, 40-80 mm and 80 mm over in

Table 4.3.1 Record of Production of Precast Block

Unit : number

Month	Full	Half	Total
1984/May	3	-	3
Jun	24	-	24
Jul	144	10	154
Aug	325	19	344
Sep	260	97	357
Total	756	126	882

diameter. The river bed materials were used as the raw materials for the aggregate production.

Until the delivery of a screen plant on 13 april 1984, KDC produced the aggregates manually. KDC started from the beginning of May 1984 the operation of their self-manufactured screen plant of simple trommel screen type imported from Korea. According to KDC, this plant was newly developed model but had not been tested yet before shipment from korea to confirm its performance. Due to improper designs of inclined angle and length of screen, rotary speed of screen, size of screen mesh, etc., no specified aggregates could be produced from this screen plant. A reformation work of the plant was done at the site by KDC and completed in the beginning of June 1984. The production of aggregates was started by the improved screen plant at the left bank from 17 June 1984.

The production at the left bank was continued during the rainy season up to end of October 1984. KDC delivered an additional screen plant of the same type as the above one to the site on 5 August 1984 and this screen plant was installed in the right bank. The operation of new one was started from 7 November 1984 with higher efficiency as compared with the old one. The production by only this plant was continued during the remaining whole period until 13 May 1985.

Until the foundation excavation of the stilling basin was started, the raw materials was collected from the screen plant area nearby. However the content of coarse aggregates particularly larger sizes of 40 mm over was relatively low. From the middle of December 1984, the excavated materials from the construction site of stilling basin, which contained high density of gravels, were used for the aggregate production.

The raw materials were loaded by a Wheel Loader (2 cu.m) on the Dump Trucks (12 ton) and transported to the screen plant. The materials were directly poured from the Dump Truck into the inlet hopper and pushed into the rotary screen by water jet for classification. Silt and clay were washed away before classification. The production capacity of the screen plant was estimated at about 60 mt at the maximum.

The required quantity of aggregates initially estimated was about 32,000 cu.m including sand and the progress of the production is summarized as below:

Period	Produced quantity (cu.m)	Accumulated quantity (cu.m)	Progress rate (%)
Mar.84 - Oct.84	9,530	9,530	30
Nov.84 - Mar.85	30,000	39,530	124

The progress on monthly and aggregate size basis are shown in Table 4.4.1.

Table 4.4.1 Record of Production of Aggregates

Unit : m^3

	5-20mm	20-40mm	40-80mm	Sand	Total
1984/Mar-May	300	220	190	250	960
Jun	500	450	240	420	1,610
Jul	420	390	190	350	1,350
Aug	430	420	210	400	1,460
Sep	620	560	330	540	2,050
Oct	640	570	340	550	2,100
Nov	1,860	1,230	1,530	1,500	6,120
Dec	1,270	930	690	1,020	3,910
1985/Jan	2,530	1,700	1,220	1,950	7,400
Feb	1,100	940	680	880	3,600
Mar	1,010	730	560	810	3,110
Apr	1,890	1,440	230	1,240	4,800
May	340	270	180	270	1,060
Total	12,910	9,850	6,590	10,180	39,530

4.5 Construction of Stilling Basin

4.5.1 River Diversion, Care of Water and Approach Roads

A river diversion in the second dry season had been planned basically on two stages basis by providing partial closure of the river channel with aiming to construct the stilling basin from the right-half area, and thus the arrangement of sheet pile walls was set up as shown in the "As BUilt Drawing" No.ADB/RW-004.

A capacity of diversion channel was employed at 150 cumsec as mentioned in the previous sub-section 2.3.3.

Three diversion channels were constructed during the construction period with the progress, though the river diversion method was on two stages basis as originally planned. The detailed description of river diversion work at each period including care of water and approach roads arrangement is given below:

1) First period (20 November 1984 - 22 January 1985)
(See Fig. 4.5.1 (1/3))

With decrease of the river discharge of the Kankai river, KDC started the coffering work from 5 November 1984. Sand bags with height of 1.5 m were piled on the right-half of the weir's crest of about 86 m long out of 126 m in the total length. Compacted clay to prevent seepage and wooden piling were provided among the sand bag coffer bank. The top elevation of coffer bank on the weir crest were guided to be El 122.75m by the Engineer to encounter floods of 150 cumsec.

A coffer bank made by sand and gravel was provided on the center portion of weir's apron downstream from the weir's crest and the left side slope of the bank was protected by sand bags lining from the surface erosion. This bank was connected to the river center sheet pile wall having top elevation of around El. 119 m which was higher enough to prevent overflowing of 150 cumsec flood from the left-side diversion channel into the construction area at the right-half area. Since the grounding of this sheet pile wall was enough deep, no particular treatments to protect the wall were made.

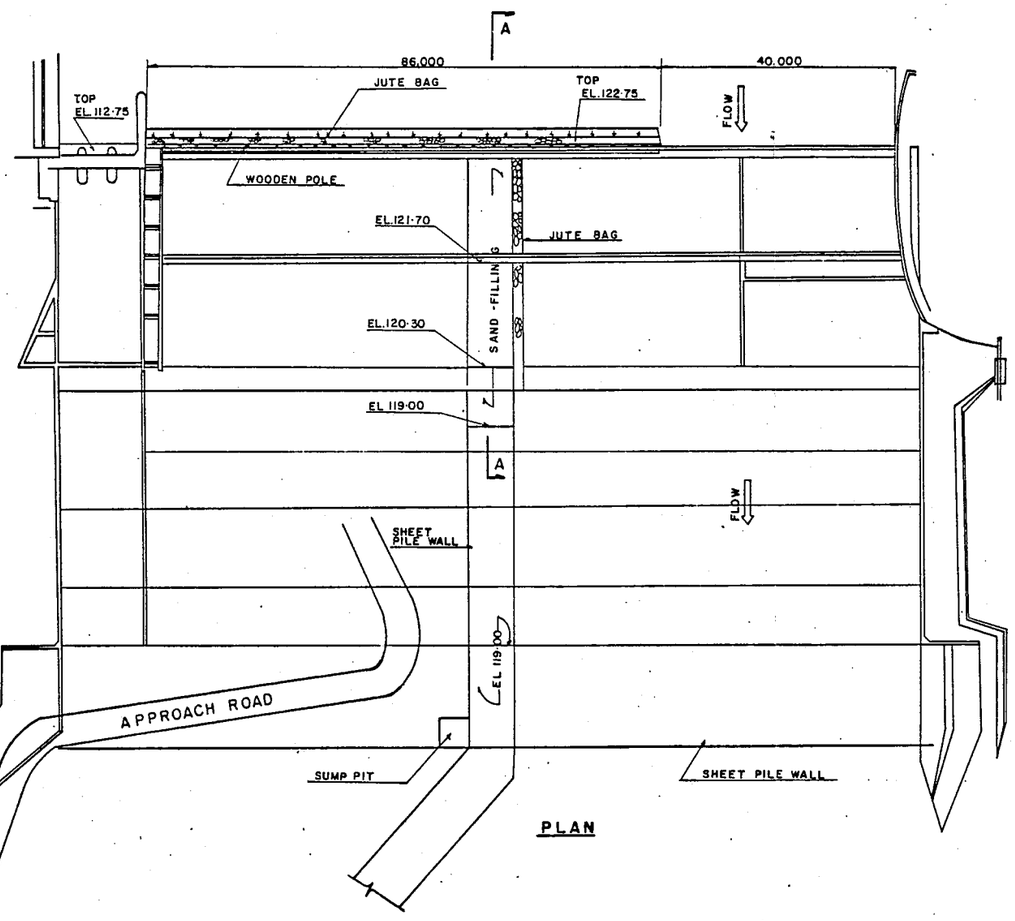
The scouring sluice gates at the right bank were closed on 20 November 1984 and the river water was diverted to the left-half river channel of about 70 m wide. A leakage of water through the scouring sluice gates were completely stopped by compacted clay filled between stoplog shutters and sluice gates.

The coffer bank in the downstream area beyond the downstream sheet pile wall were gradually made and heightened by the excavated materials.

A sump pit for dewatering was situated at the joint portion of the river center sheet pile wall and the downstream one as shown Fig. 4.5.1 (1/3). A submersible pump (8") was set in this sump pit for dewatering the right-half area. The pit was gradually deepened with the progress of foundation excavation and the bottom of pit finally reached to the level of about El.109.5 m. Since the discharge of seepage water was very small, the submersible pump was intermittently operated and no particular record regarding pump operation was therefore made.

An approach road from the downstream area to the construction site was provided as entering from the right corner of and stretching downward along the downstream sheet pile wall as shown in Fig. 4.5.1 (1/3).

FIG. 4.5.1 LAYOUT OF DIVERSION CHANNEL, SUMP PITS AND APPROACH ROAD (1/3)
(20NOV84 — 22 JAN 85)



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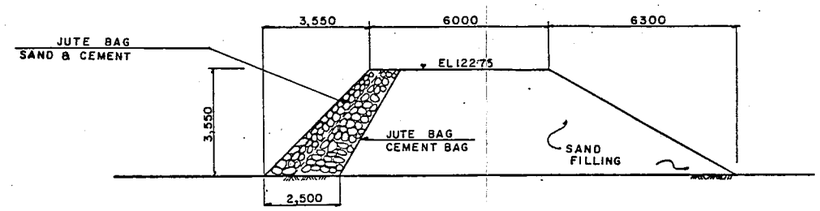
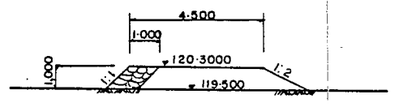
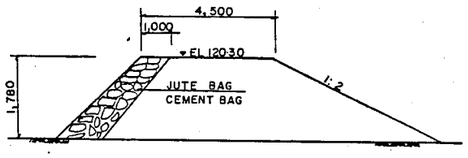


SECTION B-B



SECTION C-C



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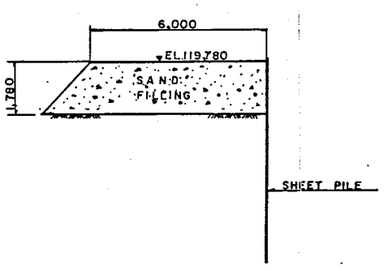
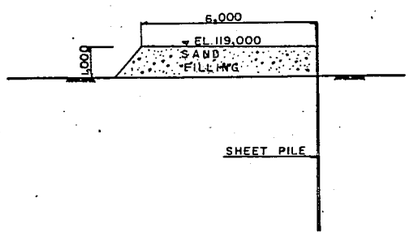
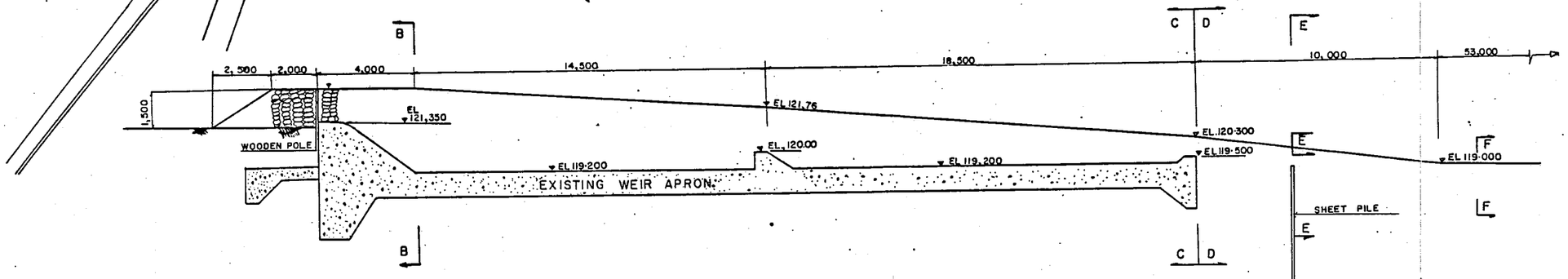


SECTION E-E



SECTION F-F



SECTION A-A

2) Second period (23 January 1985 - 24 March 1985)
(See Fig. 4.5.1 (2/3))

According to the original construction schedule, the both right-side wall and guidewall of the stilling basin were to be completed in the early January 1985 so that the river water was to be diverted to the right bank through the scouring sluice gates and a downstream channel made between the above both walls. However the construction of walls were far delayed and those completions were shifted to the early March 1985 on the revised construction schedule. While, the concrete placing for all the stilling basin slab in the right-half area was completed by 19 February 1985.

In order to start the foundation excavation in the left-half area as quickly as possible under keeping the river flow still in the left bank, a diversion channel was constructed at the left-corner of the Kankai river along the foot of hill. The channel was of concrete lined for preventing the seepage of water into the excavation area and also to minimize the size of channel. The capacity of diversion channel was taken as a probable flood of 5 years chance during the mid dry period from the end of January to March at 80 cumsec. The dimension of channel was about 5 m wide and 1.8 m high with a hydraulically steep bed slope of about 1%. A part of the river water was shared to the irrigation canal through the intake structure.

KDC started the construction of the diversion channel from 12 January 1985 and diverted the river water to the channel from 23 January 1985. The coffer bank was enlarged to lead the river water smoothly into the channel. Due to this diversion channel, about 80% of the stilling basin in area could be completed without changing the river flow course from the left to right.

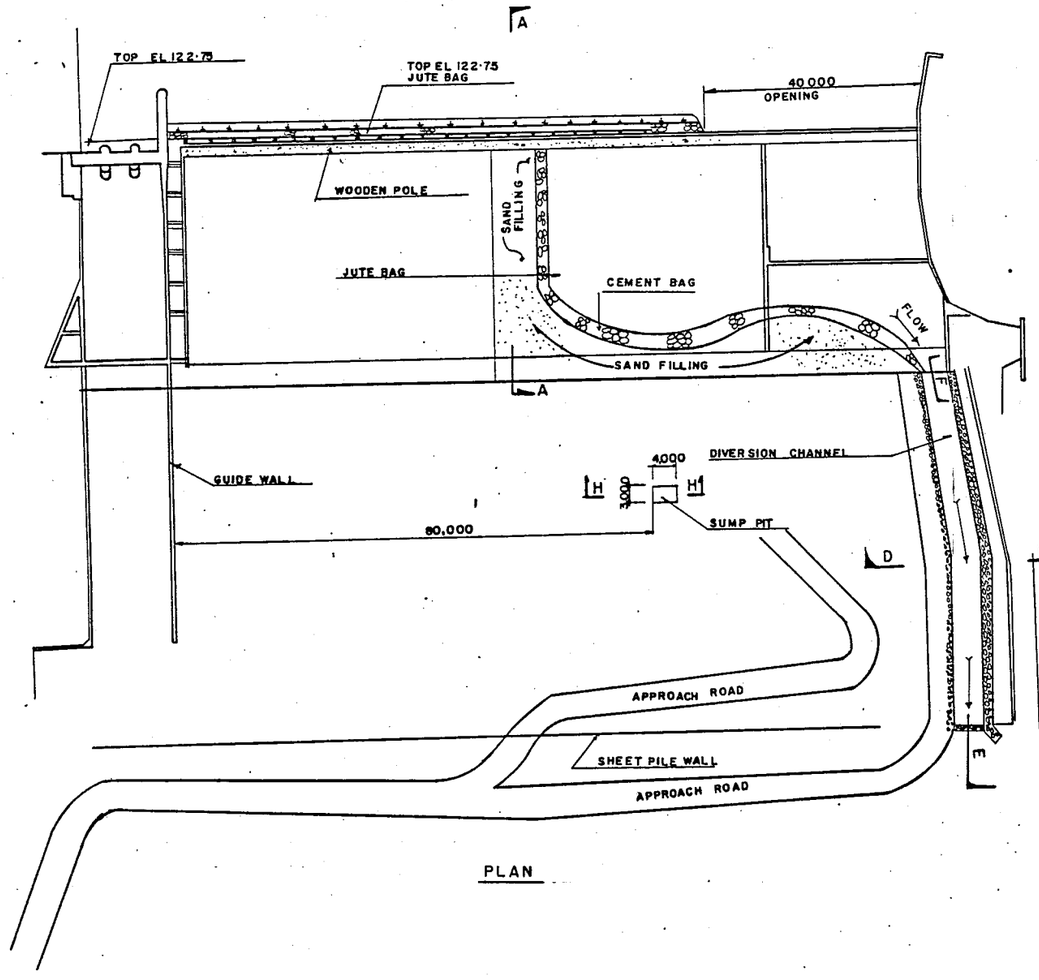
The foundation excavation in the left-half area was immediately started. During the excavation, sump pits were installed place to place with the progress. After the major excavation in the left-half area was completed, a fixed sump pit was installed at the foot of slope portion of the stilling basin about 80 m left from the guidewall because of the deepest filterate layer being here as shown in Fig. 4.5.1 (2/3). A slitted caisson made by steel sheet piles having dimensions of 3m (L) x 4m (B) x 1.8m (H) was installed at this pit as the well on 18 February 1985. The level of well's bottom was about El.108.2 m and gravel filter zone with two different grading in size, 40-80 mm inner side adjacent to the caisson and 5-20 mm outer side, was provided surrounding the caisson.

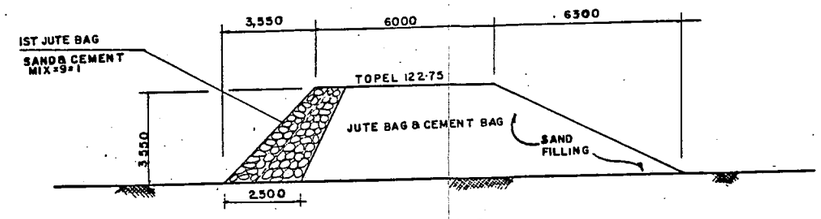
Two submersible pumps were set here and the seepage water was drain out to the weir's apron. The amount of seepage water was so insignificant that the dewatering was made generally by one pump (8").

Two approach roads in the left area were provided. One was the road to the deeper area of the stilling basin slab entering from the joint portion of center sheet pile wall and downstream line and streching along the downstream sheet pile wall to the left direction and the other was along the right-side of the diversion channel connecting downstream river bed and the weir's apron, as shown in Fig. 4.5.1 (2/3).

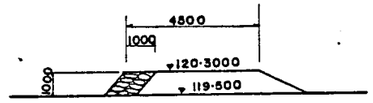
With the progress of stilling basin slab, sheet piles of center wall were removed time to time and the former approach road was extended to the right-half area.

FIG.4.5.1 LAYOUT OF DIVERSION CHANNEL, SUMPPITS AND APPROACH ROAD (2/3)
(23JAN85 - 24MAR85)

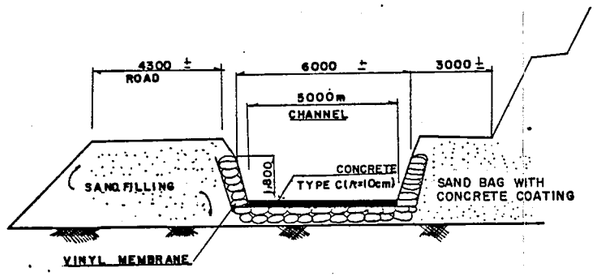




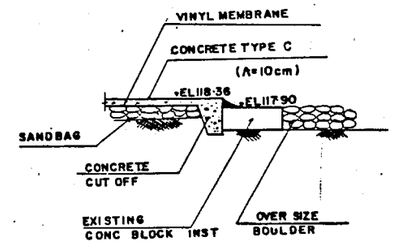
SECTION-B-B

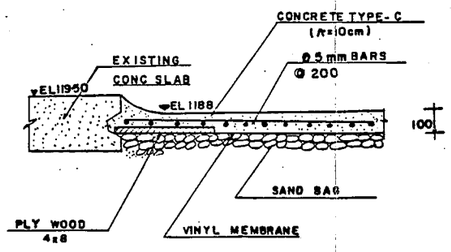


SECTION-C-C

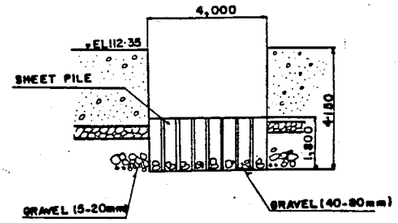


DIVERSION CHANNEL SECTION-D-D

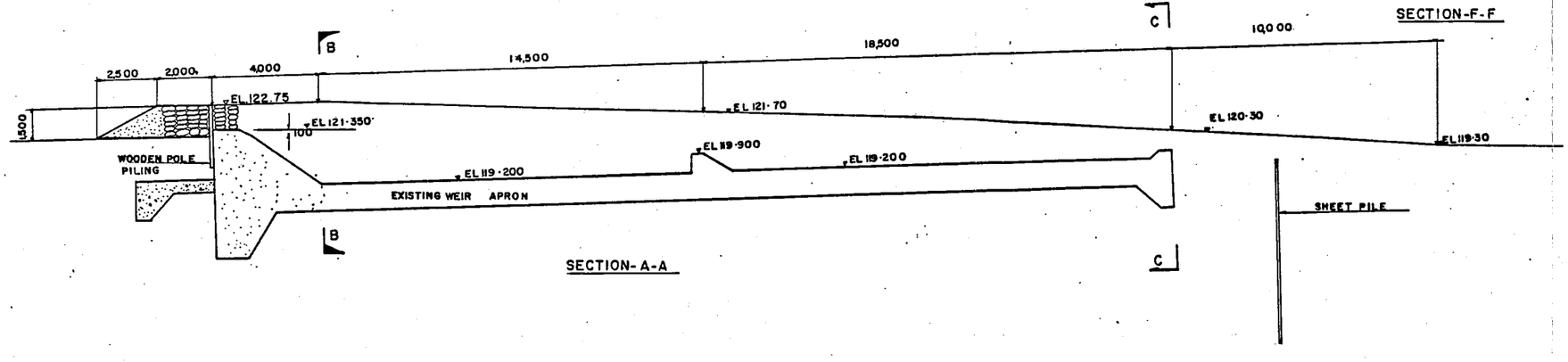




SECTION-F-F



SECTION-H-H



SECTION-A-A

3) Third period (25 March 1985 - 5 June 1985)
(See Fig. 4.5.1 (3/3))

The construction of both the right-side wall and guidewall were again delayed and the heightening of those wall up to El.119.00 m enough to pass the river flow was finally completed on 18 March 1985. Before diverting the river water to the right bank, an additional sheet pile wall was installed along the same line straightly downstream from the guidewall to the downstream sheet pile wall for a distance of about 16 m. The sheet piles of the wall were driven into the base rock, and the foot portion of wall was consolidated by the concrete with a height of about 2m and a width of about 1m for the stability of sheet pile wall as well as preventing the seepage of water from the diversion channel to the deeper construction site as shown in Fig. 4.5.1 (3/3).

The scouring sluice gates were finally opened on 25 March 1985 and the river diverted to the right bank. The capacity of diversion channel was 150 cumsec as designated in the original design.

An additional coffer bank was provided on the remaining left-half portion of the weir crest in a same manner using sand bags as before, and it all along the crest were strengthened and heightened up to El. 123 m to encounter the pre-monsoon floods.

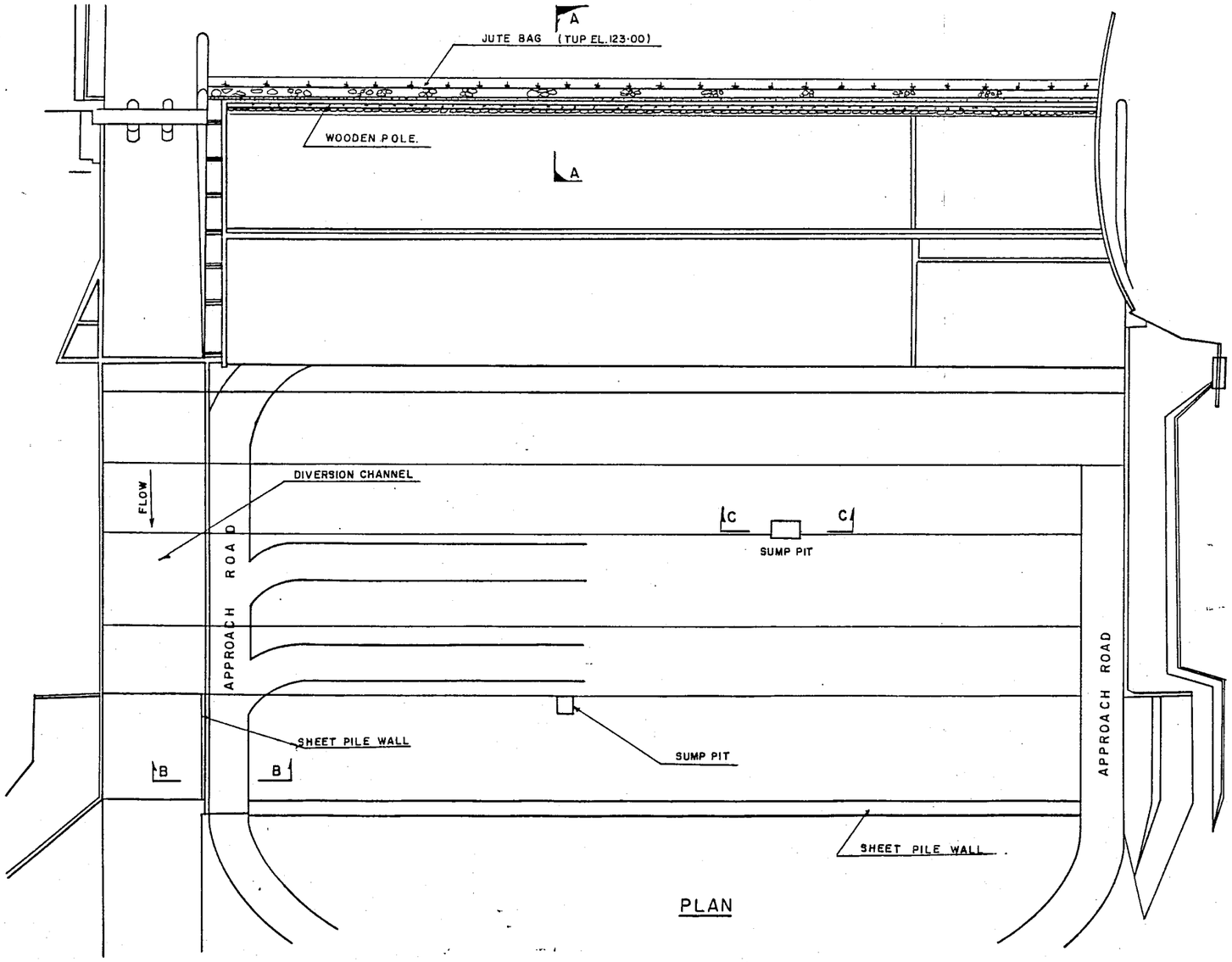
The well for dewatering installed in the above second period was maintained until the completion of stilling basin structure except the left-side wall and it was plugged by concrete on 8 May 1985. The method of plugging the well is shown in Fig. 4.5.1 (3/3). An additional sump pit was also made in the launching apron area as shown in Fig. 4.5.1 (3/3) after the diverting the flow to the right bank and it was also removed on 8 May 1985. After the removal of the above sump pits, the sub-soil water stagnated in the stilling basin keeping the water table at El. 114.5 m with using one submersible pump for drainage.

Two approach roads were constructed in this period. One constructed immediately after the river diversion to the right bank was provided along the guidewall for both places of the stilling basin slab and the weir's apron and the other after 8 May 1985 provided along the left-side wall, as shown in Fig. 4.5.1 (3/3).

FIG. 4.5.1 LAYOUT OF DIVERSION CHANNEL,

SUMP PITS AND APPROACH ROAD (3/3)

(25 MAR 85- 4 JUN 85)



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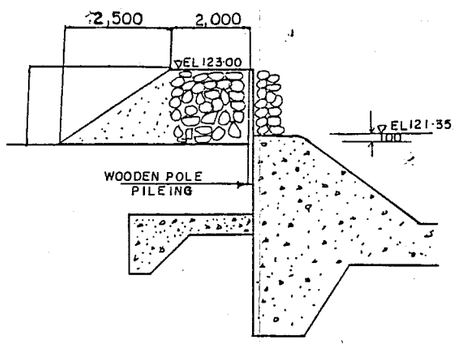
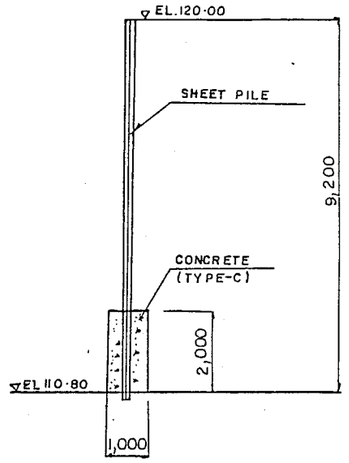
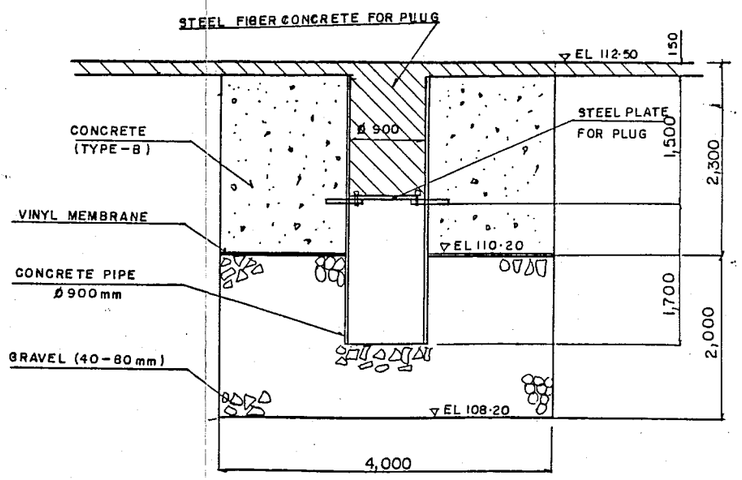


SECTION A-A



SECTION B-B



SECTION C-C

4.5.2 Removal of Existing Concrete Blocks

The removal of the remaining concrete blocks was carried out in two periods, one was from 21 November 1985 to 15 December 1985 in the right-half area and the other from 26 January 1985 through 31 March 1985 time to time in the left-half area.

All the reinforcement bars articulating the concrete blocks were cut by acetylene/oxygen gas or by thrusting force of Bulldozer. The concrete blocks were thrusted up by a Bulldozer (D65A or D50A) and lifted by a Crawler Crane to load on the Dump Trucks to a dumping yard about 100 m downstream from the weir.

Due to the shortage of Bulldozers in good condition at the initial stage, the progress of block removal was far delayed and this resulted one of the cause for the lag in starting the foundation excavation and subsequent concrete works at the earlier period of the second dry season.

The quantity of concrete blocks removed at this time was about 2,985 cu.m or about 1,970 pcs of blocks. The total quantity including those removed in the preceding dry season was 3,985 cu.m, being double quantity more than anticipated in the Bill of Quantity in the Contract. This was the fact that almost all the concrete blocks have been sunken vertically into the river bed in contradiction of expectation prior to the Project that the concrete block damaged be washed away downstream.

4.5.3 Foundation Excavation in River Bed

The foundation excavation in the river bed was started from 12 December 1984 and completed on 20 April 1985. The excavation area was at the immediate downstream of the weir apron with an area of about 9,400 sq.m, 165m (B) x 57m (L), as shown in Fig. 4.5.2. The excavation depth was 8.2m from El.118.0m of river bed to El.109.8m. All the excavation works could be carried out in the dry condition owing to the sheet pile curtain walls and dewatering by submersible pumps.

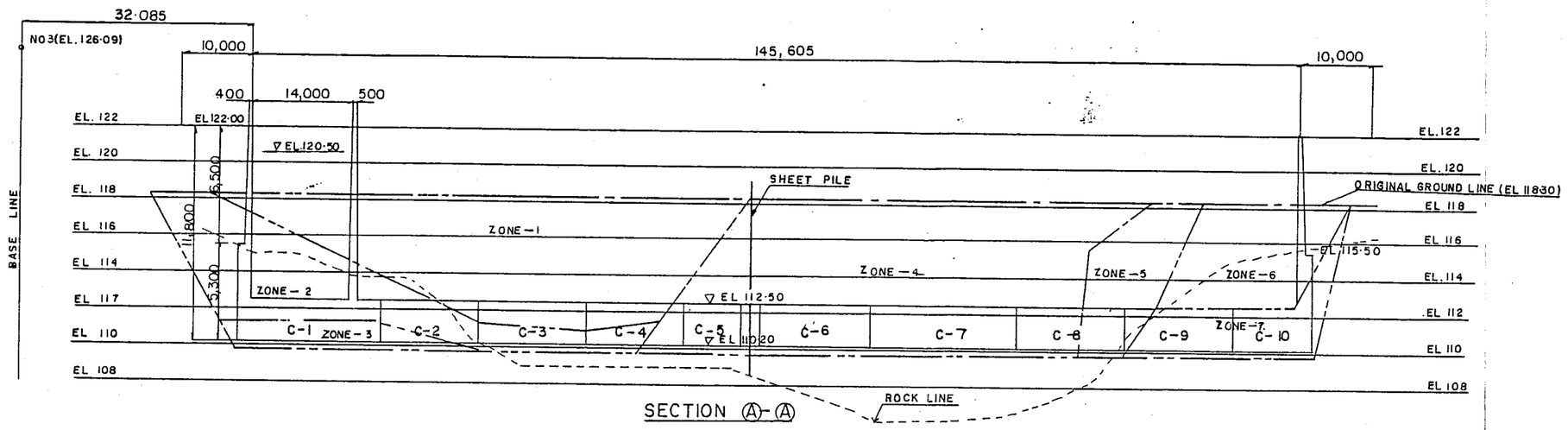
The total quantity of the foundation excavation was 56,000 cu.m consisting of sand and gravel of 45,700 cu.m and weathered soft rock of 10,300 cu.m. The weathered soft rock could be excavated by the Bulldozer's blade and backhoe shovel though work efficiencies of the equipment were lowered.

The foundation excavation was done for about 4 months which was divided into the following seven periods based on the excavation conditions.

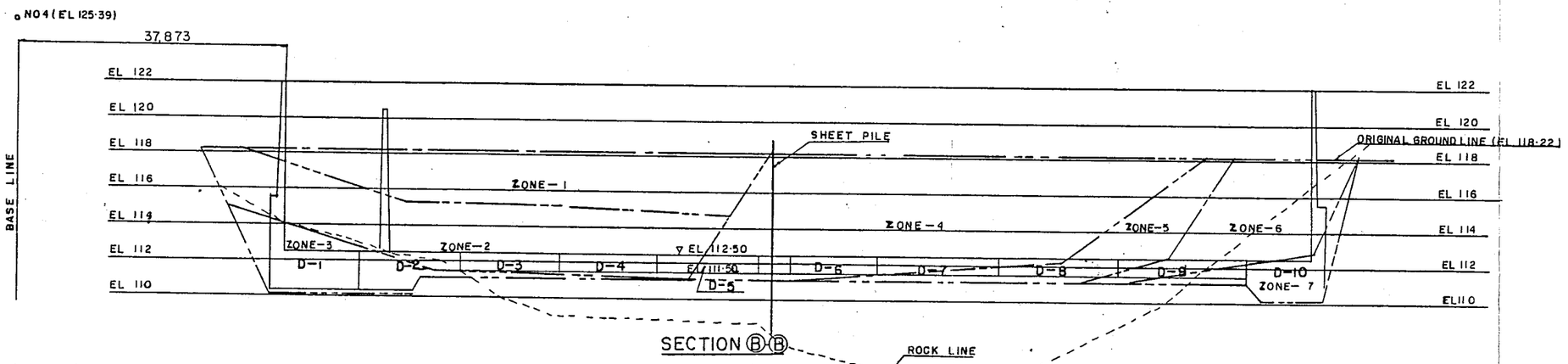
Zone	Period	Excavation Quantity (cu.m) Total	Common	Rock	Condition
1.	12 Dec.84 to 20 Dec.84	9,500	9,500	0	Excavation at upper layer of the right-half area in full swing condition
2.	21 Dec.84 to 31 Dec.84	9,700	7,800	1,900	Excavation at lower layer of the right-half area in full swing condition
3.	1 Jan.85 to 22 Jan.85	4,800	1,700	3,100	Excavation at mainly right-corner rock portion with progress of concrete placing work for stilling basin slab
4.	23 Jan.85 to 15 Feb.85	16,800	16,800	0	Excavation of left-half area down to level El.112.5 m in full swing condition
5.	16 Feb.85 to 25 Mar.85	4,200	4,200	0	Time to time excavation of left-half area and launching apron portion with the progress of concrete works for stilling basin
6.	26 Mar.85 to 31 Mar.85	7,000	4,500	2,500	Excavation of left-corner area from river bed down to El.112.5 m in full swing condition
7.	1 Apr.85 to 20 Apr.85	4,000	1,200	2,800	Time to time excavation at deeper layer of left-corner area and launching apron portion with progress of the works

Excavation zones carried out in the each period are shown in Fig. 4.5.2 as Zone-1 to Zone-7. The detailed description of the foundation excavation in the above each period is given below.

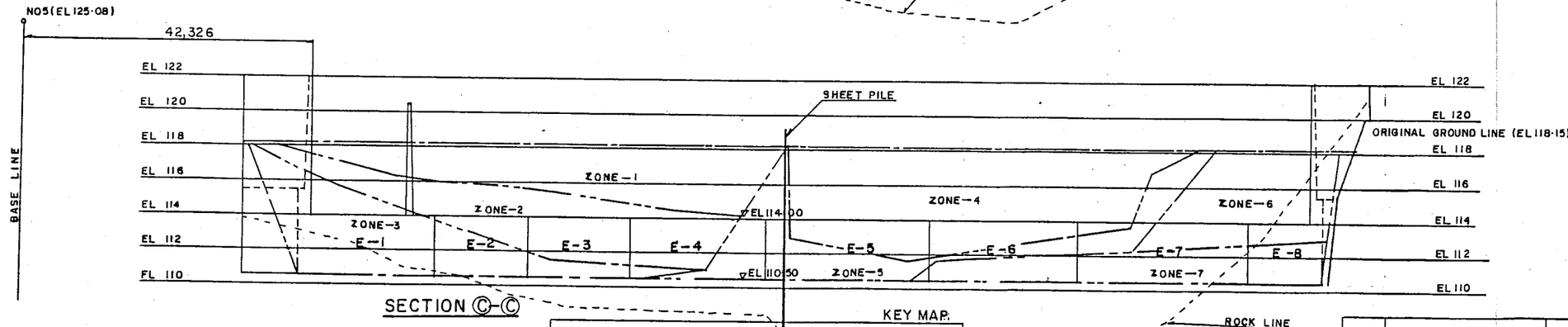
FIG. 4.5.2 FOUNDATION EXCAVATION



SECTION Ⓐ-Ⓐ



SECTION Ⓑ-Ⓑ



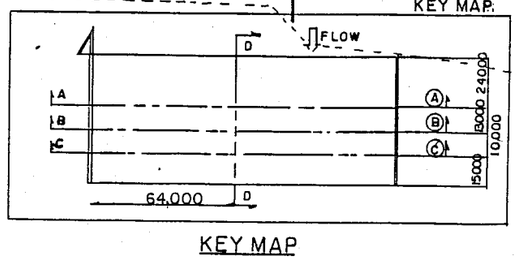
SECTION Ⓒ-Ⓒ

SCALE

VERTICAL 0 2 4 6 8 10 m. (1/200)

HORIZONTAL 0 10 20 30m. (1/500)

KEY MAP



KEY MAP

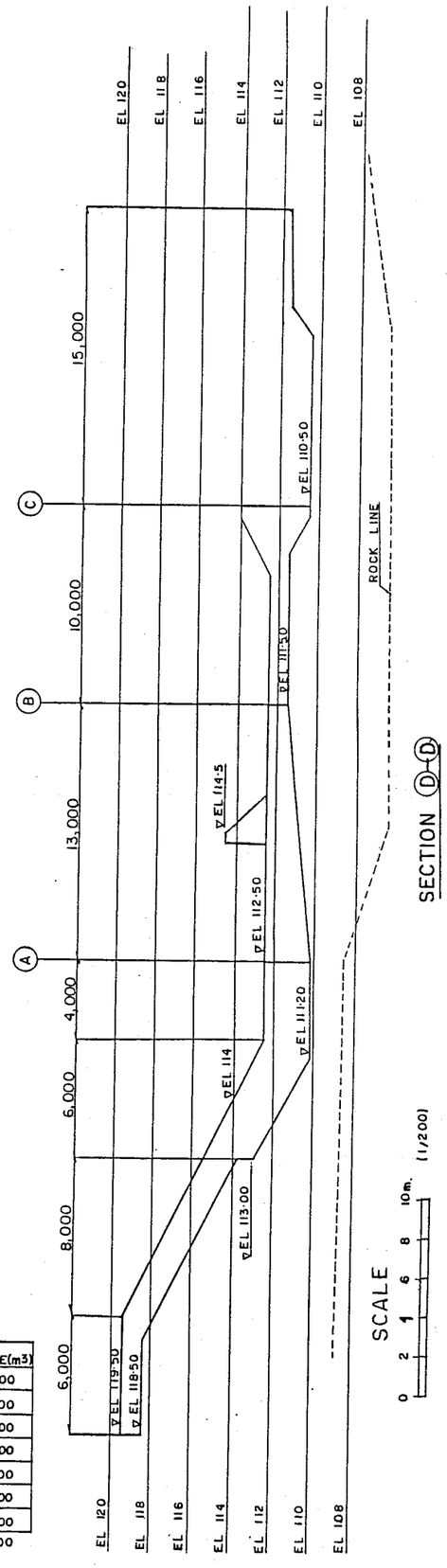
LEGEND

C-5 : BLOCK NUMBER

——— : EXCAVATION LINE

ZONE	PERIOD	VALUME(m3)
1	12 DEC 84 — 20 DEC 84	9,500
2	21 DEC 84 — 31 DEC 84	9,700
3	1 JAN 85 — 22 JAN 85	4,800
4	23 JAN 85 — 15 FEB 85	16, 800
5	16 FEB 85 — 25 MAR 85	4,200
6	26 MAR 85 — 31 MAR 85	7, 000
7	1 APR 85 — 20 APR 85	4, 000

TOTAL. 56,000



SECTION Ⓓ-Ⓓ

SCALE 0 2 4 6 8 10m. (1/200)

1) 1st Period (12 December 1984 - 20 December 1984)

The excavation area was the right-half one. The upper layer, Zone-1 as given in the Fig. 4.5.2, was mainly excavated with a depth of about 4 m from the river bed El.118 m down to El.114.0 m. The excavation quantity was 9,500 cu.m of common soil.

The upper layer was push out by Bulldozers and lower layer's soil was transported by 2 to 3 DumpTrucks (12 tons) to the dumping yard 200 to 300 m downstream. The excavation equipment used and those working hours are shown as follow:

Equipment	Unit	Model	Capacity	Working hour (hour)
Bulldozer	1	CAT D7F	20.3 ton	28
"	1	Komatsu D65A	15.5 "	83
"	1	" D50A	11.4 "	22
Backhoe	1	Hitachi UH06D	0.6 cu.m	131
Wheel Loader	1	Clark 75 IIIA	2.1 cu.m	103

2) 2nd Period (21 December 1984 - 31 December 1984)

The lower layer of the right-half area, Zone-2 as given in Fig. 4.5.2, was mainly excavated with a depth of about 3 m from the El.114.0 m down to El.111.0 m. The excavation quantity was 9,700 cu.m consisting of common soil 7,800 cu.m and soft weathered rock 1,900 cu.m. The excavation was done by Bulldozers and excavated soils were transported by three Dump Trucks (12 tons) to the same dumping yard as in the 1st period. The excavation equipment usd and those working hours are shown as follows:

Equipment	Unit	Model	Capacity	Working hour (hour)
Bulldozer	1	Komatsu D65A	15.5 ton	105
"	2	" D50A	11.4 "	107
Backhoe	1	Hitachi UH06D	0.6 cu.m	131
Wheel Loader	1	Clark 75 IIIA	2.1 cu.m	157

3) 3rd period (1 January 1985 - 22 January 1985)

The right-corner, given as Zone-3, mainly consisting of soft weathered rock was excavated. The quantity of excavation was 4,800 cu.m with a depth of about 4 m from El.114.0 m down to El.110.0 m. The excavation was done time to time with the progress of the concrete placing work for the right-bank stilling basin slab by Bulldozers and a Backhoe. The excavated soil was dumped in the immediate downstream right bank as the embankment materials for the guide bank.

4) 4th period (23 January 1985 - 15 February 1985)

The excavation in the left-half area was immediately started after the construction of a diversion channel at the left-corner of the river along hill was completed. Major excavation in the left-half area with a depth of about 5.5 m from the river bed down to the level El.112.5 m was completed in this period. The upper layer's soil was push out by Bulldozers and the lower layer's one was transported by two to three Dump Trucks (12 ton) to the dumping yard 50 m to 100 m downstream. The quantity of excavation was 16,800 cu.m of common soil. The excavation equipment used and those working hours are shown as follows:

Equipment	Unit	Model	Capacity	Working hour (hour)
Bulldozer	1	CAT D7F	20.3 ton	21
"	1	Komatsu D65A	15.5 ton	78
"	2	" D50A	11.4 ton	194
Shovel Dozer	1	" D60S	1.8 cu.m	122
Backhoe	1	Hitachi UH06D	0.6 "	52
"	1	IHI IS 190	0.7 "	172
Wheel Loader	1	Clark 75 IIIA	2.1 "	46

5) 5th period (16 February 1985 - 25 March 1985)

The excavation done in this period, given as Zone-5, were for the portion below the level El.112.5 m as the final treatment for the concrete placing for stilling basin slab and of the launching apron. The excavation was made time to time with the progress of the concrete works and the quantity was about 4,200 cu.m of common soil.

6) 6th period (26 March 1985 - 31 March 1985)

The excavation area, given as Zone-6, was the left-corner of the stilling basin area where the diversion channel had been situated.

The excavation was started immediately after the river water was diverted to the right bank through scouring sluice gates. The excavation depth was 5.5 m from the river bed El.118 m down to EL.112.5 m. The excavated soil was transported by three Dump Trucks (12 tons) to the dumping yard 100 m to 150 m downstream. The quantity of excavation was 7,000 cu.m consisting mainly of soft weathered rock. Since the river diversion to the right bank was far delayed, the excavation here was carried out in very full swing in order to recover the lagging progress. The excavation equipment used and those working hours are shown as follows:

Equipment	Unit	Model	Capacity	Working hour (hour)
Bulldozer	1	Komatsu D65A	15.5 ton	62
"	1	" D50A	11.4 "	39
Shovel Dozer	1	" D60S	1.8 cu.m	82
Backhoe	1	IHI IS190	0.7 "	7.5
Wheel Loader	1	Clerk 75 IIIA	2.1 "	15

7) 7th period (1 April 1985 - 20 April 1985)

The excavation done in this period, given as Zone-7, were for the portion below level El.112.5 m as the final treatment for the stilling basin slab at the left-corner's area and of the launching apron. The excavation was made time to time with the progress of the work and the quantity was about 4,000 cu.m consisting of common soil 2,800 cu.m and soft weathered rock 2,800 cu.m.

The monthly progress of the foundation excavation are shown as follows:

(Unit: cu.m)

Month	Excavated Quantity		
	Total	Common	Rock
December 1984	19,200	17,300	1,900
January 1985	7,800	4,700	3,100
February 1985	18,000	18,000	0
March 1985	7,000	4,500	2,500
April 1985	4,000	1,200	2,800
Total	56,000	45,700	10,300

4.5.4 Underdrainage System of Stilling Basin

An underdrainage system was provided beneath the level portion of the stilling basin slab in order to decrease the uplift pressure. The underdrainage system consists of gravel filter layer, an underdrain pipe network and weep holes.

The gravel filter layer with a thickness of 40 cm is composed of two sub-layer of gravels having each 20 cm thick. The well graded gravels produced at the screen plant were used for the filter materials. The gradation of the lower layer was of 5 mm to 20 mm in diameter and the upper layer 40 mm to 80 mm. This gradation order was decided by a result of sieve analysis of river bed materials taken from the deepest excavated level of El.109.8 m and by making reference to the USBR's guideline (Design of Small Dams) as shown in Fig. 4.5.3. The filter gravels were carefully placed by man-power.

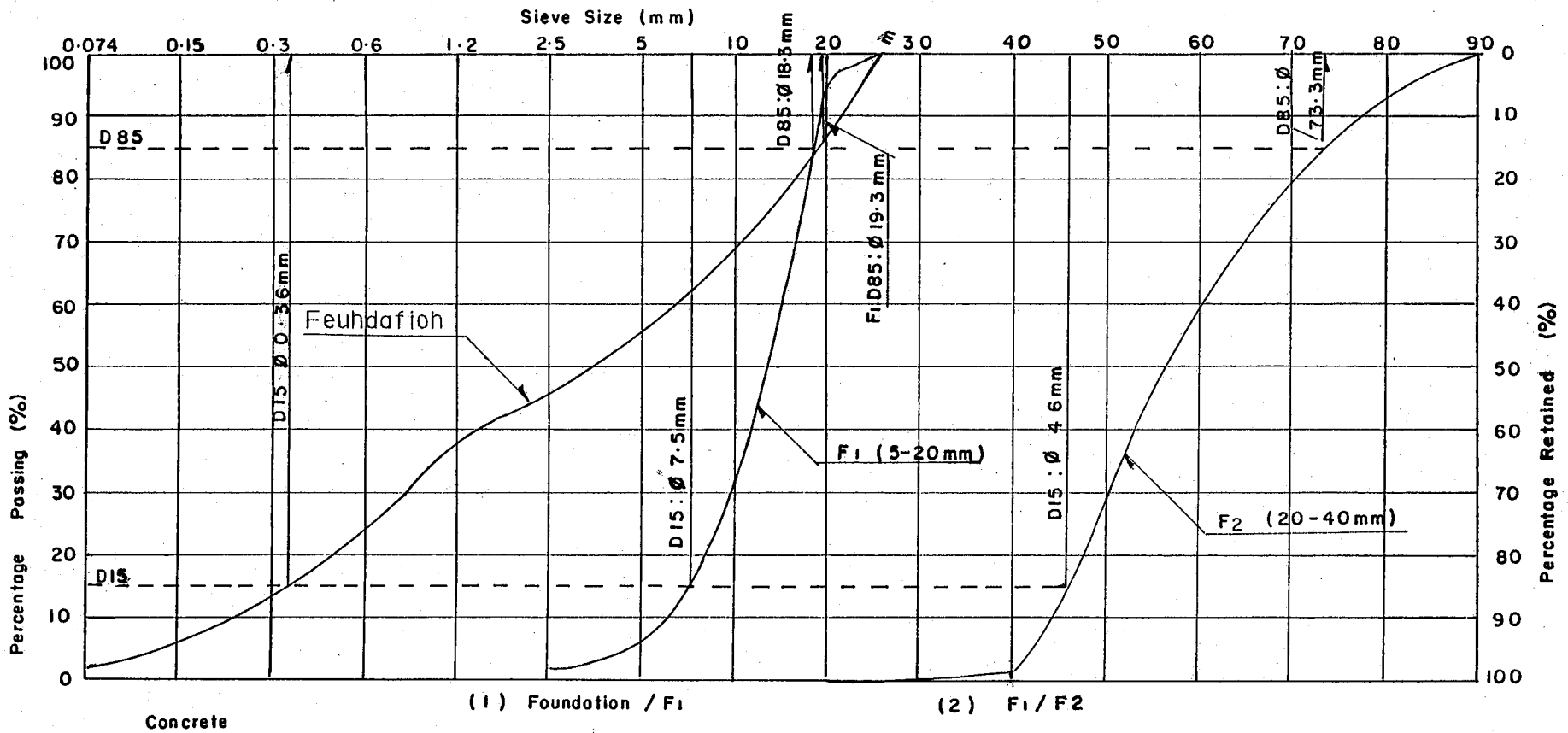
The underdrain pipe network was provided only beneath the deepest stilling basin slab. Although concrete pipe with open joing was originally planned as the material of the underdrain pile, perforated PVC pipe with an inside diameter of 100 mm was employed. Its durability under the heavy concrete slab was confirmed by a field test. Pipes were placed between the above two filter gravel layers and perforated holes of 6 mm dia were given to the lower side contacting with 5-20 mm filter. The pipe network was provided with about 5m x 5m mesh on the pervious foundation and about 10m x 10m one on the impervious foundation. Three outlets discharging water from the underdrainage pipes were installed at each right and left wall at El.113.0 m, 50 cm higher than the stilling basin slab surface.

Weep holes made by PVC pipes were installed at two places, one was in the upper stilling basin slab and the other in the lower slab between chute and baffle blocks. Weep holes were placed with an interval of 2m and those top portion was protected with thick steel frame and mesh.

The both underdrain pipes and weep holes were installed just before the concrete for basin slab be cast. The surface of filter gravel layer was covered by an impervious membrane, consisting of double layers of jute sheet and a layer of plastic vinyl sheet sandwiched in the jute ones, in order to prevent cement mortar seeping into the filter gravel.

The details of underdrainage system of the stilling basin are shown on the "As Built Drawings" Drw. No. ABD/RWO.-009.

Fig. 4.5.3 Design of Filter Gravel Layer



Concrete

F2 (40 – 80 mm)

F1 (5 – 20 mm)

Foundation

$\frac{F_1 : D15}{Foun: D15} = \frac{7.5}{0.36} = 20.8 > 5$

$\frac{F_1 : D15}{Foun: D85} = \frac{7.5}{18.3} = 0.41 < 5$

$\frac{F2 : D15}{F1 \ D15} = \frac{46}{7.5} = 6.1 > 5$

$\frac{F2 : D15}{F1 : D85} = \frac{46}{19.3} = 2.4 < 5$

(3) Diameter of Pipe's Perfortion

6 mm dia. $F1 : \frac{D85}{6} = \frac{19.3}{6} = 3.2 > 5$

$F2 : \frac{D85}{6} = \frac{73.3}{6} = 12.2 > 2$

4.5.5 Stilling Basin Slab

The stilling basin slab is divided transversely into 5 lines from A-line to E-line downward. Each line is further divided into 8 or 11 blocks and the basin slab is composed of 49 blocks in number as shown in Fig. 4.5.4. Features of slab block of each line are as follows:

Line	Block Nos.	Block Size B (m)	L (m)	T (m)	Remark
A	11	4.5 to 15	5	1.0 to 1.0	Flat
B	10	10.5 to 15	9	1.5	Slope
C	10	9.1 to 18	10	2.3	Slope/Flat
D	10	10.5 to 18	13	2.3 to 1.0	Flat
E	8	9.1 to 18	10	1.0	Flat

The concrete placing for the A-line was started from 1 May 1984 in the first dry season and completed before starting the foundation excavation for the B to E-line on 12 December 1984. Five blocks were completed before the rainy season of 1984 and the rest were completed on 10 December 1984. The quantity of concrete of A-line was 680.7 cu.m in total.

The concrete placing for the stilling basin slabs at the deeper portion from B to E-lines was started from 22 December 1984 and basically completed on 23 April 1985 except a portion of well for dewatering.

During the above 4 months, slab blocks of 38 in number or about 10,335 cu.m of concrete were placed. The well for dewatering was plugged on two stages basis, on 30 April 1985 first and on 8 May 1985 second on which the construction of stilling basin slab was substantially completed.

The foundation of stilling basin slab consisting of two geological layers, one was soft weathered silt stone or sand stone and the other sand and gravel one. 1st to 4th slab blocks from the right and 10th to 9th ones from the left at each were constructed on the weathered rock zone. The rest from 5th to 7th blocks were on the sand and gravel zone. These sand and gravel about 8m below the original river bed was well compacted naturally. The final excavation at the sand and gravel zone was made carefully without disturbing the soil surface as much as possible after the sub-soil water table be fully lowered. Those soil surface was further compacted by the heavy equipment such

as Bulldozers and Dump Trucks.

The filter gravels under slab at the joint portion of the slab was carefully treated by hands so as to keep the continuity of the filter layer. The joint of slab to slab was the construction joint having key joint.

The placing work of the concrete for a block was done continuously without interruption, except for the right side blocks in which reinforcement bars with double layers were provided. Concrete for these blocks were cast on two stages basis in such a manner as that the upper layer concrete be cast after the installation of upper layer's reinforcement bars.

The placing concrete was carried out by the following three methods:

	Transporting	Casting
i)	Transit Mixers	Bucket 1.0 cu.m lifted by crane
ii)	Transit Mixers and Dump Trucks	Backhoe 0.6 cu.m
iii)	Transit Mixers	Inclined Chute

The concrete placing by inclined chute was not allowed except special cases because segregation of concrete was remarkable. Immersion type vibrators were used for the compaction of concrete.

The monthly progress records of the construction of stilling basin slab are shown in Table 4.5.1 and the order of placing the concrete on block basis is shown in Fig. 4.5.4. The average rate of concrete placing per hour ranged from 10 cu.m to 26 cu.m as shown in Table 4.5.2.

Table 4.5.1 Monthly Record of Concrete Placing for the Stilling Basin Slab

Month	Block Number	Volume (m^3)
1984/May	4	258
Jun	1	69
Nov	1	69
Dec	9	1,417
1985/Jan	7	1,875
Feb	11	2,585
Mar	5	1,665
Apr	11	3,045
Total	49	10,983

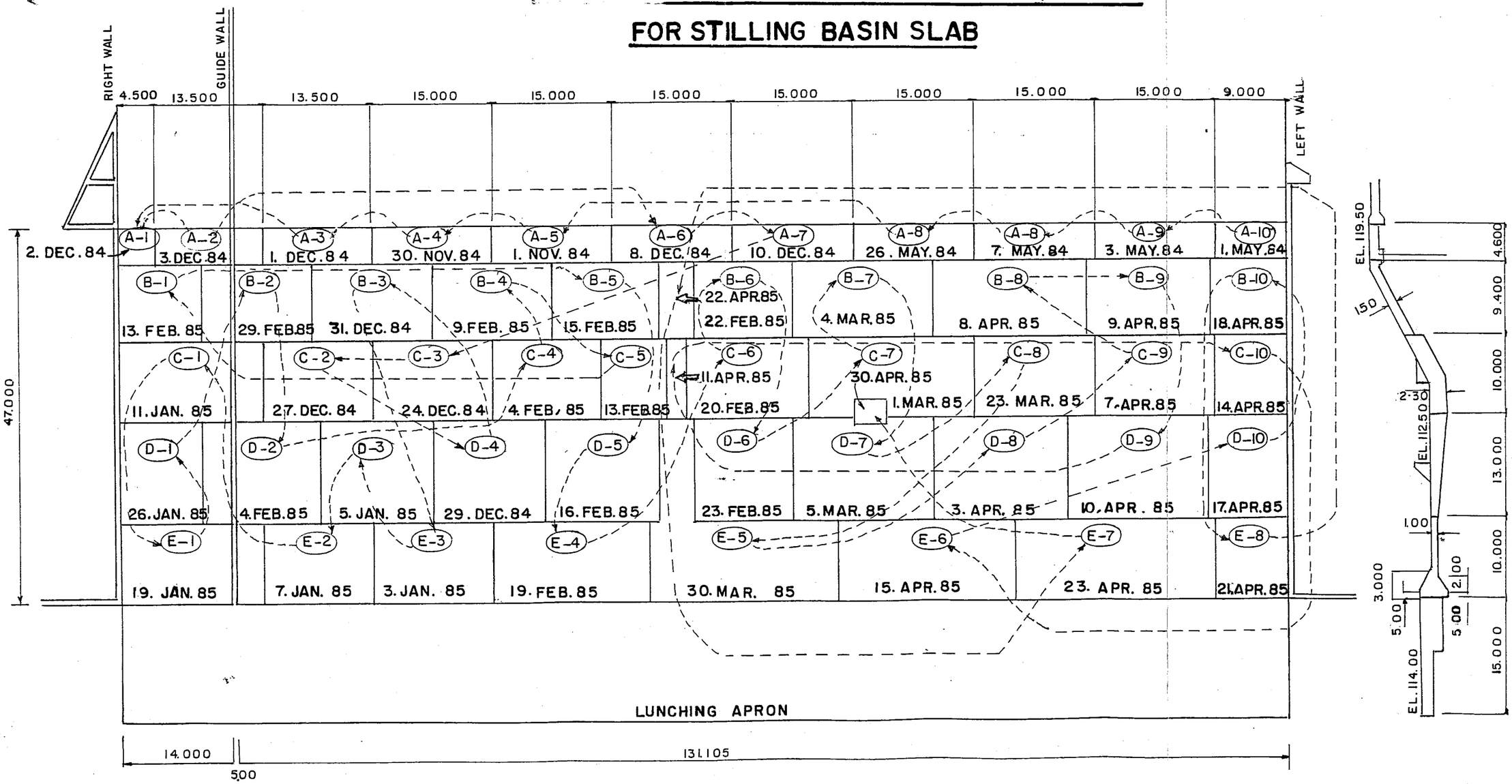
Table 4.5.2 Detailed Record of Concrete Placing for the Stilling Basin Slab

Date	Name of Block	Concrete Volume (m^3)	Casting Hour (hr)	Hourly Rate for casting	Average Hourly Rate for casting
1984/May 1	A-11	51	NA	NA	
" 3	A-10	69	"	"	
" 7	A-9	69	"	"	
" 26	A-8	69	"	"	
Jun 1	A-5	69	"	"	
Nov 30	A-4	69	10	6.9	
Dec 1	A-3	62	10	6.2	
" 2	A-1	30	3	10.0	
" 3	A-2	62	10.5	5.9	
" 8	A-6	69	5	13.8	
" 10	A-7	69	6	11.5	
Sub-total		688	44.5	8.1	
Dec 24	C-3	350	35	10.0	
" 27	C-2	315	25	12.6	
" 29	D-4	270	18.5	14.6	
" 31	B-3	190	15	12.7	
1985/Jan 3	E-3	150	11	13.6	
" 5	D-3	270	19	14.2	
" 7	E-2	135	9.5	14.2	
" 11	C-1	470	36	13.1	
" 19	E-1	360	22	16.4	
" 26	D-1	310	21.5	14.4	
" 29	B-2	180	20.5	8.8	
Feb 5	D-2	300	21.5	14.0	
" 7	C-4	320	31	10.3	
" 9	B-4	200	14	14.3	
" 13	C-5	150	14	10.7	
" 15	B-1	170	21	8.1	
" "	B-5	175	13	13.5	

Date	Name of Block	Concrete Volume (m^3)	Casting Hour (hr)	Hourly Rate for casting	Average Hourly Rate for casting
1985/Feb 16	D-5	255	19.5	13.1	
" 19	E-4	200	11	18.2	
" 20	C-6	370	22	16.8	
" 22	B-6	180	11.5	15.7	
" 23	D-6	265	15	17.7	
Mar 1	C-7	450	27	16.7	
" 4	B-7	220	13	16.9	
" 5	D-7	325	12.5	26.0	
" 23	C-8	350	21.5	16.3	
" 30	E-5	320	20	16.0	
Apr 3	D-8	325	18	18.1	
" 7	C-9	380	30.5	12.5	
" 8	B-8	250	18	13.9	
" 9	B-9	215	15.5	13.9	
" 10	D-9	350	14	25.0	
" 11	Along Sheet Pile portion	60	4	15.0	
" 13	C-10	260	15.5	16.8	
" 15	E-6	225	13	17.3	
" 17	D-10	270	16	16.9	
" 18	B-10	160	12.5	12.8	
" 21	E-8	200	11	18.2	
" 22	Along Sheet Pile portion	60	4	15.0	
" 23	E-7	250	13.5	18.5	
" 30	Well portion	40	2	20.0	
Sub-total		10,295	707.5		14.6
Total		10,983	760.0		*14.0

*/ Excluding "NA"

FIG.4.5.4 PROGRESS OF CONCRETE PLACING FOR STILLING BASIN SLAB



LEGEND

C—3 : Block No.

----→ Concrete Casting Order

24. DEC. 84 Complection Date Of Concrete Casting

4.5.6 Steel Fiber Reinforced Concrete (SFRC)

1) General

The purpose of SFRC used for the structures in the stilling basin was to minimize damages of concrete by abrasion due to extremely high velocity of flood flow containing considerable amount of rubbles and boulders. Structures constructed by SFRC were both chute and baffle blocks and endsill all of which were made entirely by SFRC, and overlay, of 15 cm thick coated over all the surface of stilling basin slab.

Steel fiber applied this time was a hook end type, called Dramix steel Fibers manufactured by Bekaert Steel Wire Corporation, USA. A fiber has a length of 30 mm and a diameter of 0.5 mm.

A quantity of fibers mixing with concrete, 350 kg cement used as discussed later in the sub-section 4.8.2, was 80 kg per 1 cu.m concrete. Steel fibers were mixed in the concrete at the concrete plant such a manner as adding fibers on top of the sand and coarse aggregates in the weighting hopper in accordance with a guideline of manufacturers. One batch of mixing concrete was 0.375 cu.m with a bag of steel fiber of 30 kg. The concrete mixer at the plant was of compulsory type and mixing time was set at 1 minutes. Steel fibers were well mixed with the concrete without segregation or formation of fiber balls.

Transportation of and placing the SFRC were done in the same manner as the other ordinary concrete. However, the workability of SFRC was fairly low due to lower W/C ratio for obtaining higher compressive strength and to relatively courser sands used, and this resulted the difficulties in discharging the concrete from the Transit Mixer and compaction of concrete during the placing.

2) Chute and Baffle Blocks

The quantity of SFRC cast for chute and baffle blocks was 376.875 cu.m as shown below:

Description	Nos. of block (Nos.)	Q'ty of SFRC per block (cu.m)	Q'ty of SFRC (cu.m)
Chute Block	49	3.375	165.375
Baffle Block	47	4.5	211.50
Total	96	-	376.875

The construction period of both blocks were as follows:

Chute Blocks	5 March 1985 - 26 April 1985
Baffle Blocks	19 March 1985 - 5 May 1985

Foot portion of reinforcement bars for blocks had been embeded in the slab concrete and upper bars above slab surface were jointed by welding method time to time with the concrete progress for the blocks. Wooden forms for blocks of about 5 in number were erected and concrete was cast at a time. Casting concrete was generally done by a Backhoe because Cranes Lifting concrete buckets were being occupied by the installation work of precast concrete blocks at the launching apron.

The progress of both blocks are shown in Table 4.5.3 and Fig. 4.5.5.

3) Endsill

The endsill has a length of 144.69 m in total and a concrete volume of 434.07 cu.m (3.0 cu.m/m long). The construction of endsill was started from 15 March 1985 and completed on 8 May 1985. The concrete placing for the endsill was done by dividing it into 8 blocks with a length ranging from 6 m (18 cu.m concrete) to 34 m (102 cu.m).

Wooden forms were elected at downstream vertical face and one side of block. Concrete casting was done by a backhoe with immersion type vibrators for the compaction. The progress of endsill as shown in Table 4.5.3 and Fig. 4.5.5.

4) SFRC Overlay

SFRC overlay of 15 cm thick was coated over the entire stilling basin slab of 7,032 sq.m in total including chute and baffle blocks portion. The total concrete volume was 1054.8 cu.m.

Before casting SFRC overlay, the concrete surface of Stilling basin slab was thoroughly cleaned by pressured air with water and cement motor was laid over the concrete surface. The concrete was cast directly from Transit Mixer or by using Backhoe and compaction was made by vibratory plate tamper at the flat slab portion and by hand tamping at the slope slab portion.

The work was started from 2 March 1985 and completed on 8 May 1985. The progress is shown in Table 4.5.3 and Fig. 4.5.5.

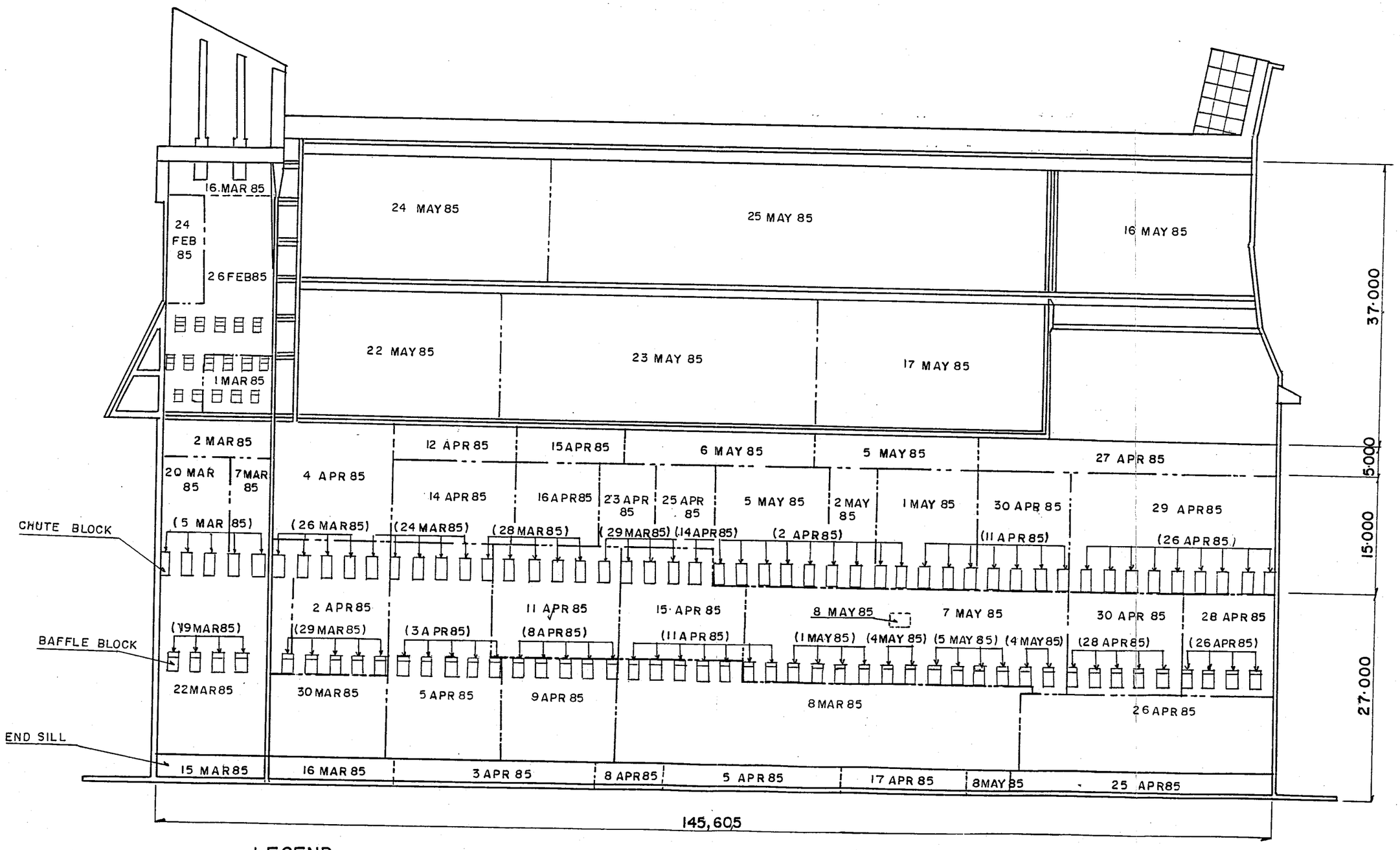
SFRC overlay was also provided on the existing weir apron surface with a thick of 15 cm and its details are mentioned later in the sub-section 4.7.5.

Table 4.5.3 Monthly Record of Placing of SFRC

Unit : m^3

	Overlay (Existing) (Area m^2)	Overlay (Basin) (Area m^2)	Chute Block (No.)	Baffle Pier (No.)	End Sill (m)	Total
1985/Feb	45 (300)	-	-	-	-	45
Mar	22 (147)	142.2 (948)	77.625 (23)	40.5 (9)	90 (30)	372.325
Apr	-	589.8 (3,932)	87.75 (26)	121.5 (27)	320.07 (106.69)	1,119.12
May	612.2 (3,400)	322.8 (2,152)	- -	49.5 (11)	24 (8)	1,008.5
Total	679.2 (3,847)	1,054.8 (7,032)	165.375 (49)	211.5 (47)	434.07 (144.69)	2,544.945

FIG.4.5.5 PROGRESS OF PLACING OF SFRC.



LEGEND

30MAR85 : Completion Date of Concrete Casting.

4.5.7 Concrete Walls

1) General

The following three concrete vertical walls were constructed in the stilling basin.

i) Guide wall
ii) Right-side wall
iii) Left-side wall

The quantity of concrete was 1452.1 cu.m in total.

Ply wood plate (4′ x 8′ x 12 mm) were used for the forms for concrete. A lift height ranged from 1.0 m to 2.3 m. The forms at the higher position were fixed by tie-rods of 16 mm in diameter and wire ropes with turn buckles anchord at the ground.

A height of placing concrete at a time was limited to 1m to 1.2 m and next layer was cast keeping enough time after the lower layer concrete be cast. A bucket of 1.0 cu.m capacity lifted by crane was used for casting concrete. The concrete was once discharged on the platform fitted with the top of forms and then cast into the right places by scoops. When the concrete was cast from the higher place than 1.5 m high, it was re-mixed by hands before compaction as practicably much as possible. The immersion type vibrators drived by electric or engine were used for the compaction of concrete.

The progress of concrete works for the above walls are shown in Table 4.5.4 and Fig. 4.5.6.

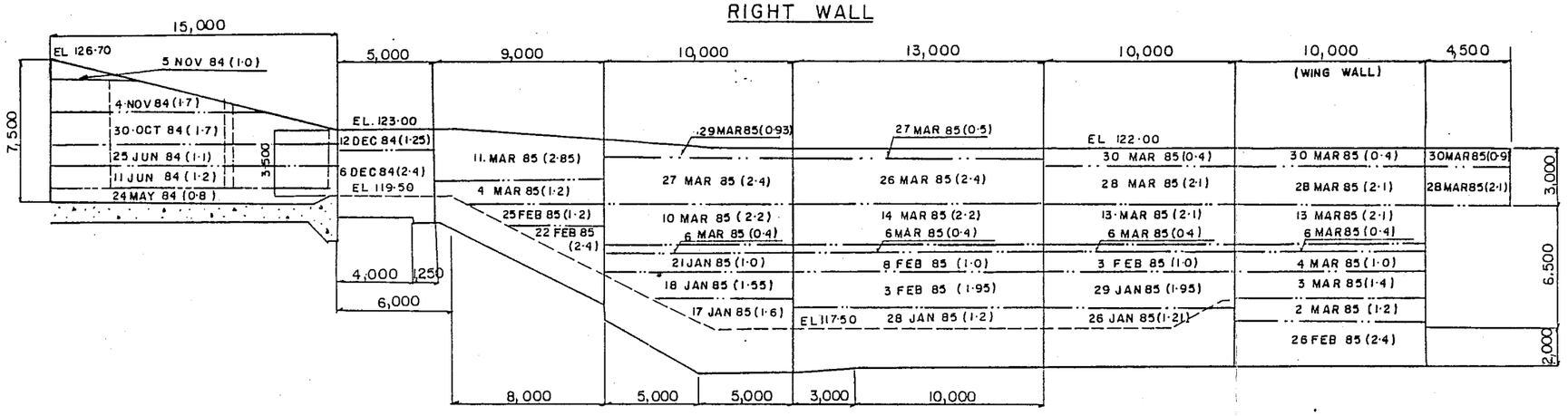
Table 4.5.4 Monthly Record of Concrete Placing for Wall

Unit : cu.m

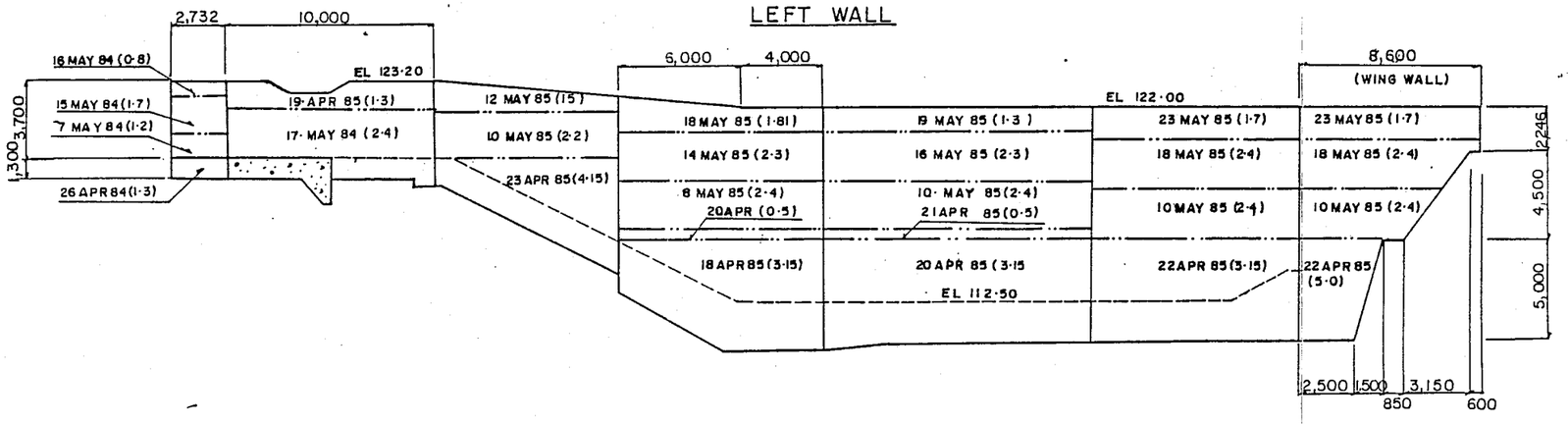
Month	Retaining wall	Right wall	Guide wall	Left Wall	Total
1984/Apr	-	-	-	6.1	6.1
May	-	35.3	21.0	34.0	90.3
Jun	5.2	39.4	-	-	44.6
Jul	7.9	-	-	-	7.9
Aug	88.8	-	-	-	88.8
Sep	4.5	-	-	-	4.5
Oct	1.6	17.4	-	-	19.0
Nov	-	17.9	-	-	17.9
Dec	-	10.3	8.0	-	18.3
1985/Jan	-	148.7	50.3	-	199.0
Feb	-	120.5	106.8	-	227.3
Mar	-	231.1	80.8	-	311.9
Apr	-	-	-	235.8	235.8
May	-	-	-	180.7	180.7
Total	108.0	620.6	266.9	456.6	1,452.1

FIG. 4.5.6 PROGRESS OF CONCRETE WALL

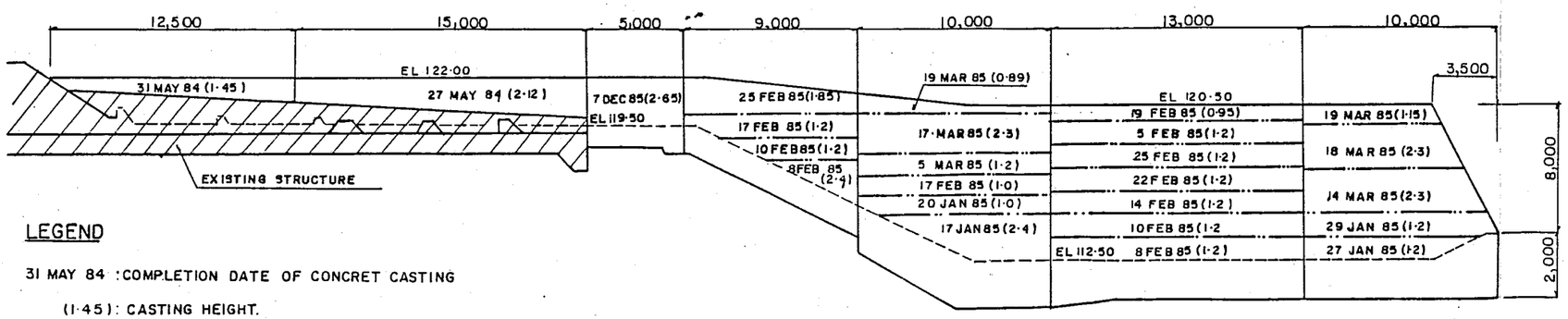
RIGHT WALL



LEFT WALL



GUIDE WALL



LEGEND

31 MAY 84 : COMPLETION DATE OF CONCRET CASTING

(1·45) : CASTING HEIGHT.

2) Guide wall

The guide wall consists of an additional guide wall of 27.5 m long constructed on the existing one of the weir with height of 0.5 m to 2.2 m and a wall of 47 m long constructed on the stilling basin slab with height ranging from 2.5 m to 8.0 m. The quantity of concrete of the guidewall was 266.9 cu.m, 21.0 cu.m for the additional wall and 245.9 cu.m for one in the stilling basin.

The former wall was constructed in May 1984 before the rainy season. The latter one was started from 7 December 1984 and completed on 19 March 1985.

3) Right-side Wall

The right-side wall is composed of the following three types of walls:

i) Hollow sylinder type wall
ii) L-type retaining wall
iii) Wing wall

The quantity of concrete was 620.6 cu.m in total.

A hollow sylinder type wall was constructed on the existing scouring sluice bay as a transition wall from the weir to stilling basin. The wall has 15 m in longitudinal length with height ranging from 7.5 m to 5.8 m. The quantity of concrete of this wall was 111.7 cu.m. The construction was started from 24 MAY 1984 and completed on 5 November 1984.

A L-type retaining wall was divided into 5 blocks due to division of basin slab blocks. This wall has a longitudinal length of 47 m with height ranging from 3.5 m to 9.5 m. The quantity of concrete was 401.9 cu.m. The construction was started from 6 December 1984 and completed 30 March 1985.

A wing wall has a length of 10 m basically and a height of 11.5 m. An additional wall of 4.5 m long and 3.0 m high was connected at the top portion of the wall for adjusting the river bank slope protection. The quantity of concrete was about 107 cu.m. The wall was constructed in parallel with the above L-type relaining wall during a period from 26 February 1985 to 30 March 1985.

4) Left-side wall

The left-side wall is composed of the following three types of walls:

i) Mass concrete wall

ii) L-type retaining wall

iii) Wing wall

The quantity of concrete was 456.6 cu.m in total.

A mass concrete wall having a height of 3.7 m a longitudinal length of about 2.7 m and a thickness of about 3 m was constructed at the weir apron portion as a transition from the weir to the stilling basin. The construction was done between 26 April 1984 and 16 May 1984.

A L-type retaining was divided into the same 5 blocks as the right wall. This wall was of 47 m in a longitudinal length, height ranging from 3.7 m to 9.5 m and a concrete volume of about 390 cu.m. A small part of the wall in the upperstream portion was constructed in the first dry season and the major was constructed in the second dry season, started from 17 May 1985 and completed on 23 May 1985.

A wing wall in the left bank was constructed in such a way as grounding the wall into the slope of hill by about 1 m in depth. The wall has a height of 11.5 m, a bottom length of 2.5 m and a top length of 8.6 m. The quantity of concrete was about 40 cu.m cast between 22 April 1985 and 23 May 1985.

5) Provision of Weep holes

Weep holes were provided in the L-type retaining walls of the both banks. The spaces of weep holes were 2 m to 2.5 m horizontally and 1.0 m vertically with alternate arrangement as shown on the As Built Drawings. Weep holes was made of PVC pipe of an inside diameter of 50 mm. A plastic made bowl 30 cm (O) x 15 cm (H) type filter containing filter gravels was fitted at each end of weep hole on the backside wall surface. Weep holes of 141 in total number were provided in the both walls.

4.5.8 Back-filling

Back-filling in the excavated areas were required at the back-side of concrete walls of both banks. The quantity of back-filling for both sides was 4,074 cu.m in total.

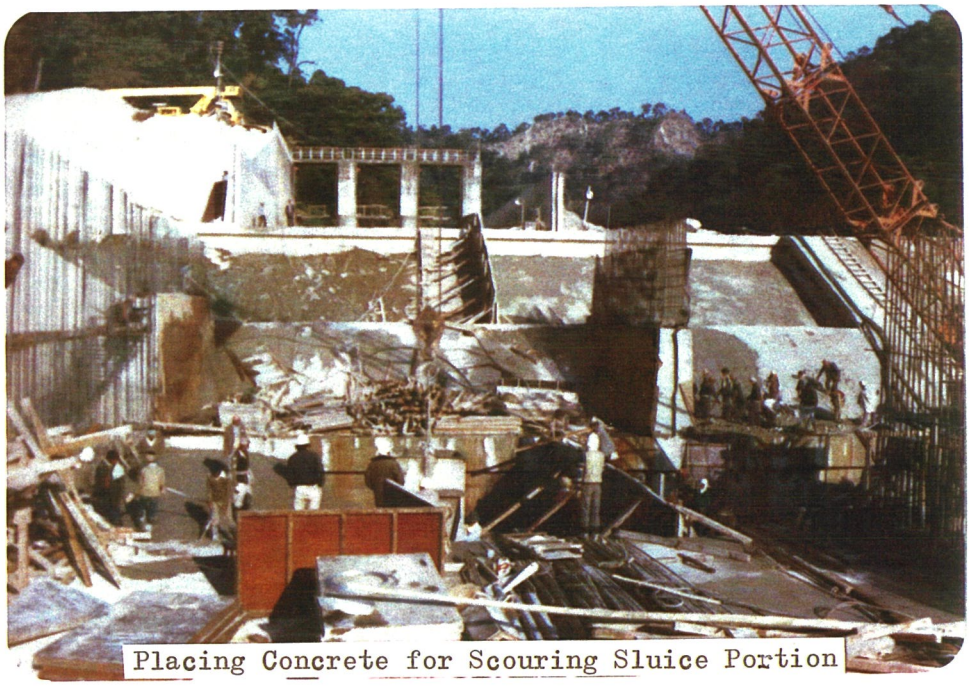
Back-filling work behind the right-side wall was started from the middle of March 1985 and completed by the end of April 1984.

Finishing works such as levelling and soding on the top of back-filled soils were done in May and June 1985. The soils used for back-filling was excavated sand and gravels from the stilling basin foundation. A vertical gravel filter with a thickness of 30 cm was provided on the surface of concrete wall. The quantity of back-filling here was 2,293 cu.m.

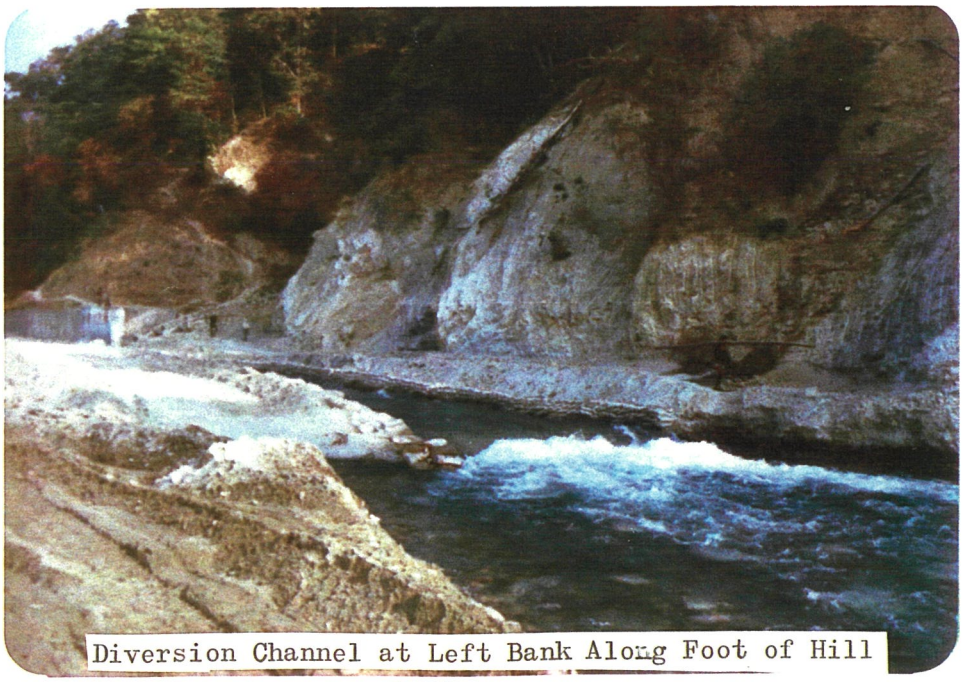
Back-filling for left-side wall was started from 27 May 1985 and completed on 16 June 1985. Finishing work such as levelling and overlay by concrete with a thickness of 30 cm was subsequently made and completed on 19 June 1985. The materials for back-filling was river bed materials.

The quantity of back-filling here was 1,781 cu.m.

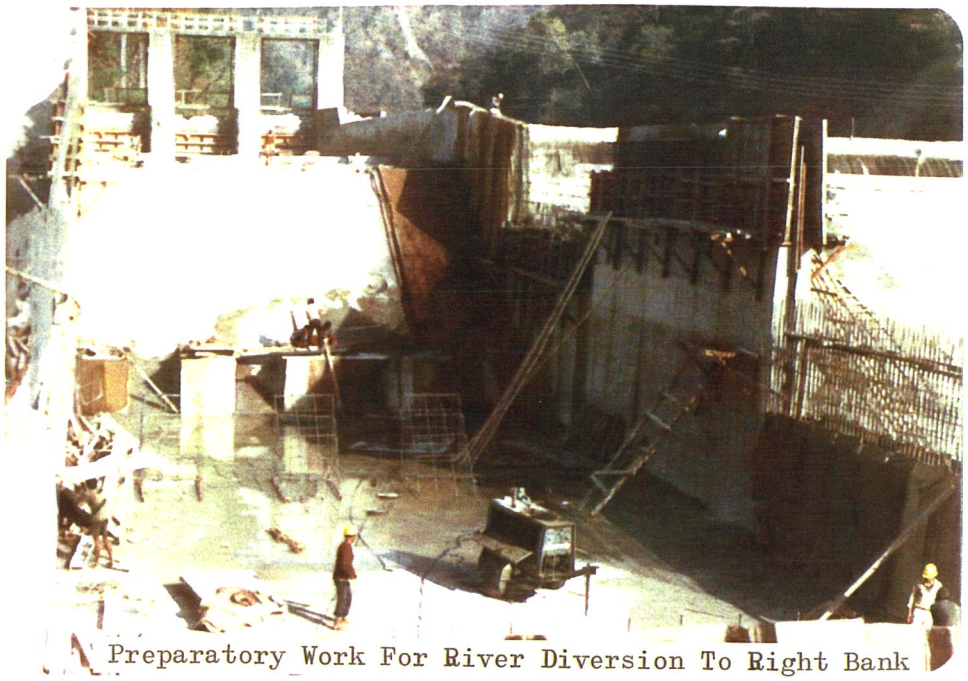
Placing Concrete for Stilling Basin



Placing Concrete for Scouring Sluice Portion

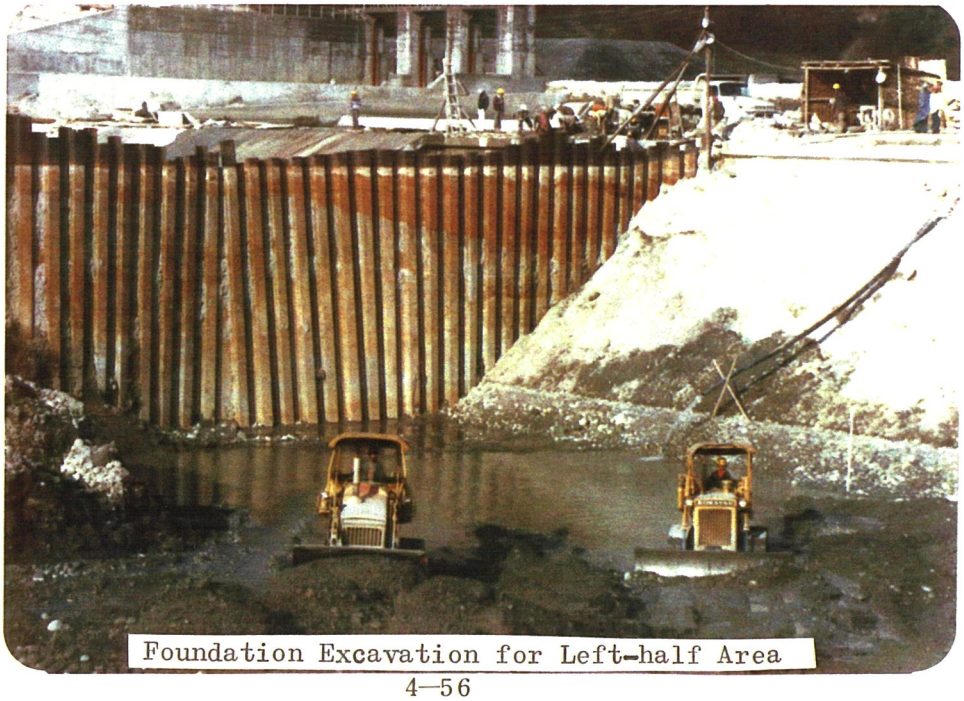


Diversion Channel at Left Bank Along Foot of Hill



Preparatory Work For River Diversion To Right Bank

Completion of Placing Concrete for Right-half of Stilling Basin



Foundation Excavation for Left-half Area

Diversion Channel at Right Bank through Scouring Suice

Placing Plug Concrete for Dewatering Well

View of Slope Protection on Leftside Hill

4.6 Installation of Precast Concrete Block for Launching Apron

The launching apron, with a longitudinal length of about 16 m and 144.8 m in width, is composed of two parts, one is of the double layers of precast concrete blocks in the upstream half of launching apron of about 8.5 m in length and the other single layer of block in the downstream-half of about 6.5 m in length. As the detailed placement method of precast concrete blocks is shown in the As Built Drawing Draw No. ABD/RW-007, the blocks of 3.5 in number were installed in the lower layer and 6 and 6.5 blocks alternately in the upper layer.

Before starting the installation of concrete blocks, a field test to examine the installation methods and also to seek any problems anticipated in the course of the work was carried out. This test gave a fact that four legs of a block sank to the gravel foundation differentially by 10 cm to 15 cm deep due to a point load of about 2 mt at each leg. From this result, laying foundation concrete with a 10 cm thick was proposed in order to avoid a distortion of the entire launching apron which might cause an improper interlock of concrete blocks each other, and this treatment was actually applied to about 15% in area of the lauching apron. However, this proposal was not employed for the remaining area for the reasons that

i) Laying foundation concrete would make the schedule of block installation very tight

ii) Distortion of block arrangement could be observed by small space at joints of block to block, and

iii) Proper interlocks of concrete blocks could be achieved by careful installation work on the compacted sand and gravel foundation.

Equipment used for the installation of concrete blocks were a Crawler Crane (37 tons), a Truck Crane (20 tons) and two to three Dump Truck (12 tons). A concrete block was loaded by Truck Crane at stock yard on Dump Truck and transported to the launching apron for a distance of about 350 m.

The installation of blocks was done by Crawler Crane with lifting a block by steel wire. The block was led to the right place with aids of 4 to 5 labourers. An effective range workable by crawler crane was about 10 meter in radius at the maximum.

The number of concrete blocks installed for the launching apron consisting of full size block of 711 pcs and half ones of 118 pcs. The installation work was started from 16 March 1985 and completed on 8 May 1985. As the progress of installation work is shown in both Table 4.6.1 and Fig.4.6.1, the actual working days during the above periods and this meant the average number of block installed a day was about 33 pcs.

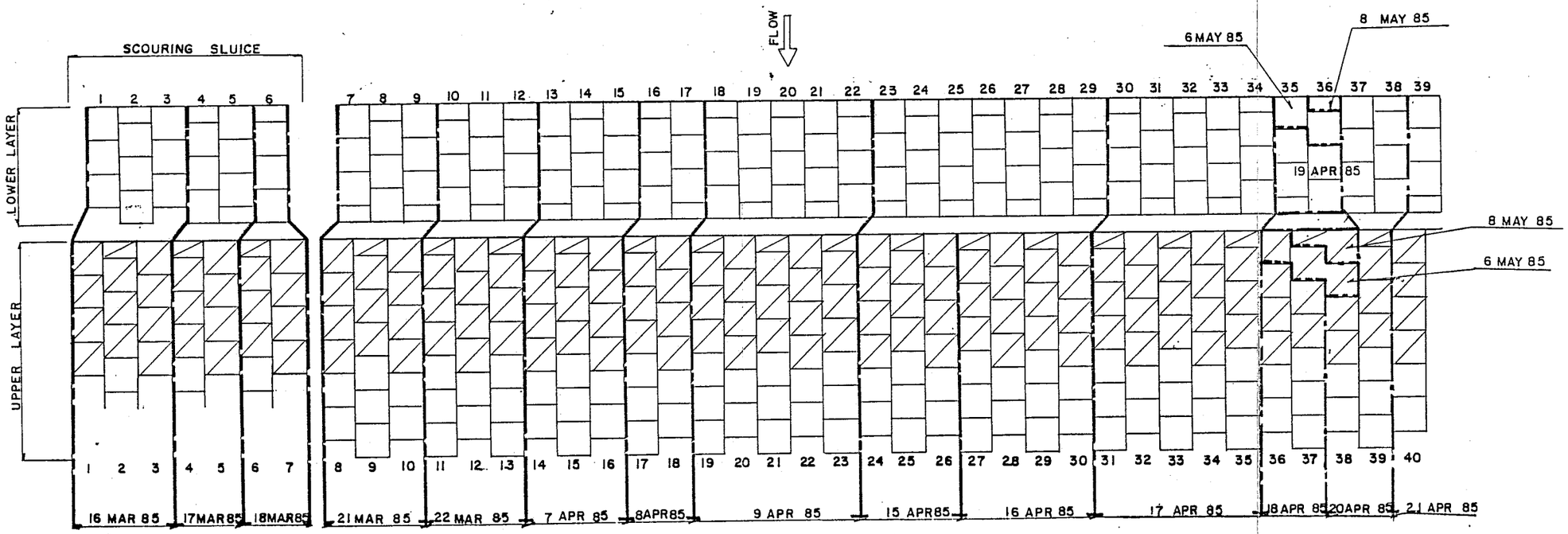
Two kinds of gravel filter in gradation, one is 5 mm to 20 mm in diameter for the lower layer and the other 40 mm to 80 mm for the upper layer, was filled in the gaps of the blocks amounting at about 1,215 cu.m. This filling work was done by Dump Trucks, Bulldozer and Backhoe and completed on 8 May 1985.

Table 4.6.1 Progress of Installation of Precast Concrete Blocks

Unit : number

Date	Full	Half	Total
1984/Mar 16	21	3	26
17	16	3	19
18	13	2	15
21	27	4	31
22	27	5	32
Sub-total	104	17	123
Apr 7	27	4	31
8	18	3	21
9	45	8	53
15	27	4	31
16	36	6	42
17	45	8	53
19	14	1	15
20	16	3	19
21	36	6	42
23	27	4	31
24	27	5	32
26	18	3	21
29	44	8	52
30	35	6	41
Sub-total	415	69	484
May 1	45	7	52
2	18	3	21
4	54	9	63
5	40	6	46
6	34	5	39
8	1	2	3
Sub-total	192	32	224
Total	711	118	831

FIG.4.6.1 PROGRESS OF INSTALLATION OF PRECAST CONCRETE BLOCK



NUMBER OF CONCRETE BLOCKS

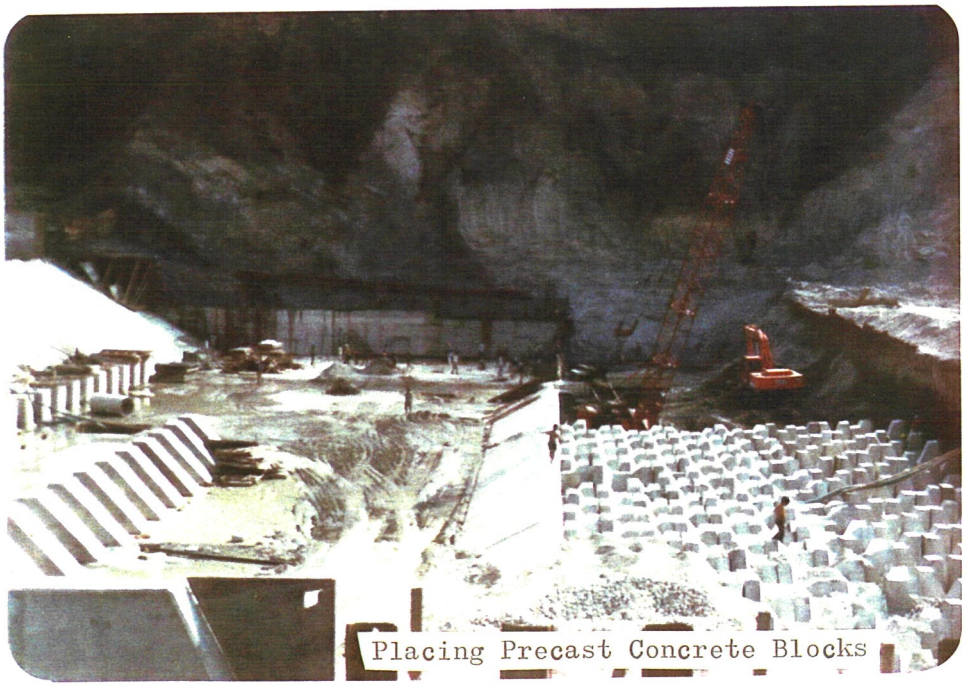
Hull	:	714
Half		117
Total		831

LEGEND

Half Block

Production and Stock Yard of Precast Concrete Blocks

Placing Precast Concrete Blocks



Placing Precast Concrete Blocks

4.7 Other Associated Works

4.7.1 General

In association with the construction of stilling basin structure as have been mentioned in the preceding sub-section of 4.5 and 4.6, the following structures were constructed:

(i) Additional embankment at the canal intake

(ii) River bank protection works of both right and left banks

(iii) Raising height of scouring sluice gates

(iv) SFRC overlay on the existing weir apron

(v) Installation of weep holes on existing weir apron

(vi) Lowering height of baffle wall on existing weir apron

(vii) Construction of outlet structure of escape channel from the settling basin.

The detailed description of the each work are made hereinafter.

4.7.2 Additional Embankment at the Canal Intake

The work consisted of the concrete retaining wall and the placement of additional compacted fill on the canal intake with a height of 2.3 m. The retaining wall was extended into the embankment as the cut-off wall. The slope of embankment was protected by wet rubble masonry. Hand rail with a height of 0.8 m was provided on the top of the embankment.

The quantity of major works were as follows:

Excavation	450	cu.m
Embankment and Backfill	1,200	"
Concrete	180	"
Form for concrete	700	sq.m
Reinforcement bars	11	tons
Wet rubble masonry	310	sq.m

The construction of the retaining and cut-off walls were started from June 1984 and completed on 19 May 1985. Except the installation of hand rail, the embankment and wet rubble masonry works were completed by the end of June 1985. The completion of hand rail was on 12 July 1985.

The excavated weathered rock mixing with the river bed materials were used for the fill materials. These materials were transported by dump trucks and compacted by vibiating plate compactor.

4.7.3 River Bank Protection Works

The river bank protection works were provided for both right and left banks.

Right Bank: The work in the right bank consisted of the construction of the downstream guide bank with slope protection of concrete and wet rubble masonry. The guide bank was provided from the immediate downstream of the right wing wall of the stilling basin with heights ranging from 8 m to 2.5 m and a length of about 90 m. The bank was connected to the existing right bank as shown in the "As Built Drawing" No. ABD/RW-008.

The quantity of major works were as follows:

Embankment	5,800 cu.m
Concrete	130 "
Wet rubble masonry	500 sq.m
Sod facing	2,200 sq.m
Inst. of concrete block	52 pcs

The major part of the embankment was gradually filled by using the excavated weathered rock mixing with river bed materials during the foundation excavation of the river bed for the stilling basin. The final treatment of embankment and slope protection by concrete and wet rubble masonry were completed by the end of June 1985. The sod facing provided on the top surface of the embankment was completed on 8 July 1985.

The fill materials were compacted by a Road Roller.

Left Bank: The work in the left bank involved the following components of the protection works:

(i) Slope protection of side hill by concrete and wet rubble masonry

(ii) Gully protection dam

(iii) Concrete overlay on the backfill behind the left-side wall of the stilling basin.

A gully protection dam was constructed at the debouching point of the left side steep stream located near to the endsill of the existing weir apron. The inclined type concrete wall with a slope of about 7% was provided on the slope of left-side hill upstream from the gully protection dam to the upstream end of the existing concrete wall. The height of inclined wall ranged from 5.5 m to 1.8 m.

The wet rubble masonry wall having heights of 2 to 3 m was provided on the slope of hill downstream from the gully protection dam to the left wing wall of the stilling basin. A further slope protection wall made by concrete and wet rubble masonry, ranging heights from 8 m to 4 m, was constructed beyond the wing wall downstream over 34 m long.

The top surface of backfill behind the left-side wall was coated by the concrete with thicknesses of 0.4 m to 0.3 m.

The quantity of major works were as follows:

Excavation	810 cu.m
Concrete	500 "
Wet rubble masonry	280 sq.m

The construction of inclined type concrete wall was started from the end of May 1985 and completed on 5 June 1985. The gully protection dam was subsequently started and completed on 15 June 1985. Wet rubble masonry and concrete overlay were completed by 20 June 1985.

4.7.4 Raising Height of Scouring Sluice Gates

Upon a proposal to raise the height of scouring sluice gates by 0.5 m, NK made a structural calculation of modified gates. The calculation resulted that no additional works such as the replacement of spindle shafts and hoists were necessary other than installing simply additional gates.

The additional gate is composed of channels (300 mm (W) x 100 mm (H) x 12 mm (t)) and skinplate of 12 mm thick. Since the ready-made channels were not available in the market, KDC fabricated the channels from the steel plates at the site.

The fabrication of channels was started from the beginning of June 1985. The installation of additional gates, however, was far delayed and carried out beyond June. It was started on 12 July and completed on 15 July 1985 including painting on the surface of gates.

The quantity of steel materials for the additional gates was about 1,620 kg (540 kg/gate) in total.

4.7.5 SFRC Overlay on the Existing Weir Apron

For the same purpose as minimizing the abrasion of the stilling basin surface, SFRC overlay was provided on the surface of existing weir apron except a left part of apron having a top elevation El.119.50 m, 0.3 m higher than those coated by SFRC. (*/ This apron surface was raised by 0.3 m in height in order to lead the river flow to the existing local channel covering a small part of the left bank of the Kankai river when the balance of river water after diverting to the KIP be available.)

The work was started from 15 May and completed on 25 May 1985 as shown in Fig.4.5.5 . SFRC was placed by backhoe and compacted by vibrating plate compactor.

There was relatively thick sand and gravels naturally deposited over the entire existing apron. These sand and gravels were thoroughly removed by Bulldozer, air compressor and labour works before placing SFRC.

The quantity of SFRC was about 680 cu.m.

4.7.6 Installation of Weep holes on Existing Weir Apron

In order to relief uplift pressure acting the existing weir apron as much as possible, weep holes were installed on it. Though the weep hole was proposed to have a diameter of 50 mm and to be installed with a space of 2 m long, the diameter of 38 mm (1.5") with a space of 1.25 m was actually applied to the work due to the unavailability of adequate equipment.

Weep holes were dug by pneumatic drilling equipment. As shown in the "As Built Drawing" No. ABD/RW-009, hole in the concrete slab was filled by gravels (5 - 20 mm) and strainer well anchored in the concrete was placed on the top of the weep hole.

The weep holes of 98 Nos. in total were installed on the apron. The work was done in parallel with the SFRC overlay on the existing weir apron.

4.7.7 Lowering Height of Baffle Wall on Existing Weir Apron

It was the intention to remove the top portion of 0.3 m high of the baffle wall with a height of 0.8 m on the existing weir apron. Although KDC started the work and removed a very small part of the wall manually in May 1985, the work could not be continued due to floods flowing over the weir crest after 4 June 1985.

It was agreed between the Engineer and KDC that the work would be done in

the coming dry season.

The work quantity is estimated at about 40 cu.m.

4.7.8 Outlet Structure of Escape Channel from Settling Basin

This work was additionally ordered to KDC to be done under the contract.

The original outlet structure of escape channel from the settling basin located about 1.5 km downstream from the diversion weir, was washed away by floods during the rainy season of 1984. The nature of the work was the recovery of the structure.

The work involved the steel sheet piling, concrete works and outlet slope protection by gabions. The quantities of major works were as follows;

Steel sheet pile	19 mt
Excavation	2,100 cu.m
Concrete	190 "
Form for concrete	300 sq.m
Reinforcement bars	7 mt
Gabion	200 cu.m

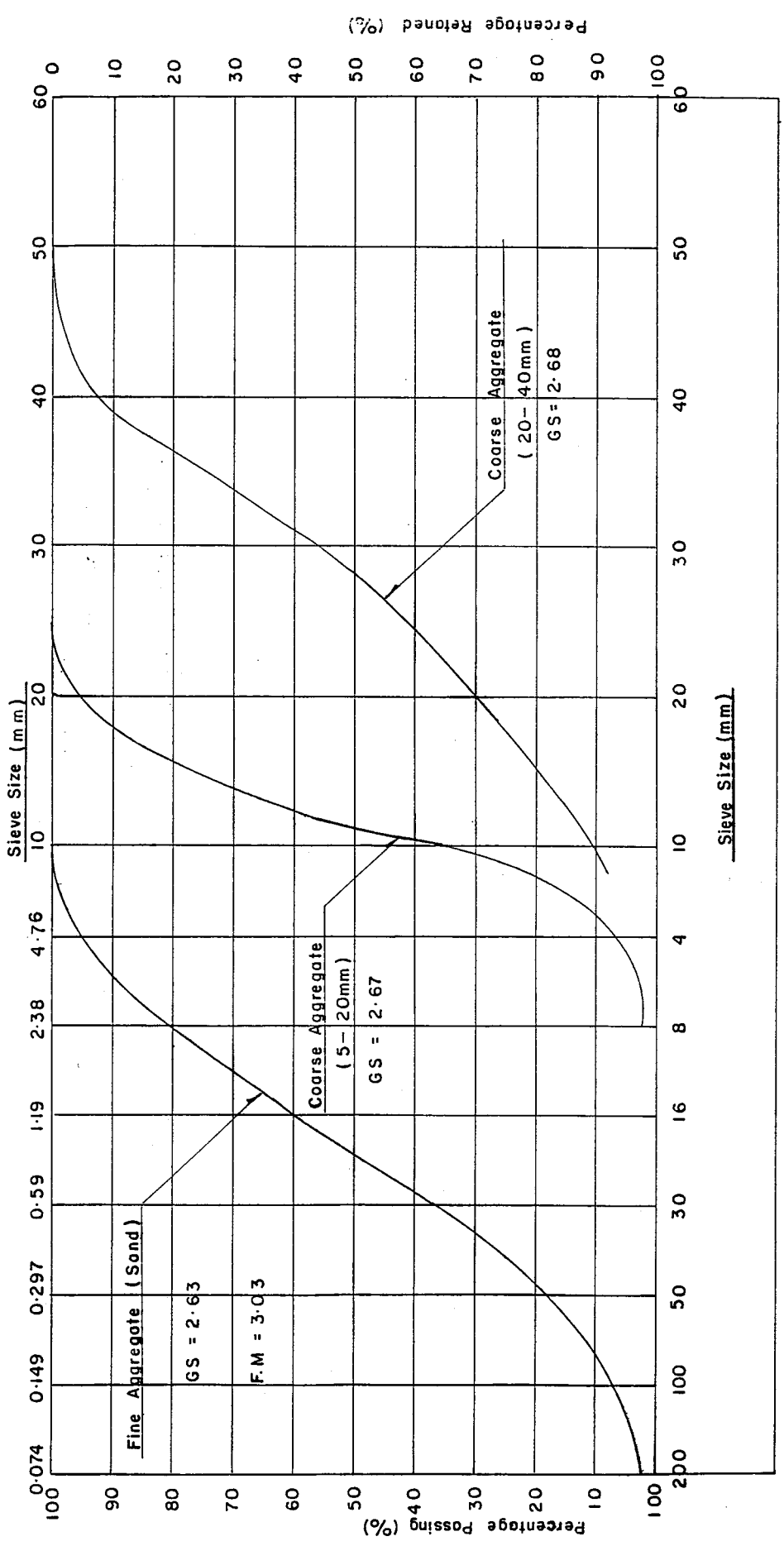
The sheet piling was carried out during the period of 7 to 23 June 1875. The concrete works were subsequently made and completed on 7 July 1985. The remaining works such as gabion installation and sod facing on the embankment were completed by 15 July 1985.

4.8 Quality Control and Test

4.8.1 Aggregates

Raw materials obtained from the Kankai river bed were washed and screened into five kind of aggregates, i.e., sand -5 mm under, 5-20 mm, 20 to 40 mm, 40 to 80 mm and 80 mm over in diameter. Sieve analysis of each groups of aggregates was made time to time, and typical gradation of aggregates are shown in Fig. 4.8.1. As seen in the Figure, FM value of sand was very high due to excessive washing by water, and it could not be improved till the end. Workability of concrete was fairly affected by this.

Fig. 4.8.1 Grading Curve of Aggregates



4.8.2 Design of Concrete Mix proportion

1) Ordinary Concrete

Before starting the concrete works, a trial mix test was done. Test pieces (15 cm dia. x 30 cm high) for four kinds of cement contents per 1 cu.m concrete were produced for the compressive strength test. The result of test is shown in Fig. 4.8.2. From this test result, mix proportions of two types of concrete (Type A and Type B) were decided as shown in Table 4.8.1.

2) SFRC

Test for five cases based on the unit quantity of water (W/C ratio) was done. This five cases were further divided into ten sub-cases (2 sub-cases per 1 case) based on the size of aggregates, i.e., the range of sizes for 5-40 mm and 5-20 mm. Thus test pieces (15 cm dia x 30 cm high) for ten kinds were produced for the compressive test. A mix proportion of steel fibers was set at 1% in volume or 80 kg per 1 cu.m concrete. The result of test for 28 days compressive strength is shown in Fig. 4.8.3. From this test result, mix proportion of SRFC was decided as shown in Table 4.8.2.

Fig. 4.8.2 Result of Trial Mix of Ordinary Concrete

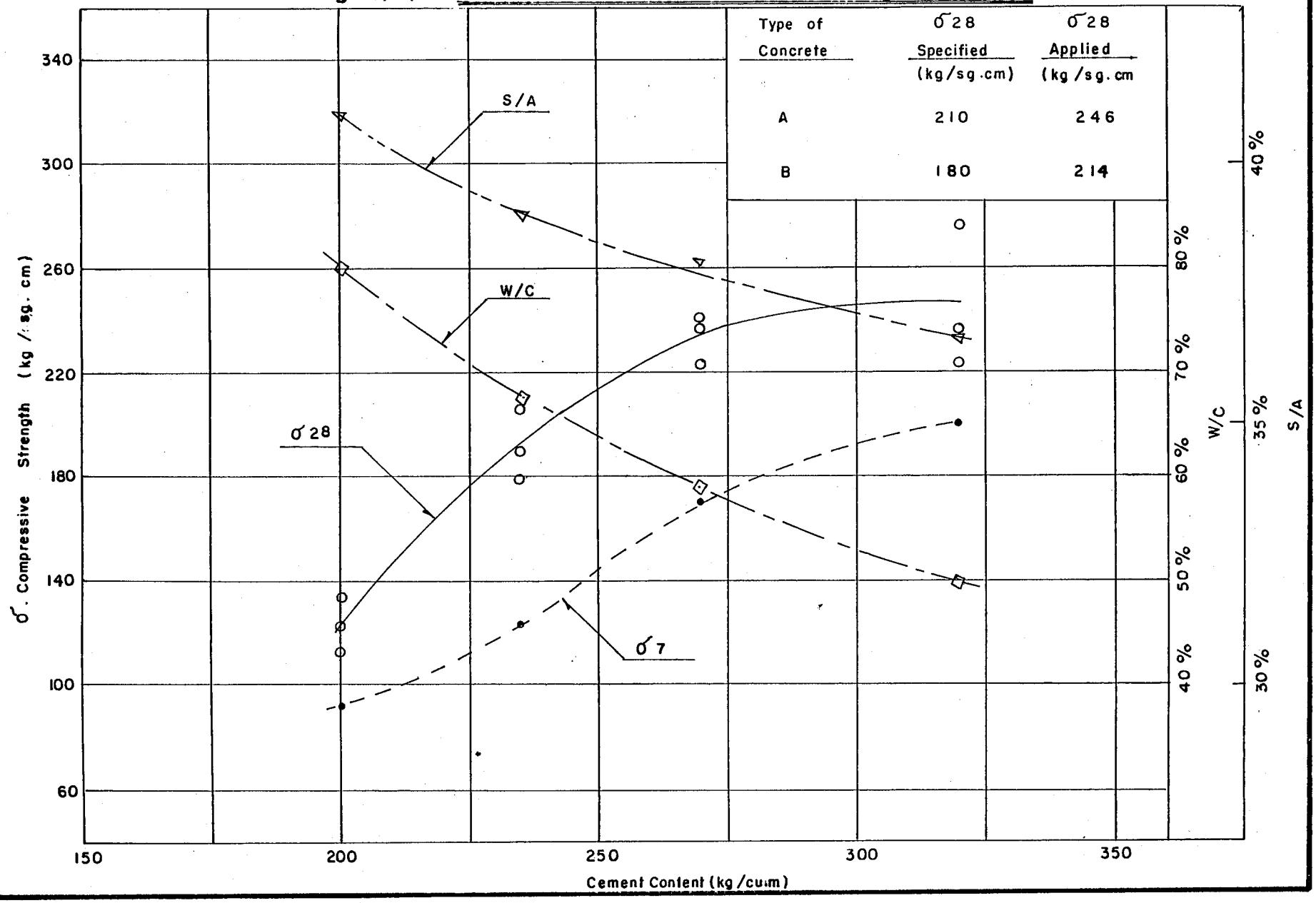


Table 4.8.1 Mix Proportion of Concrete

Description	Concrete Type A		Concrete Type B	
Purpose of concrete	Reinforced concrete		Plain concrete for slabs	
	Specified Mix Proportion	Mix Proportion in site	Specified Mix Proportion	Mix Proportion in site
Max. aggregate size (mm)	40	40	40	40
Slump (cm)	6 ± 1.5	-	6 ± 1.5	-
W/C (%)	53	-	64	-
S/A (%)	0.371	-	0.385	-
Unit requirement of materials per 1 cu.m concrete (kg/m^3)				
Water	159	139	160	139
Cement	300	300	250	250
Fine aggregate	715	732	757	777
Coarse aggregate	1,233	1,236	1,231	1,272
(5-20mm)	-	(742)	-	(763)
(20-40mm)	-	(494)	-	(509)

Fig.4.8.3 Result of Trial Mix of SFRC

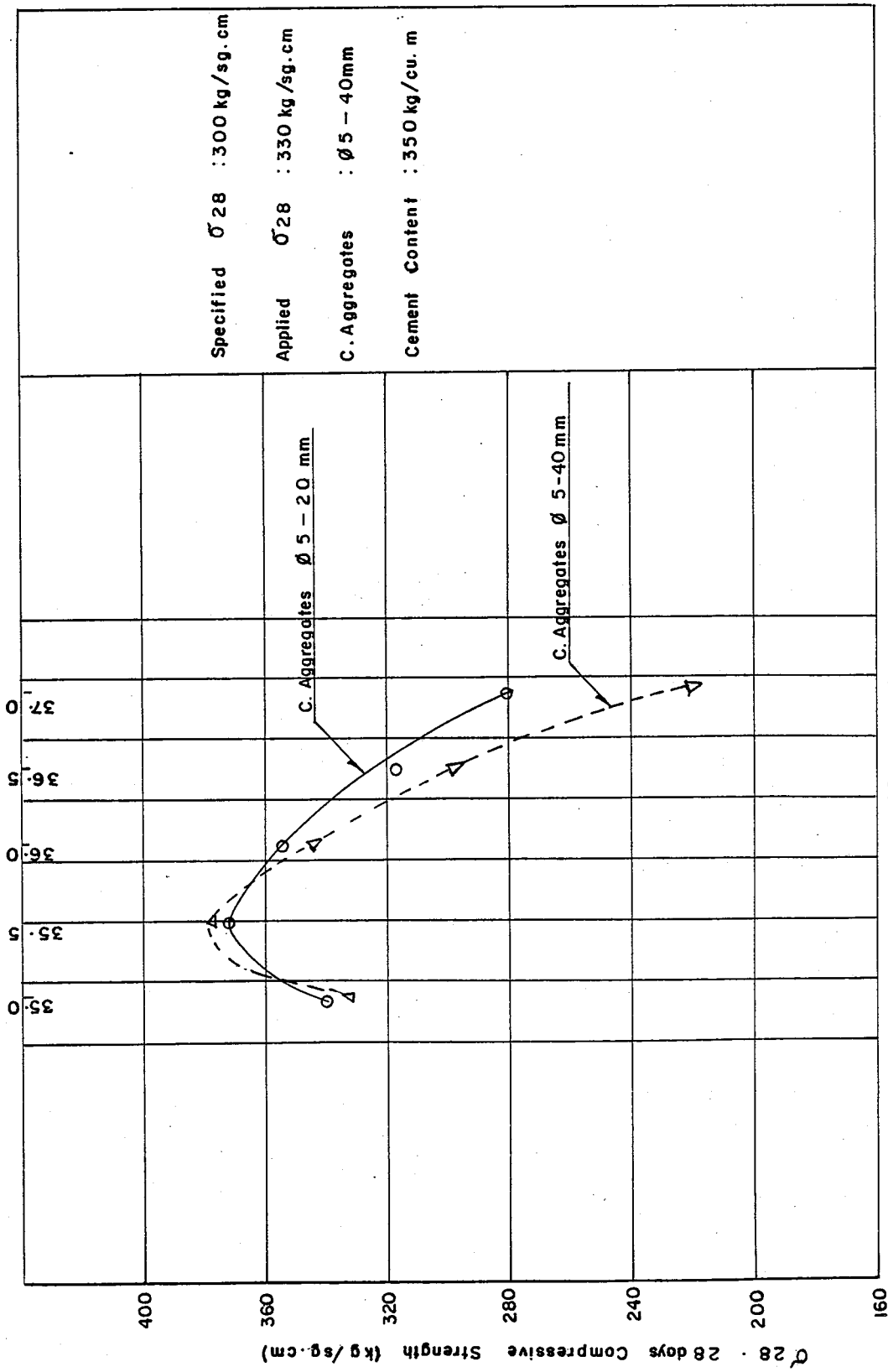


Table 4.8.2 Mix Proportion of SFRC

Description	Specified Mix Proportion	Mix Proportion in site
Max. aggregate size (mm)	40	40
Slump (cm)	5 ± 1.5	5 ± 1.5
W/C (%)	47.4	
S/A (%)	0.362	
Unit requirement of materials per 1 cu.m concrete (kg/m^3)		
Water	166	147
Cement	350	350
Steel fiber	80	80
Fine aggregate	665	668
Coarse aggregate	1,196	1,212
(5-20mm)		(727)
(20-40mm)		(485)

4.8.3 Quality Control of Concrete

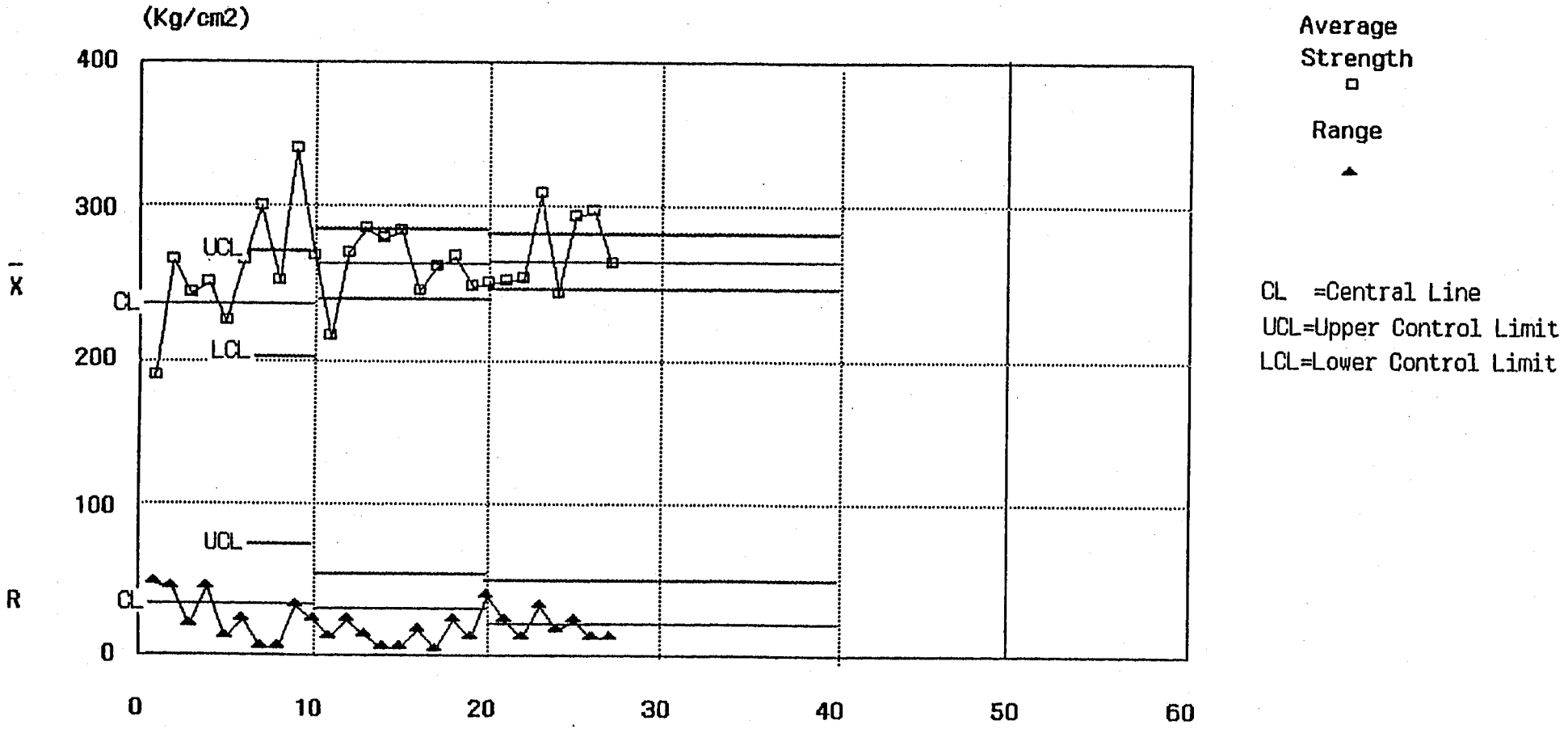
In order to maintain the specified quality of concrete, site supervision works were carefully carried out. The quantity of water mixing with concrete was particularly controlled at the concrete plant by observing moisture in the aggregate and slump tests made time to time during casting the concrete.

The concrete plant batching scales were inspected and calibrated time to time in the presence of the project staffs, the Consultant and the Contractor.

The quality control of the concrete was made based on the 28 days compressive strength test. Three cylinder specimens (15 cm dia x 30 cm high) of concrete were taken at each concrete job. The results of quality control of the concrete made by mean of X-Rs-Rm control for Type A and Type B concrete and SFRC are shown in Fig. 4.8.4.

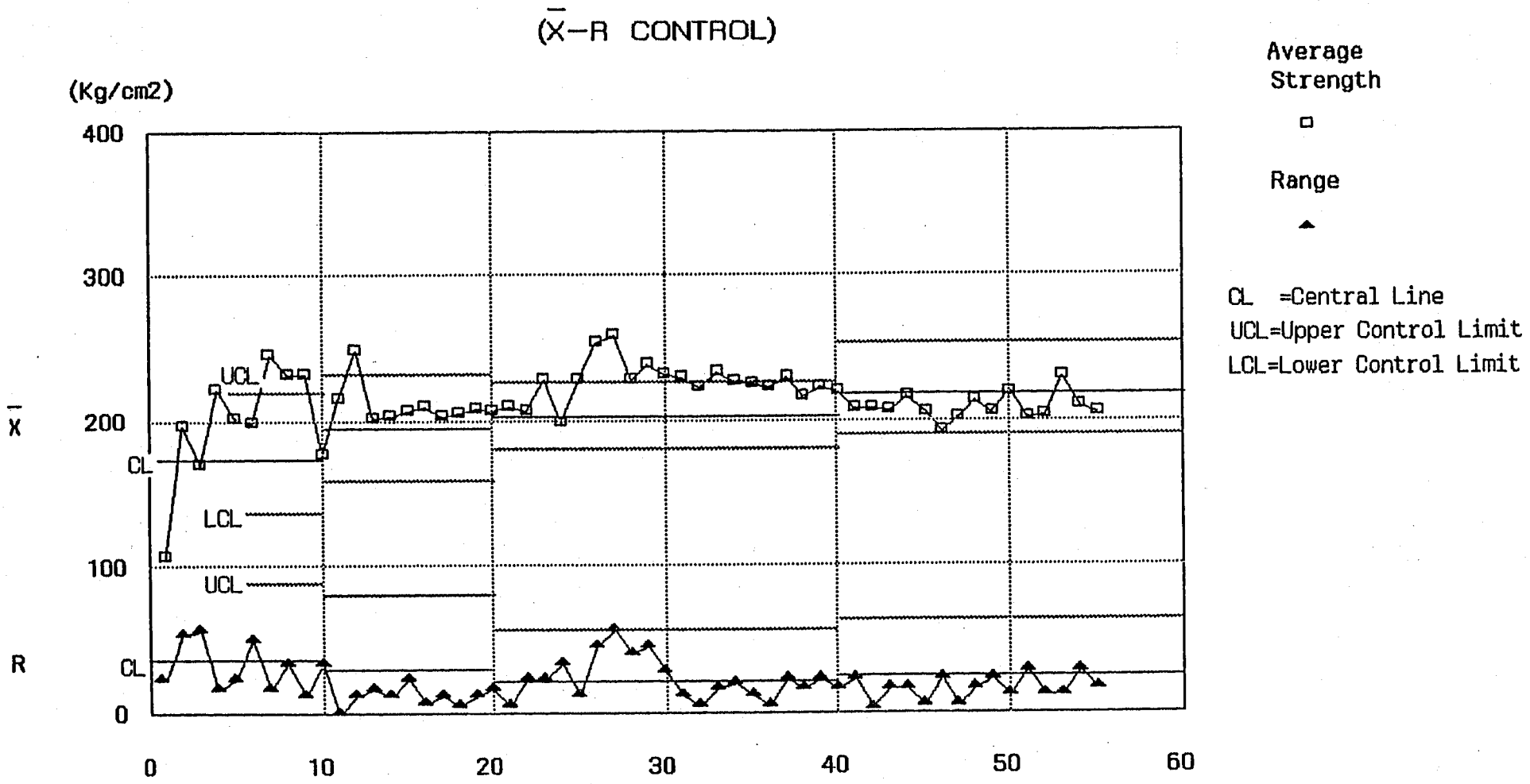
FIG. 4.8.4 QUALITY CONTROL CHART OF CONCRETE (1/3)

($\bar{X}$–R CONTROL)



TYPE – A

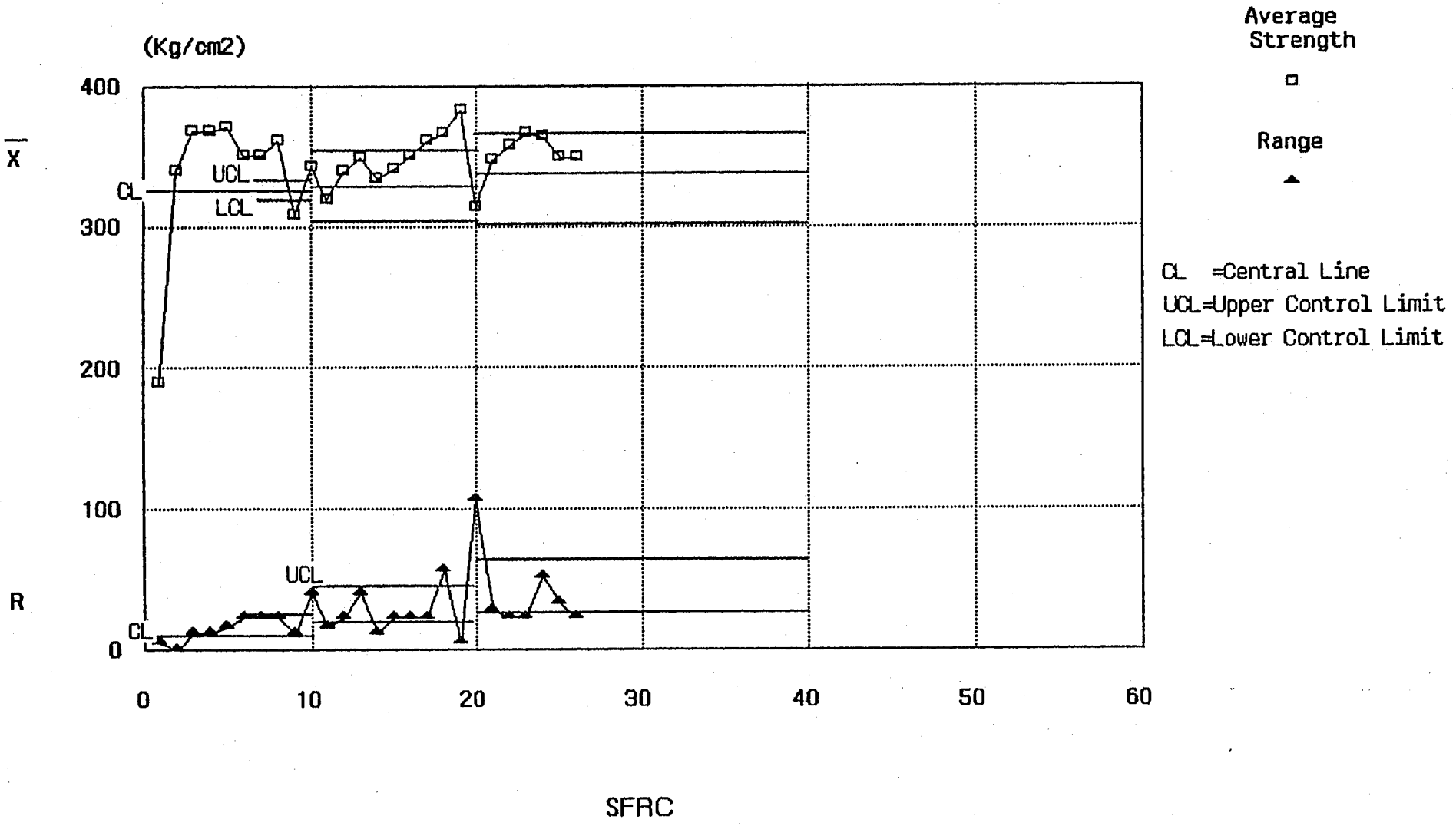
FIG. 4.84 QUALITY CONTROL CHART OF CONCRETE (2/3)



TYPE - BB

FIG. 4.8.4 QUALITY CONTROL CHART OF CONCRETE (3/3)

($\bar{X}$–R CONTROL)



4.8.4 Compaction Test of Soil for Embankment

Except for the backfilling using raw river materials (sand and gravel) behind the vertical retaining concrete walls of the both basin banks, a soil filling work was required for only a downstream guide bank of the right bank with a quantity of about 5,200 cu.m and an additional embankment at the intake of about 930 cu.m.

Materials excavated from deeper layer of the stilling basin composed mainly of weathered shale rocks, crushed during the excavation, with some mixation of sand were used for the embankment.

Compaction tests of the above soils were made both in the laboratory and field. As shown in Fig. 4.8.5 (1/2), the result of laboratory compaction test gave a maximum dry density at 1.65 g/cm3 with a water content of about 9%. While a field compaction test gave quite different results from the laboratory test as shown in Fig. 4.8.5 (2/2). The field test was done by using a Road Roller (8 tons) with a spread layer of 30 cm. A considerable amount of gravels were mixed in the soil to be used for the compaction and the removal of bigger size of gravels than 5 to 6 cm dia could not be practically done. The dry density of compacted soil higher than 1.90 g/cm3 was obtained in the field test.

The further study to seek causes of difference of results between laboratory and field was not made due to time constraints.

The compaction of soil was actually done by a Road Roller with passage of five times.

Fig.4.8.5 Results of Compaction Tests

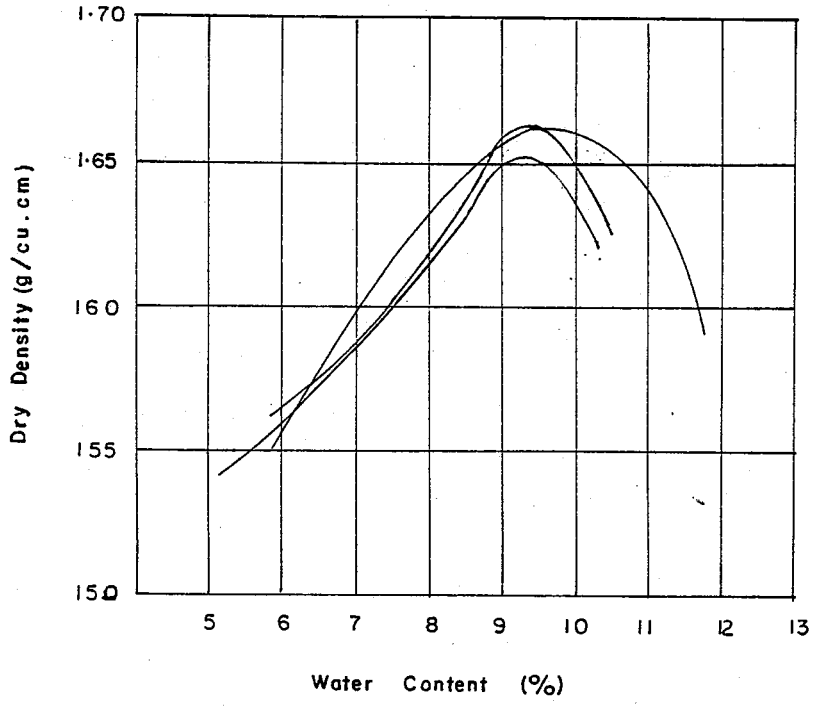


Fig.4.8.5 (1) Laboratory Test

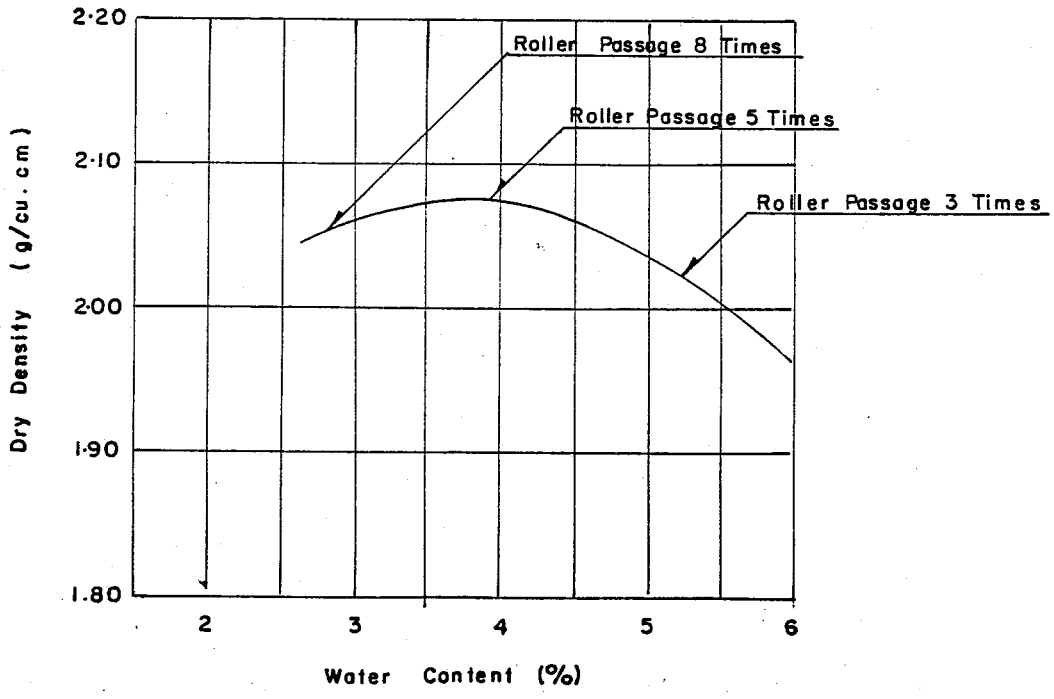


Fig.4.8.5 (2) Field Test

4.9 Accidents

During the construction, some accidents at the site occurred causing person injured and equipment damaged, but without persons to death. Those accidents resulted from:

1) Carelessness,
2) Lack of experience, and
3) Incomplete step for safety

Accidents occurred during the construction are shown as follows:

	Accident	Person injured	Equipment damaged
i)	Traffic accident of Jeep on the high-way	1	Jeep out of order for 4 months
ii)	Fall of Wheel Loader (1.4 m3) about 4m high	1	Complete out of use of Wheel Loader
iii)	Fall of fully loaded concrete bucket (1.0 cu.m) about 5 m high due to mechanical trouble of crane	-	-
iv)	Fall-down of about 6 m high concrete partition wall (6.5 m long and 25 cm thick) entirely at the concrete plants aggregates stock pile	1	Wheel Loader (2.1 cu.m) out of order for two days
v)	Fall of a carpenter about 6 m high	1	-
vi)	Fall-down of about 2.5 m high brick wall of ware house and other collapse of the Contractor's facilities due to strong storm	7 (Minor injured only)	-

V CONSTRUCTION PLANT AND EQUIPMENT

5.1 General

The major part of plant and equipment use for the construction of the Project were the KDC's own ones. The following shows sources of plant and equipment delivered to the site.

i) KDC's own plant and equipment consisting of
   a) newly procured and imported,
   b) shifted from depot in Kathmandu, and
   c) imported from depot in Bangladesh
ii) Provided plant and equipment by KIP on hire basis
iii) Hired plant and equipment from other Contractor in Nepal

Except a few equipment, the major plant and equipment were generally used ones for a long time and this resulted to require frequent repair works.

All the operators and drivers for the plant and equipment were Nepalese working under the guidance of KDC's expatriate staffs. Major operators and drivers were well experienced because KDC had been training them through the past projects in Nepal.

A workshop was established in KDC's camp, however facilities were generally minor ones and intricate repair or maintenance were done in their equipment depot in Kathmandu.

Major spareparts were imported from Bangkok and Singapore by air cargo except some minor ones available in Nepal and India. It took generally three weeks to one months to import those spareparts till the delivery to the site.

5.2 Construction Plant and Equipment Used

A list of construction plant and equipment used for the construction of the Project is given in Table 5.2.1, with presenting each equipment's model and capacity, unit delivered, date of delivery to and removal from the site, and the source or produced year of plant and equipment.

Table 5.2.1 List of Construction Plant and Equipment used for the construction

Name	Model	Capacity	Number	Delivery Date	Remove Date	Year Produ.
Bulldozer	D7F	19 t	1	1 Mar '84	-	1973
"	D65A		1	7 Dec '84	-	1982
"	D50A		1	17 Dec '84	26 Feb '85	(HMG)
"	D50A		1	27 Dec '84	1 May '85	(HMG)
Wheel Loader	CLARK 75III A	2.1 m^3	1	25 Mar '84	-	1982
"	CAF-920	1.3 m^3	1	12 Apr '84	26 Mar '85	1974
Back Hoe	YS4500	0.4 m^3	1	17 Apr '84	10 Nov '84	-
"	UH06-D	0.6 m^3	1	9 Nov '84	-	1969
"	IS-190	0.7 m^3	1	30 Jan '84	-	1984
Crawler Crane	A-460A	37 t	1	12 Apr '84	-	
Truck Crane	-	30 t	1	25 Apr '84	17 May '84	1980
"	40 MKP	20 t	1	30 Dec '84	-	
Shovel Dozer	D60S	1.8 t	1	2 Feb '85	25 Apr '84	1980
Screen Plant			1	13 Apr '84	3 Mar '85	1984
"			1	5 Aug '84	-	
Vibratory Hammer	VM-500E	6.6 t	1	13 Apr '84	-	1980
Pile Hammer with Loader	K-25	7 t	1	12 Apr '84	12 Jun '84	1983
Batching Plant	DS-75H	40m^3/hr	1	6 Jun '84	-	1984
Generator	DEA-350AK	240 KW	1	13 Apr '84	-	1980
"	NDG-73-L-A	73 KW	2	12 Apr '84	-	1973
"	C334B	87.5 KW	1	12 Apr '84	16 Mar '85	1981
Engine Welder	IM507E	400 A	1	12 Apr '84	-	1980
Mixer Truck	SPZ-441	4.6 m^3	1	"	-	1980
"		3 m^3	1	4 Dec '84	6 May '85	
"	NT035B	3 m^3	1	14 Feb '85	-	1978
Concrete Mixer	NC-S	160 FT/Hr	1	12 Apr '84	-	1981
" Vibrator	EY-18	-	16	13 Apr '84	-	1979
Bar Cutter	TK-42	42 mm	1	13 Apr '84	-	1980
Bar Bender	TB-42	42 mm	1	"	-	1980
Rotary Cut plywood			16	"	-	1980
Air Compressor	DRC-465	600 CFM	1	"	-	1980
Vibrating Screen	3D305		1	7 Dec '84	-	-

Name	Model	Capacity	Number	Delivery Date	Remove Date	Year Produ.
Clamsell Bucket	08-CB-SR-2.1	0.8 m^3	1	7 Dec '84	-	1980
Submersible Pump	KRS-8H	2-4m^3/min	3	12 Apr '84	-	1980
"	063/V6-25	2-4m^3/min	1	"	-	1980
Road Roller			1	6 Mar '85	-	(HMG)
Dump Truck	TDJ-50	8 t	1	25 Oct '84	-	1982
Dump Truck	TMH-67Z	12 t	4	25 Apr '84	-	1982

5.3 Working Records

The operation hours or distance and fuel consumption of the major construction plant and equipment during the construction period from March 1984 to May 1985 recorded on KDC's daily reports basis are summarized in Table 5.3.1.

The detailed monthly records including the consumption of lubricant oils are shown in Table 5.3.2.

Table 5.3.1 Summary of Working Records of Construction Plant and Equipment
(March 84 - May 85)

Cont. No.	Equipment	Unit	Capacity	Running Hours or Distance	D-Oil Consum. (lit)	Average Consum. (*)
0-1	Water Pump	Hr	-	1,392	-	-
0-2	Water Pump	Hr	-	2,186	2,568	1.17
0-3	Water Pump	Hr	-	1,192	1,312	1.10
0-4	Water Pump	Hr	-	424	628	1.48
0-5	Water Pump	Hr	-	1,248	1,694	1.36
0-6	Water Pump	Hr	-	17	35	2.06
01-2	B/Dozer	Hr	20.3t	1,023	13,745	13.44
01-3	B/Dozer	Hr	15.5t	770	14,255	18.51
01-5	B/Dozer	Hr	11.4t	346	5,185	14.99
01-6	B/Dozer	Hr	11.4t	919	10,650	11.59
01-7	S/Dozer	Hr	1.8cum	801	7,970	9.95
-	Back Hoe	Hr	0.4cum	1,127	8,062	7.15
02-2	Back Hoe	Hr	0.6cum	1,085	11,681	10.77
02-5	Back Hoe	Hr	0.7cum	786	4,820	6.13
03-3	W/Loader	Hr	2.1cum	3,680	29,548	8.03
03-4	W/Loader	Hr	1.3cum	643	5,125	7.97
06-1	D/Truck	Km	8t	1,300	355	3.66
06-4	D/Truck	Km	8t	18,924	4,538	4.17
06-5	D/Truck	Km	8t	276	50	5.52
06-6	D/Truck	Km	8t	50,524	13,795	3.66
06-7	D/Truck	Km	12t	34,773	15,271	2.28
06-8	D/Truck	Km	12t	14,528	9,203	1.58
06-9	D/Truck	Km	12t	28,747	14,729	1.95
06-11	D/Truck	Km	12t	11,707	6,821	1.72
07-1	C/Crane	Hr	37t	2,168	8,760	4.04
-	T/Crane	Hr	30t	26	300	11.54
07-2	T/Crane	Hr	20t	541	3,440	6.36
11-2	B/Plant	Hr	40cum/hr	1,447	-	-
14-6	M/Truck	Hr	3cum	2,093	8,945	4.27
14-7	M/Truck	Hr	4.6cum	505	2,492	4.93
14-8	M/Truck	Hr	3cum	902	4,415	4.89
21-2	A/Compressor	Hr	600cfm	184	2,650	14.40
23-2	V/Hammer	Hr	6.6t	141	-	-
24-1	S/Plant	Hr	-	548	-	-
24-2	S/Plant	Hr	-	1,496	-	-
26-4	Generator	Hr	240kw	4,341	76,148	17.54
26-5	Generator	Hr	73kw	2,356	19,691	8.36
26-6	Generator	Hr	73kw	3,013	22,240	7.38
26-7	Generator	Hr	87.5kw	1,010	7,932	7.85
26-8	Generator	Hr	-	614	1,727	2.81
26-9	Generator	Hr	-	1,351	29,604	21.91
27-15	S/Pump	Hr	2-4cum/m	876	-	-
27-16	S/Pump	Hr	2-4cum/m	110	-	-
27-17	S/Pump	Hr	2-4cum/m	840	-	-
27-18	S/Pump	Hr	2-4cum/m	749	-	-

Remarks : (*) Unit lit/Hr or Km/lit

Table 5.3.2 Monthly Working Records of Construction Plant and Equipment(1/15)

Year: 1984 Month: March

Cont. no.	Equipment Name of Equipment	Unit	Operat.	Consumption Petrol (lit)	D- Oil (lit)	E- Oil (lit)	C- Oil (lit)	H- Oil (lit)	Grease (kg)
0-1	Water Pump	Hr	-	-	-	-	-	-	-
0-2	Water Pump	Hr	-	-	-	-	-	-	-
0-3	Water Pump	Hr	-	-	-	-	-	-	-
0-4	Water Pump	Hr	-	-	-	-	-	-	-
0-5	Water Pump	Hr	-	-	-	-	-	-	-
0-6	Water Pump	Hr	-	-	-	-	-	-	-
	Total	Hr	-	-	-	-	-	-	-
01-2	B/Dozer	Hr	110	-	2,199	40	-	9	13
01-3	B/Dozer	Hr	-	-	-	-	-	-	-
01-5	B/Dozer	Hr	-	-	-	-	-	-	-
01-6	B/Dozer	Hr	-	-	-	-	-	-	-
01-7	S/Dozer	Hr	-	-	-	-	-	-	-
	Total	Hr	110	-	2,199	40	-	9	13
-	Back Hoe	Hr	-	-	-	-	-	-	-
02-2	Back Hoe	Hr	-	-	-	-	-	-	-
02-5	Back Hoe	Hr	-	-	-	-	-	-	-
	Total	Hr	-	-	-	-	-	-	-
03-3	W/Loader	Hr	54	-	460	-	-	5	5
03-4	W/Loader	Hr	-	-	-	-	-	-	-
	Total	Hr	54	-	460	-	-	5	5
06-1	D/Truck	Km	-	-	-	-	-	-	-
06-4	D/Truck	Km	5,454	-	1,153	25	-	-	3
06-5	D/Truck	Km	-	-	-	-	-	-	-
06-6	D/Truck	Km	3,309	-	831	26	1	-	3
06-7	D/Truck	Km	2,606	-	1,093	26	1	-	-
06-8	D/Truck	Km	-	-	-	-	-	-	-
06-9	D/Truck	Km	-	-	-	-	-	-	-
06-11	D/Truck	Km	-	-	-	-	-	-	-
	Total	Km	11,369	-	3,077	77	2	-	6

Cont. no.	Equipment Name of Equipment	Unit	Operat.	Consumption Petrol (lit)	D- Oil (lit)	E- Oil (lit)	C- Oil (lit)	H- Oil (lit)	Grease (kg)
07-1	C/Crane	Hr	-	-	-	-	-	-	-
-	T/Crane	Hr	-	-	-	-	-	-	-
07-2	T/Crane	Hr	-	-	-	-	-	-	-
	Total	Hr	-	-	-	-	-	-	-
11-2	B/Plant	Hr	-	-	-	-	-	-	-
14-6	M/Truck	Hr	-	-	-	-	-	-	-
14-7	M/Truck	Hr	-	-	-	-	-	-	-
14-8	M/Truck	Hr	-	-	-	-	-	-	-
	Total	Hr	-	-	-	-	-	-	-
21-2	A/Compressor	Hr	-	-	-	-	-	-	-
23-2	V/Hammer	Hr	-	-	-	-	-	-	-
24-1	S/Plant	Hr	-	-	-	-	-	-	-
24-2	S/Plant	Hr	-	-	-	-	-	-	-
	Total	Hr	-	-	-	-	-	-	-
26-4	Generator	Hr	-	-	-	-	-	-	-
26-5	Generator	Hr	-	-	-	-	-	-	-
26-6	Generator	Hr	-	-	-	-	-	-	-
26-7	Generator	Hr	-	-	-	-	-	-	-
26-8	Generator	Hr	-	-	-	-	-	-	-
26-9	Generator	Hr	-	-	-	-	-	-	-
	Total	Hr	-	-	-	-	-	-	-
27-15	S/Pump	Hr	-	-	-	-	-	-	-
27-16	S/Pump	Hr	-	-	-	-	-	-	-
27-17	S/Pump	Hr	-	-	-	-	-	-	-
27-18	S/Pump	Hr	-	-	-	-	-	-	-
	Total	Hr	-	-	-	-	-	-	-

Table 5.3.2 Monthly Working Records of Construction Plant and Equipment(2/15) Year: 1984 Month: April

Cont. no.	Equipment Name of Equipment	Unit	Operat.	Petrol (lit)	Consumption D-Oil (lit)	E-Oil (lit)	C-Oil (lit)	H-Oil (lit)	Grease (kg)
0-1	Water Pump	Hr	202	26	-	-	-	-	-
0-2	Water Pump	Hr	-	-	-	-	-	-	-
0-3	Water Pump	Hr	-	-	-	-	-	-	-
0-4	Water Pump	Hr	-	-	-	-	-	-	-
0-5	Water Pump	Hr	-	-	-	-	-	-	-
0-6	Water Pump	Hr	-	-	-	-	-	-	-
	Total	Hr	202	26	-	-	-	-	-
01-2	B/Dozer	Hr	82	-	1,285	127	10	-	-
01-3	B/Dozer	Hr	-	-	-	-	-	-	-
01-5	B/Dozer	Hr	-	-	-	-	-	-	-
01-6	B/Dozer	Hr	-	-	-	-	-	-	-
01-7	S/Dozer	Hr	-	-	-	-	-	-	-
	Total	Hr	82	-	1,285	127	10	-	-
-	Back Hoe	Hr	46	-	330	22	-	-	11
02-2	Back Hoe	Hr	-	-	-	-	-	-	-
02-5	Back Hoe	Hr	-	-	-	-	-	-	-
	Total	Hr	46	-	330	22	-	-	11
03-3	W/Loader	Hr	198	-	1,494	20	-	-	11
03-4	W/Loader	Hr	118	-	825	16	-	-	1
	Total	Hr	316	-	2,319	36	-	-	12
06-1	D/Truck	Km	-	-	-	-	-	-	-
06-4	D/Truck	Km	3,937	-	906	8	-	-	-
06-5	D/Truck	Km	-	-	-	-	-	-	-
06-6	D/Truck	Km	3,853	-	1,060	30	-	-	3
06-7	D/Truck	Km	2,660	-	953	2	-	-	-
06-8	D/Truck	Km	-	-	-	-	-	-	-
06-9	D/Truck	Km	-	-	-	-	-	-	-
06-11	D/Truck	Km	-	-	-	-	-	-	-
	Total	Km	10,450	-	2,919	40	-	-	3

Cont. no.	Equipment Name of Equipment	Unit	Operat.	Petrol (lit)	Consumption D-Oil (lit)	E-Oil (lit)	C-Oil (lit)	H-Oil (lit)	Grease (kg)
07-1	C/Crane	Hr	151.5	-	1,600	9	35	-	7
-	T/Crane	Hr	3	-	200	50	-	-	1
07-2	T/Crane	Hr	-	-	-	-	-	-	-
	Total	Hr	154.5	-	1,800	59	35	-	8
11-2	B/Plant	Hr	-	-	-	-	-	-	-
14-6	M/Truck	Hr	-	-	-	-	-	-	-
14-7	M/Truck	Hr	-	-	-	-	-	-	-
14-8	M/Truck	Hr	-	-	-	-	-	-	-
	Total	Hr	-	-	-	-	-	-	-
21-2	A/Compressor	Hr	2	-	85	-	-	-	-
23-2	V/Hammer	Hr	141	-	-	-	-	80	-
24-1	S/Plant	Hr	-	-	-	-	-	-	-
24-2	S/Plant	Hr	-	-	-	-	-	-	-
	Total	Hr	-	-	-	-	-	-	-
26-4	Generator	Hr	164	-	1,600	9	-	-	-
26-5	Generator	Hr	162	-	1,739	13	-	-	-
26-6	Generator	Hr	-	-	-	-	-	-	-
26-7	Generator	Hr	33	-	470	4	-	-	-
26-8	Generator	Hr	157	-	447	5	-	-	-
26-9	Generator	Hr	-	-	-	-	-	-	-
	Total	Hr	516	-	4,256	31	-	-	-
27-15	S/Pump	Hr	-	-	-	-	-	-	-
27-16	S/Pump	Hr	-	-	-	-	-	-	-
27-17	S/Pump	Hr	-	-	-	-	-	-	-
27-18	S/Pump	Hr	-	-	-	-	-	-	-
	Total	Hr	-	-	-	-	-	-	-

Table 5.3.2 Monthly Working Records of Construction Plant and Equipment(3/15) Year: 1984 Month: May

Cont. no.	Equipment Name of Equipment	Unit	Operat.	Consumption Petrol (lit)	D-Oil (lit)	E-Oil (lit)	C-Oil (lit)	H-Oil (lit)	Grease (kg)
0-1	Water Pump	Hr	120	48	-	-	-	-	-
0-2	Water Pump	Hr	97	1	134	10	-	-	-
0-3	Water Pump	Hr	-	-	-	-	-	-	-
0-4	Water Pump	Hr	-	-	-	-	-	-	-
0-5	Water Pump	Hr	-	-	-	-	-	-	-
0-6	Water Pump	Hr	-	-	-	-	-	-	-
	Total	Hr	217	49	134	10	-	-	-
01-2	B/Dozer	Hr	147	-	1,840	120	-	-	-
01-3	B/Dozer	Hr	-	-	-	-	-	-	-
01-5	B/Dozer	Hr	-	-	-	-	-	-	-
01-6	B/Dozer	Hr	-	-	-	-	-	-	-
01-7	S/Dozer	Hr	-	-	-	-	-	-	-
	Total	Hr	147	-	1,840	120	-	-	-
-	Back Hoe	Hr	261	-	1,668	35	-	-	1
02-2	Back Hoe	Hr	-	-	-	-	-	-	-
02-5	Back Hoe	Hr	-	-	-	-	-	-	-
	Total	Hr	261	-	1,668	35	-	-	1
03-3	W/Loader	Hr	220	-	1,840	22	-	-	-
03-4	W/Loader	Hr	67	-	485	-	-	-	1
				-					
	Total	Hr	287	-	2,325	22	-	-	1
06-1	D/Truck	Km	-	-	-	-	-	-	-
06-4	D/Truck	Km	4,405	-	1,041	37	-	-	-
06-5	D/Truck	Km	276	-	50	2	-	-	-
06-6	D/Truck	Km	4,271	-	963	9	-	-	-
06-7	D/Truck	Km	3,250	-	1,175	57	-	-	2
06-8	D/Truck	Km	-	-	-	-	-	-	-
06-9	D/Truck	Km	2,877	-	1,021	2	-	-	-
06-11	D/Truck	Km	-	-	-	-	-	-	-
	Total	Km	15,079	-	4,250	107	-	-	2
07-1	C/Crane	Hr	182	-	1,340	34	-	-	2
-	T/Crane	Hr	23	-	100	5	-	-	-
07-2	T/Crane	Hr	-	-	-	-	-	-	-
	Total	Hr	205	-	1,440	39	-	-	2
11-2	B/Plant	Hr	-	-	-	-	-	-	-
14-6	M/Truck	Hr	82	-	430	10	-	-	2
14-7	M/Truck	Hr	-	-	-	-	-	-	-
14-8	M/Truck	Hr	-	-	-	-	-	-	-
	Total	Hr	82	-	430	10	-	-	2
21-2	A/Compressor	Hr	-	-	-	-	-	-	-
23-2	V/Hammer	Hr	-	-	-	-	-	-	-
24-1	S/Plant	Hr	-	-	-	-	-	-	-
24-2	S/Plant	Hr	-	-	-	-	-	-	-
	Total	Hr	-	-	-	-	-	-	-
26-4	Generator	Hr	265	-	3,495	52	-	-	-
26-5	Generator	Hr	224	-	1,882	37	-	-	-
26-6	Generator	Hr	13	-	195	1	-	-	-
26-7	Generator	Hr	87	-	705	10	-	-	-
26-8	Generator	Hr	70	-	241	-	-	-	-
26-9	Generator	Hr	-	-	-	-	-	-	-
	Total	Hr	659	-	6,518	100	-	-	-
27-15	S/Pump	Hr	-	-	-	-	-	-	-
27-16	S/Pump	Hr	-	-	-	-	-	-	-
27-17	S/Pump	Hr	-	-	-	-	-	-	-
27-18	S/Pump	Hr	-	-	-	-	-	-	-
	Total	Hr	-	-	-	-	-	-	-

Table 5.3.2 Monthly Working Records of Construction Plant and Equipment(4/15)

Year: 1984 Month: June

Cont. no.	Equipment Name of Equipment	Unit	Operat.	Consumption Petrol (lit)	D-Oil (lit)	E-Oil (lit)	C-Oil (lit)	H-Oil (lit)	Grease (kg)
0-1	Water Pump	Hr	176	26	5	5	-	-	-
0-2	Water Pump	Hr	89	-	78	6	-	-	-
0-3	Water Pump	Hr	64	-	53	-	-	-	-
0-4	Water Pump	Hr	-	-	-	-	-	-	-
0-5	Water Pump	Hr	-	-	-	-	-	-	-
0-6	Water Pump	Hr	-	-	-	-	-	-	-
	Total	Hr	329	26	157	11	-	-	-
01-2	B/Dozer	Hr	60	-	765	47	-	-	2
01-3	B/Dozer	Hr	-	-	-	-	-	-	-
01-5	B/Dozer	Hr	-	-	-	-	-	-	-
01-6	B/Dozer	Hr	-	-	-	-	-	-	-
01-7	S/Dozer	Hr	-	-	-	-	-	-	-
	Total	Hr	60	-	765	47	-	-	2
-	Back Hoe	Hr	164	-	680	10	-	-	1
02-2	Back Hoe	Hr	-	-	-	-	-	-	-
02-5	Back Hoe	Hr	-	-	-	-	-	-	-
	Total	Hr	164	-	680	10	-	-	1
03-3	W/Loader	Hr	148	-	1,395	-	-	-	1
03-4	W/Loader	Hr	101	-	870	38	-	-	1
	Total	Hr	249	-	2,265	38	-	-	2
06-1	D/Truck	Km	-	-	-	-	-	-	-
06-4	D/Truck	Km	2,545	-	730	8	-	-	-
06-5	D/Truck	Km	-	-	-	-	-	-	-
06-6	D/Truck	Km	2,750	-	795	11	-	-	2
06-7	D/Truck	Km	2,871	-	1,473	3	-	-	-
06-8	D/Truck	Km	-	-	-	-	-	-	-
06-9	D/Truck	Km	2,742	-	1,543	50	-	-	2
06-11	D/Truck	Km	-	-	-	-	-	-	-
	Total	Km	10,908	-	4,541	72	-	-	4

Cont. no.	Equipment Name of Equipment	Unit	Operat.	Consumption Petrol (lit)	D-Oil (lit)	E-Oil (lit)	C-Oil (lit)	H-Oil (lit)	Grease (kg)
07-1	C/Crane	Hr	86	-	120	-	15	-	-
-	T/Crane	Hr	-	-	-	-	-	-	-
07-2	T/Crane	Hr	-	-	-	-	-	-	-
	Total	Hr	86	-	120	-	15	-	-
11-2	B/Plant	Hr	-	-	-	-	-	-	-
14-6	M/Truck	Hr	108	-	404	-	-	-	1
14-7	M/Truck	Hr	-	-	-	-	-	-	-
14-8	M/Truck	Hr	-	-	-	-	-	-	-
	Total	Hr	108	-	404	-	-	-	1
21-2	A/Compressor	Hr	-	-	-	-	-	-	-
23-2	V/Hammer	Hr	-	-	-	-	-	-	-
24-1	S/Plant	Hr	90	-	-	-	-	-	-
24-2	S/Plant	Hr	-	-	-	-	-	-	-
	Total	Hr	90	-	-	-	-	-	-
26-4	Generator	Hr	302	-	4,025	1	-	-	-
26-5	Generator	Hr	175	-	1,767	40	-	-	-
26-6	Generator	Hr	97	-	1,335	17	-	-	-
26-7	Generator	Hr	56	-	330	5	-	-	-
26-8	Generator	Hr	26	-	85	-	-	-	-
26-9	Generator	Hr	-	-	-	-	-	-	-
	Total	Hr	656	-	7,542	63	-	-	-
27-15	S/Pump	Hr	-	-	-	-	-	-	-
27-16	S/Pump	Hr	-	-	-	-	-	-	-
27-17	S/Pump	Hr	-	-	-	-	-	-	-
27-18	S/Pump	Hr	-	-	-	-	-	-	-
	Total	Hr	-	-	-	-	-	-	-

Table 5.3.2 Monthly Working Records of Construction Plant and Equipment(5/15) Year: 1984 Month: July

Cont. no.	Equipment Name of Equipment	Unit	Operat.	Consumption Petrol (lit)	D-Oil (lit)	E-Oil (lit)	C-Oil (lit)	H-Oil (lit)	Grease (kg)
0-1	Water Pump	Hr	86	17	-	4	-	-	-
0-2	Water Pump	Hr	75	-	88	1	-	-	-
0-3	Water Pump	Hr	80	-	103	-	-	-	-
0-4	Water Pump	Hr	-	-	-	-	-	-	-
0-5	Water Pump	Hr	-	-	-	-	-	-	-
0-6	Water Pump	Hr	-	-	-	-	-	-	-
	Total	Hr	241	17	191	5	-	-	-
01-2	B/Dozer	Hr	-	-	-	-	-	-	-
01-3	B/Dozer	Hr	-	-	-	-	-	-	-
01-5	B/Dozer	Hr	-	-	-	-	-	-	-
01-6	B/Dozer	Hr	-	-	-	-	-	-	-
01-7	S/Dozer	Hr	-	-	-	-	-	-	-
	Total	Hr	-	-	-	-	-	-	-
-	Back Hoe	Hr	164	-	1,252	16	-	-	-
02-2	Back Hoe	Hr	-	-	-	-	-	-	-
02-5	Back Hoe	Hr	-	-	-	-	-	-	-
	Total	Hr	164	-	1,252	16	-	-	-
03-3	W/Loader	Hr	222	-	2,207	73	-	165	-
03-4	W/Loader	Hr	7	-	-	-	-	-	-
	Total	Hr	229	-	2,207	73	-	165	-
06-1	D/Truck	Km	-	-	-	-	-	-	-
06-4	D/Truck	Km	2,583	-	708	31			
06-5	D/Truck	Km	-	-	-	-	-	-	-
06-6	D/Truck	Km	3,206	-	1,050	7	-	-	-
06-7	D/Truck	Km	2,387	-	924	31	-	-	-
06-8	D/Truck	Km	756	-	308	-	-	-	-
06-9	D/Truck	Km	3,039	-	1,970	25	-	-	4
06-11	D/Truck	Km	-	-	-	-	-	-	-
	Total	Km	11,971	-	4,960	94	-	-	4

Cont. no.	Equipment Name of Equipment	Unit	Operat.	Consumption Petrol (lit)	D-Oil (lit)	E-Oil (lit)	C-Oil (lit)	H-Oil (lit)	Grease (kg)
07-1	C/Crane	Hr	102	-	-	720	5	10	-
-	T/Crane	Hr	-	-	-	-	-	-	-
07-2	T/Crane	Hr	-	-	-	-	-	-	-
	Total	Hr	102	-	-	720	5	10	-
11-2	B/Plant	Hr	-	-	-	-	-	-	-
14-6	M/Truck	Hr	60	-	517	-	-	6	-
14-7	M/Truck	Hr	-	-	-	-	-	-	-
14-8	M/Truck	Hr	-	-	-	-	-	-	-
	Total	Hr	60	-	517	-	-	6	-
21-2	A/Compressor	Hr	-	-	-	-	-	-	-
23-2	V/Hammer	Hr	-	-	-	-	-	-	-
24-1	S/Plant	Hr	73	-	-	-	-	-	-
24-2	S/Plant	Hr	-	-	-	-	-	-	-
	Total	Hr	73	-	-	-	-	-	-
26-4	Generator	Hr	417	-	5,680	80	-	-	-
26-5	Generator	Hr	238	-	2,403	36	-	-	-
26-6	Generator	Hr	94	-	690	-	-	-	-
26-7	Generator	Hr	121	-	952	26	-	-	-
26-8	Generator	Hr	121	-	239	8	-	-	-
26-9	Generator	Hr	-	-	-	-	-	-	-
	Total	Hr	991	-	9,964	150	-	-	-
27-15	S/Pump	Hr	-	-	-	-	-	-	-
27-16	S/Pump	Hr	-	-	-	-	-	-	-
27-17	S/Pump	Hr	-	-	-	-	-	-	-
27-18	S/Pump	Hr	-	-	-	-	-	-	-
	Total	Hr	-	-	-	-	-	-	-

Table 5.3.2 Monthly Working Records of Construction Plant and Equipment(6/15) Year: 1984 Month: August

Cont. no.	Equipment Name of Equipment	Unit	Operat.	Petrol (lit)	Consumption D- Oil (lit)	E- Oil (lit)	C- Oil (lit)	H- Oil (lit)	Grease (kg)
0-1	Water Pump	Hr	170	35	3	-	-	-	-
0-2	Water Pump	Hr	160	-	127	5	-	-	-
0-3	Water Pump	Hr	158	-	130	-	-	-	-
0-4	Water Pump	Hr	-	-	-	-	-	-	-
0-5	Water Pump	Hr	-	-	-	-	-	-	-
0-6	Water Pump	Hr	-	-	-	-	-	-	-
	Total	Hr	488	35	260	5	-	-	-
01-2	B/Dozer	Hr	137	5	1,310	115	-	84	-
01-3	B/Dozer	Hr	-	-	-	-	-	-	-
01-5	B/Dozer	Hr	-	-	-	-	-	-	-
01-6	B/Dozer	Hr	-	-	-	-	-	-	-
01-7	S/Dozer	Hr	-	-	-	-	-	-	-
	Total	Hr	137	5	1,310	115	-	84	-
-	Back Hoe	Hr	243	-	1,515	32	-	2	-
02-2	Back Hoe	Hr	-	-	-	-	-	-	-
02-5	Back Hoe	Hr	-	-	-	-	-	-	-
	Total	Hr	243	-	1,515	32	-	2	-
03-3	W/Loader	Hr	311	-	2,765	82.5	-	659	20
03-4	W/Loader	Hr	-	-	-	-	-	-	-
	Total	Hr	311	-	2,765	82.5	-	659	20
06-1	D/Truck	Km	-	-	-	-	-	-	-
06-4	D/Truck	Km	-	-	-	-	-	-	-
06-5	D/Truck	Km	-	-	-	-	-	-	-
06-6	D/Truck	Km	2,872	-	797	11.5	-	-	-
06-7	D/Truck	Km	599	-	135	1	3	-	-
06-8	D/Truck	Km	5,200	-	2,285	51	1	-	3
06-9	D/Truck	Km	4,873	-	2,483	25	25	-	-
06-11	D/Truck	Km	-	-	-	-	-	-	-
	Total	Km	13,544	-	5,700	88.5	29	-	3

Cont. no.	Equipment Name of Equipment	Unit	Operat.	Petrol (lit)	Consumption D- Oil (lit)	E- Oil (lit)	C- Oil (lit)	H- Oil (lit)	Grease (kg)
07-1	C/Crane	Hr	275	-	765	41	-	48	2
-	T/Crane	Hr	-	-	-	-	-	-	-
07-2	T/Crane	Hr	-	-	-	-	-	-	-
	Total	Hr	275	-	765	41	-	48	2
11-2	B/Plant	Hr	124	-	-	-	-	-	-
14-6	M/Truck	Hr	197	-	775	50	-	-	-
14-7	M/Truck	Hr	-	-	-	-	-	-	-
14-8	M/Truck	Hr	-	-	-	-	-	-	-
	Total	Hr	197	-	775	50	-	-	-
21-2	A/Compressor	Hr	5	-	40	-	-	-	-
23-2	V/Hammer	Hr	-	-	-	-	-	-	-
24-1	S/Plant	Hr	151	-	10	-	-	-	-
24-2	S/Plant	Hr	-	-	-	-	-	-	-
	Total	Hr	151	-	10	-	-	-	-
26-4	Generator	Hr	437	-	6,100	130.5	-	-	-
26-5	Generator	Hr	296	-	2,965	44	-	1	-
26-6	Generator	Hr	181	-	1,377	20	-	-	-
26-7	Generator	Hr	118	-	800	2.5	-	-	-
26-8	Generator	Hr	-	-	-	-	-	-	-
26-9	Generator	Hr	-	-	-	-	-	-	-
	Total	Hr	1,101	-	11,387	197	-	1	-
27-15	S/Pump	Hr	-	-	-	-	-	-	-
27-16	S/Pump	Hr	-	-	-	-	-	-	-
27-17	S/Pump	Hr	-	-	-	-	-	-	-
27-18	S/Pump	Hr	-	-	-	-	-	-	-
	Total	Hr	-	-	-	-	-	-	-

Table 5.3.2 Monthly Working Records of Construction Plant and Equipment(7/15) Year: 1984 Month: September

Cont. no.	Equipment Name of Equipment	Unit	Operat.	Consumption Petrol (lit)	D-Oil (lit)	E-Oil (lit)	C-Oil (lit)	H-Oil (lit)	Grease (kg)
0-1	Water Pump	Hr	160	12	-	1	-	-	-
0-2	Water Pump	Hr	110	-	127	3	-	-	-
0-3	Water Pump	Hr	112	-	122	4	-	-	-
0-4	Water Pump	Hr	-	-	-	-	-	-	-
0-5	Water Pump	Hr	-	-	-	-	-	-	-
0-6	Water Pump	Hr	-	-	-	-	-	-	-
	Total	Hr	382	12	249	8	-	-	-
01-2	B/Dozer	Hr	168	-	1,923	135	-	-	2
01-3	B/Dozer	Hr	-	-	-	-	-	-	-
01-5	B/Dozer	Hr	-	-	-	-	-	-	-
01-6	B/Dozer	Hr	-	-	-	-	-	-	-
01-7	S/Dozer	Hr	-	-	-	-	-	-	-
	Total	Hr	168	-	1,923	135	-	-	2
-	Back Hoe	Hr	207	-	940	30	-	-	5
02-2	Back Hoe	Hr	-	-	-	-	-	-	-
02-5	Back Hoe	Hr	-	-	-	-	-	-	-
	Total	Hr	207	-	940	30	-	-	5
03-3	W/Loader	Hr	163	-	1,233	45	-	588	145
03-4	W/Loader	Hr	-	-	-	-	-	-	-
	Total	Hr	163	-	1,233	45	-	588	145
06-1	D/Truck	Km	-	-	-	-	-	-	-
06-4	D/Truck	Km	-	-	-	-	-	-	-
06-5	D/Truck	Km	-	-	-	-	-	-	-
06-6	D/Truck	Km	439	-	185	-	-	-	-
06-7	D/Truck	Km	2,475	-	1,080	28	-	-	2
06-8	D/Truck	Km	2,595	-	1,205	-	-	-	2
06-9	D/Truck	Km	2,743	-	1,410	25	-	-	2
06-11	D/Truck	Km	-	-	-	-	-	-	-
	Total	Km	8,252	-	3,880	53	-	-	6

Cont. no.	Equipment Name of Equipment	Unit	Operat.	Consumption Petrol (lit)	D-Oil (lit)	E-Oil (lit)	C-Oil (lit)	H-Oil (lit)	Grease (kg)
07-1	C/Crane	Hr	177	-	610	30	-	-	9
-	T/Crane	Hr	-	-	-	-	-	-	-
07-2	T/Crane	Hr	-	-	-	-	-	-	-
	Total	Hr	177	-	610	30	-	-	9
11-2	B/Plant	Hr	164	-	-	-	-	-	11
14-6	M/Truck	Hr	201	-	460	3	-	12	2
14-7	M/Truck	Hr	-	-	-	-	-	-	-
14-8	M/Truck	Hr	-	-	-	-	-	-	-
	Total	Hr	201	-	460	3	-	12	2
21-2	A/Compressor	Hr	1.5	-	40	3	-	-	-
23-2	V/Hammer	Hr	-	-	-	-	-	-	-
24-1	S/Plant	Hr	110	-	-	-	-	-	2
24-2	S/Plant	Hr	-	-	-	-	-	-	-
	Total	Hr	110	-	-	-	-	-	2
26-4	Generator	Hr	397	-	5,235	11	-	-	-
26-5	Generator	Hr	387	-	2,710	29	-	-	-
26-6	Generator	Hr	152	-	1,075	20.5	-	-	-
26-7	Generator	Hr	182	-	1,285	4	-	-	-
26-8	Generator	Hr	48	-	200	-	-	-	-
26-9	Generator	Hr	-	-	-	-	-	-	-
	Total	Hr	1,166	-	10,505	64.5	-	-	-
27-15	S/Pump	Hr	-	-	-	-	-	-	-
27-16	S/Pump	Hr	-	-	-	-	-	-	-
27-17	S/Pump	Hr	-	-	-	-	-	-	-
27-18	S/Pump	Hr	-	-	-	-	-	-	-
	Total	Hr	-	-	-	-	-	-	-

Table 5.3.2 Monthly Working Records of Construction Plant and Equipment(8/15) Year: 1984 Month: October

Cont. no.	Equipment Name of Equipment	Unit	Operat.	Consumption Petrol (lit)	D-Oil (lit)	E-Oil (lit)	C-Oil (lit)	H-Oil (lit)	Grease (kg)
0-1	Water Pump	Hr	28	5	-	-	-	-	-
0-2	Water Pump	Hr	175	-	212	3	-	-	-
0-3	Water Pump	Hr	173	-	214	11	-	-	-
0-4	Water Pump	Hr	-	-	-	-	-	-	-
0-5	Water Pump	Hr	-	-	-	-	-	-	-
0-6	Water Pump	Hr	-	-	-	-	-	-	-
	Total	Hr	376	5	426	14	-	-	-
01-2	B/Dozer	Hr	97	-	1,353	60	-	-	1
01-3	B/Dozer	Hr	-	-	-	-	-	-	-
01-5	B/Dozer	Hr	-	-	-	-	-	-	-
01-6	B/Dozer	Hr	-	-	-	-	-	-	-
01-7	S/Dozer	Hr	-	-	-	-	-	-	-
	Total	Hr	97	-	1,353	60	-	-	1
-	Back Hoe	Hr	42	5	550	42	-	6	1
02-2	Back Hoe	Hr	-	-	-	-	-	-	-
02-5	Back Hoe	Hr	-	-	-	-	-	-	-
	Total	Hr	42	5	550	42	-	6	1
03-3	W/Loader	Hr	214	-	1,295	4	-	-	2
03-4	W/Loader	Hr	32	-	260	-	-	10	10
	Total	Hr	246	-	1,555	4	-	10	12
06-1	D/Truck	Km	900	-	160	-	-	-	-
06-4	D/Truck	Km	-	-	-	-	-	-	-
06-5	D/Truck	Km	-	-	-	-	-	-	-
06-6	D/Truck	Km	1,732	-	550	1.5	-	-	-
06-7	D/Truck	Km	1,749	-	770	32	-	-	.5
06-8	D/Truck	Km	1,227	-	510	25	-	-	-
06-9	D/Truck	Km	858	-	330	-	-	-	-
06-11	D/Truck	Km	-	-	-	-	-	-	-
	Total	Km	6,466	-	2,320	58.5	-	-	.5

Cont. no.	Equipment Name of Equipment	Unit	Operat.	Consumption Petrol (lit)	D-Oil (lit)	E-Oil (lit)	C-Oil (lit)	H-Oil (lit)	Grease (kg)
07-1	C/Crane	Hr	12	-	-	-	-	-	-
-	T/Crane	Hr	-	-	-	-	-	-	-
07-2	T/Crane	Hr	-	-	-	-	-	-	-
	Total	Hr	12	-	-	-	-	-	-
11-2	B/Plant	Hr	-	-	-	-	-	-	-
14-6	M/Truck	Hr	29	-	225	25	-	-	-
14-7	M/Truck	Hr	-	-	-	-	-	-	-
14-8	M/Truck	Hr	-	-	-	-	-	-	-
	Total	Hr	29	-	225	25	-	-	-
21-2	A/Compressor	Hr	2	-	60	-	-	-	-
23-2	V/Hammer	Hr	-	-	-	-	-	-	-
24-1	S/Plant	Hr	124	-	-	-	-	-	-
24-2	S/Plant	Hr	-	-	-	-	-	-	-
	Total	Hr	124	-	-	-	-	-	-
26-4	Generator	Hr	409	-	5,700	11	-	-	-
26-5	Generator	Hr	286	-	2,250	49	-	-	-
26-6	Generator	Hr	158	-	978	22	-	-	-
26-7	Generator	Hr	208	-	1,630	2	-	-	-
26-8	Generator	Hr	17	-	90	9	-	-	-
26-9	Generator	Hr	-	-	-	-	-	-	-
	Total	Hr	1,078	-	10,648	93	-	-	-
27-15	S/Pump	Hr	-	-	-	-	-	-	-
27-16	S/Pump	Hr	-	-	-	-	-	-	-
27-17	S/Pump	Hr	-	-	-	-	-	-	-
27-18	S/Pump	Hr	-	-	-	-	-	-	-
	Total	Hr	-	-	-	-	-	-	-

Table 5.3.2 Monthly Working Records of Construction Plant and Equipment(9/15)

Year: 1984 Month: November

Cont. no.	Equipment Name of Equipment	Unit	Operat.	Consumption Petrol (lit)	D-Oil (lit)	E-Oil (lit)	C-Oil (lit)	H-Oil (lit)	Grease (kg)
0-1	Water Pump	Hr	75	12	13	-	-	-	-
0-2	Water Pump	Hr	223	-	339	10	-	-	-
0-3	Water Pump	Hr	3	-	15	1	-	-	-
0-4	Water Pump	Hr	227	-	340	7	-	-	-
0-5	Water Pump	Hr	-	-	-	-	-	-	-
0-6	Water Pump	Hr	-	-	-	-	-	-	-
	Total	Hr	528	12	707	18	-	-	-
01-2	B/Dozer	Hr	129	-	1,280	143	55	-	3
01-3	B/Dozer	Hr	-	-	-	-	-	-	-
01-5	B/Dozer	Hr	-	-	-	-	-	-	-
01-6	B/Dozer	Hr	-	-	-	-	-	-	-
01-7	S/Dozer	Hr	-	-	-	-	-	-	-
	Total	Hr	129	-	1,280	143	55	-	3
-	Back Hoe	Hr	-	-	-	-	-	-	-
02-2	Back Hoe	Hr	106	1	785	17	2	80	1
02-5	Back Hoe	Hr	-	-	-	-	-	-	-
	Total	Hr	106	1	785	17	2	80	1
03-3	W/Loader	Hr	279	-	1,847	33	10	-	6
03-4	W/Loader	Hr	177.5	5	1,265	41	-	95	22
	Total	Hr	456.5	5	3,112	74	10	95	28
06-1	D/Truck	Km	400	-	195	25	-	-	-
06-4	D/Truck	Km	-	-	-	-	-	-	-
06-5	D/Truck	Km	-	-	-	-	-	-	-
06-6	D/Truck	Km	557	-	245	25	-	-	-
06-7	D/Truck	Km	4,125	-	1,515	2	1	-	-
06-8	D/Truck	Km	1,067	-	685	2	-	-	-
06-9	D/Truck	Km	944	-	710	-	-	-	-
06-11	D/Truck	Km	-	-	-	-	-	-	-
	Total	Km	6,593	-	3,350	54	1	-	-

Cont. no.	Equipment Name of Equipment	Unit	Operat.	Consumption Petrol (lit)	D-Oil (lit)	E-Oil (lit)	C-Oil (lit)	H-Oil (lit)	Grease (kg)
07-1	C/Crane	Hr	88	-	350	-	2	7	1
-	T/Crane	Hr	-	-	-	-	-	-	-
07-2	T/Crane	Hr	-	-	-	-	-	-	-
	Total	Hr	88	-	350	-	2	7	1
11-2	B/Plant	Hr	13	-	-	-	-	-	-
14-6	M/Truck	Hr	22	-	60	-	-	5	-
14-7	M/Truck	Hr	-	-	-	-	-	-	-
14-8	M/Truck	Hr	-	-	-	-	-	-	-
	Total	Hr	22	-	60	-	-	5	-
21-2	A/Compressor	Hr	2	-	250	3	-	-	-
23-2	V/Hammer	Hr	-	-	-	-	-	-	-
24-1	S/Plant	Hr	-	-	-	-	-	-	-
24-2	S/Plant	Hr	230	-	-	-	-	-	2
	Total	Hr	230	-	-	-	-	-	2
26-4	Generator	Hr	80	-	1,400	73	-	-	-
26-5	Generator	Hr	378	-	2,415	28	-	-	-
26-6	Generator	Hr	370	-	2,465	40	-	-	-
26-7	Generator	Hr	176	-	1,270	2	-	-	-
26-8	Generator	Hr	-	-	-	-	-	-	-
26-9	Generator	Hr	-	-	-	-	-	-	-
	Total	Hr	1,004	-	7,550	143	-	-	-
27-15	S/Pump	Hr	-	-	-	-	-	-	-
27-16	S/Pump	Hr	-	-	-	-	-	-	-
27-17	S/Pump	Hr	-	-	-	-	-	-	-
27-18	S/Pump	Hr	-	-	-	-	-	-	-
	Total	Hr	-	-	-	-	-	-	-

Table 5.3.2 Monthly Working Records of Construction Plant and Equipment(10/15)

Year: 1984 Month: December

Cont. no.	Equipment Name of Equipment	Unit	Operat.	Consumption Petrol (lit)	D-Oil (lit)	E-Oil (lit)	C-Oil (lit)	H-Oil (lit)	Grease (kg)
0-1	Water Pump	Hr	166.5	45	-	1	-	-	-
0-2	Water Pump	Hr	193	-	268	6	-	-	-
0-3	Water Pump	Hr	11	-	25		-	-	-
0-4	Water Pump	Hr	1	-	28	1	-	-	-
0-5	Water Pump	Hr	180	-	249	9	-	-	-
0-6	Water Pump	Hr	-	-	-	-	-	-	-
	Total	Hr	551.5	45	570	17	-	-	-
01-2	B/Dozer	Hr	31	-	620	103	70.5	10	-
01-3	B/Dozer	Hr	192	-	3,050	38	-	5	2
01-5	B/Dozer	Hr	104	-	1,290	42	-	-	-
01-6	B/Dozer	Hr	9	-	100	20	-	10	-
01-7	S/Dozer	Hr	-	-	-	-	-	-	-
	Total	Hr	336	-	5,060	203	70.5	25	2
-	Back Hoe	Hr	-	-	-	-	-	-	-
02-2	Back Hoe	Hr	322	-	4,346	104	10	150	7
02-5	Back Hoe	Hr	-	-	-	-	-	-	-
	Total	Hr	322	-	4,346	104	10	150	7
03-3	W/Loader	Hr	420	1	3,490	66	2	112	3
03-4	W/Loader	Hr	140	3	1,420	62	2	145	2
	Total	Hr	560	4	4,910	128	4	257	5
06-1	D/Truck	Km	-	-	-	-	-	-	-
06-4	D/Truck	Km	-	-	-	-	-	-	-
06-5	D/Truck	Km	-	-	-	-	-	-	-
06-6	D/Truck	Km	4,626	-	1,355	39	4	-	5
06-7	D/Truck	Km	1,930	-	1,140	27	4	-	4
06-8	D/Truck	Km	954	-	1,150	13	5	-	2.5
06-9	D/Truck	Km	4,101	-	910	31	5	-	2
06-11	D/Truck	Km	2,021	-	1,185	29	5	-	-
	Total	Km	13,632	-	5,740	139	23	-	13.5

Cont. no.	Equipment Name of Equipment	Unit	Operat.	Consumption Petrol (lit)	D-Oil (lit)	E-Oil (lit)	C-Oil (lit)	H-Oil (lit)	Grease (kg)
07-1	C/Crane	Hr	262	3	1,095	27	-	2	5
-	T/Crane	Hr	-	-	-	-	-	-	-
07-2	T/Crane	Hr	10	-	-	-	-	20	1
	Total	Hr	272	3	1,095	27	-	22	6
11-2	B/Plant	Hr	. 79	-	2	-	-	-	2
14-6	M/Truck	Hr	134	-	645	5	13	73	-
14-7	M/Truck	Hr	103	-	630	27	3	10	2
14-8	M/Truck	Hr	-	-	-	-	-	-	-
	Total	Hr	237	-	1,275	32	16	83	2
21-2	A/Compressor	Hr	5	-	250	1	-	-	-
23-2	V/Hammer	Hr	-	-	-	-	-	-	-
24-1	S/Plant	Hr	-	-	-	-	-	-	-
24-2	S/Plant	Hr	192	2	-	-	-	-	-
	Total	Hr	192	2	-	-	-	-	-
26-4	Generator	Hr	381	-	6,928	22	-	-	4
26-5	Generator	Hr	152	-	1,150	8	-	-	-
26-6	Generator	Hr	403	-	2,800	20	-	-	-
26-7	Generator	Hr	19	-	425	-	-	-	-
26-8	Generator	Hr	-	-	-	-	-	-	-
26-9	Generator	Hr	97	-	1,680	6	-	-	-
	Total	Hr	1,052	-	12,984	56	-	-	4
27-15	S/Pump	Hr	183	-	100	-	-	-	-
27-16	S/Pump	Hr	110	-	-	-	-	-	-
27-17	S/Pump	Hr	140	-	-	-	-	-	-
27-18	S/Pump	Hr	155	-	-	-	-	-	-
	Total	Hr	588	-	100	-	-	-	-

Table 5.3.2 Monthly Working Records of Construction Plant and Equipment(11/15) Year: 1985 Month: January

Cont. no.	Equipment Name of Equipment	Unit	Operat.	Consumption Petrol (lit)	D-Oil (lit)	E-Oil (lit)	C-Oil (lit)	H-Oil (lit)	Grease (kg)
0-1	Water Pump	Hr	136	27	-	39.5	-	-	-
0-2	Water Pump	Hr	298	-	481	10	-	-	-
0-3	Water Pump	Hr	-	-	-	-	-	-	-
0-4	Water Pump	Hr	4.5	-	5	-	-	-	-
0-5	Water Pump	Hr	297	-	432	11	-	-	-
0-6	Water Pump	Hr	-	-	-	-	-	-	-
	Total	Hr	735.5	27	918	60.5	-	-	-
01-2	B/Dozer	Hr	62	-	1,170	287	-	45	-
01-3	B/Dozer	Hr	11	-	15	-	-	-	-
01-5	B/Dozer	Hr	200.5	-	2,900	80	-	25	3
01-6	B/Dozer	Hr	254.5	-	3,475	56	-	29	3
01-7	S/Dozer	Hr	-	-	-	-	-	-	-
	Total	Hr	528	-	7,560	423	-	99	6
-	Back Hoe	Hr	-	-	-	-	-	-	-
02-2	Back Hoe	Hr	236	-	2,825	91	11	305	11
02-5	Back Hoe	Hr	-	-	-	-	-	-	-
	Total	Hr	236	-	2,825	91	11	305	11
03-3	W/Loader	Hr	422.5	-	3,217	59	-	30	5
03-4	W/Loader	Hr	-	-	-	-	-	-	-
	Total	Hr	422.5	-	3,217	59	-	30	5
06-1	D/Truck	Km	-	-	-	-	-	-	-
06-4	D/Truck	Km	-	-	-	-	-	-	-
06-5	D/Truck	Km	-	-	-	-	-	-	-
06-6	D/Truck	Km	5,547	-	1,517	47	-	-	1
06-7	D/Truck	Km	3,349	-	1,378	8	-	-	1
06-8	D/Truck	Km	763	-	685	26	-	-	1
06-9	D/Truck	Km	882	-	797	25	-	-	1
06-11	D/Truck	Km	1,456	-	945	6	-	-	2
	Total	Km	11,997	-	5,322	112	-	-	6

Cont. no.	Equipment Name of Equipment	Unit	Operat.	Consumption Petrol (lit)	D-Oil (lit)	E-Oil (lit)	C-Oil (lit)	H-Oil (lit)	Grease (kg)
07-1	C/Crane	Hr	338	-	685	1	-	10	2
-	T/Crane	Hr	-	-	-	-	-	-	-
07-2	T/Crane	Hr	48	-	485	-	-	10	1
	Total	Hr	386	-	1,170	1	-	20	3
11-2	B/Plant	Hr	120.5	-	-	-	-	-	-
14-6	M/Truck	Hr	228.5	-	1,133	16	-	2	3
14-7	M/Truck	Hr	233	-	1,292	35	4	-	3
14-8	M/Truck	Hr	-	-	-	-	-	-	-
	Total	Hr	461.5	-	2,425	51	4	2	6
21-2	A/Compressor	Hr	-	-	-	-	-	-	-
23-2	V/Hammer	Hr	-	-	-	-	-	-	-
24-1	S/Plant	Hr	-	-	-	-	-	-	-
24-2	S/Plant	Hr	301	-	-	2	-	-	3
	Total	Hr	301	-	-	2	-	-	3
26-4	Generator	Hr	424	-	8,055	84	-	-	-
26-5	Generator	Hr	-	-	-	-	-	-	-
26-6	Generator	Hr	403	-	3,125	34	-	-	-
26-7	Generator	Hr	-	-	-	-	-	-	-
26-8	Generator	Hr	-	-	-	-	-	-	-
26-9	Generator	Hr	291	-	5,624	35	-	-	-
	Total	Hr	1,118	-	16,804	153	-	-	-
27-15	S/Pump	Hr	-	-	-	-	-	-	-
27-16	S/Pump	Hr	145	-	-	-	-	-	-
27-17	S/Pump	Hr	145	-	-	-	-	-	-
27-18	S/Pump	Hr	-	-	-	-	-	-	-
	Total	Hr	290	-	-	-	-	-	-

Table 5.3.2 Monthly Working Records of Construction Plant and Equipment(12/15) Year: 1985 Month: February

Cont. no.	Equipment Name of Equipment	Unit	Operat.	Consumption Petrol (lit)	D-Oil (lit)	E-Oil (lit)	C-Oil (lit)	H-Oil (lit)	Grease (kg)
0-1	Water Pump	Hr	25.5	-	40	1	-	-	-
0-2	Water Pump	Hr	208	-	299	1.5	-	-	-
0-3	Water Pump	Hr	192	-	120	11	-	-	-
0-4	Water Pump	Hr	-	-	-	-	-	-	-
0-5	Water Pump	Hr	227.5	-	344	3.5	-	-	-
0-6	Water Pump	Hr	-	-	-	-	-	-	-
	Total	Hr	653	-	803	17	-	-	-
01-2	B/Dozer	Hr	-	-	-	-	-	-	-
01-3	B/Dozer	Hr	127	-	2,745	11	-	-	2
01-5	B/Dozer	Hr	33.5	-	825	16	-	-	-
01-6	B/Dozer	Hr	239.5	-	2,795	39	5	10	-
01-7	S/Dozer	Hr	272	-	3,280	39	1	10	16
	Total	Hr	672	-	9,645	105	6	20	18
-	Back Hoe	Hr	-	-	-	-	-	-	-
02-2	Back Hoe	Hr	80.5	-	1,245	20	43	40	8
02-5	Back Hoe	Hr	289	-	1,025	-	-	-	8
	Total	Hr	369.5	-	2,270	20	43	40	16
03-3	W/Loader	Hr	362	-	2,295	67	-	54	-
03-4	W/Loader	Hr	-	-	-	-	-	-	-
	Total	Hr	362	-	2,295	67	-	54	-
06-1	D/Truck	Km	-	-	-	-	-	-	-
06-4	D/Truck	Km	-	-	-	-	-	-	-
06-5	D/Truck	Km	-	-	-	-	-	-	-
06-6	D/Truck	Km	5,302	-	1,254	18	-	-	-
06-7	D/Truck	Km	2,857	-	1,265	29	2	-	1
06-8	D/Truck	Km	692	-	725	5	2	-	2
06-9	D/Truck	Km	1,796	-	1,150	7	-	-	-
06-11	D/Truck	Km	2,372	-	1,215	28	-	-	-
	Total	Km	13,019	-	5,609	87	4	-	3

Cont. no.	Equipment Name of Equipment	Unit	Operat.	Consumption Petrol (lit)	D-Oil (lit)	E-Oil (lit)	C-Oil (lit)	H-Oil (lit)	Grease (kg)
07-1	C/Crane	Hr	153.5	-	725	21	-	-	18
-	T/Crane	Hr	-	-	-	-	-	-	-
07-2	T/Crane	Hr	118	-	675	9	4	-	-
	Total	Hr	271.5	-	1,400	30	4	-	18
11-2	B/Plant	Hr	276	-	-	-	-	-	3
14-6	M/Truck	Hr	327	-	1,350	15	16	-	1
14-7	M/Truck	Hr	168.5	-	570	236	-	-	5
14-8	M/Truck	Hr	162.5	-	830	3	-	-	-
	Total	Hr	628	-	2,750	254	16	-	6
21-2	A/Compressor	Hr	-	-	-	-	-	-	-
23-2	V/Hammer	Hr	-	-	-	-	-	-	-
24-1	S/Plant	Hr	-	-	-	-	-	-	-
24-2	S/Plant	Hr	222	-	-	-	-	-	-
	Total	Hr	222	-	-	-	-	-	-
26-4	Generator	Hr	322	-	6,705	59	-	-	-
26-5	Generator	Hr	-	-	-	-	-	-	-
26-6	Generator	Hr	364	-	2,700	-	-	-	2
26-7	Generator	Hr	-	-	-	-	-	-	-
26-8	Generator	Hr	-	-	-	-	-	-	-
26-9	Generator	Hr	302	-	6,910	70	-	-	-
	Total	Hr	988	-	15,685	129	-	-	2
27-15	S/Pump	Hr	-	-	-	-	-	-	-
27-16	S/Pump	Hr	-	-	-	-	-	-	-
27-17	S/Pump	Hr	-	-	-	-	-	-	-
27-18	S/Pump	Hr	-	-	-	-	-	-	-
	Total	Hr	-	-	-	-	-	-	-

Table 5.3.2 Monthly Working Records of Construction Plant and Equipment(13/15) Year: 1985 Month: March

Cont. no.	Equipment Name of Equipment	Unit	Operat.	Consumption Petrol (lit)	D- Oil (lit)	E- Oil (lit)	C- Oil (lit)	H- Oil (lit)	Grease (kg)
0-1	Water Pump	Hr	-	-	-	-	-	-	-
0-2	Water Pump	Hr	221.5	-	240	6.5	-	-	-
0-3	Water Pump	Hr	248	-	355	19	-	-	-
0-4	Water Pump	Hr	10	-	31	-	-	-	-
0-5	Water Pump	Hr	194	-	237	10.5	-	-	-
0-6	Water Pump	Hr	-	-	-	-	-	-	-
	Total	Hr	673.5	-	863	36	-	-	-
01-2	B/Dozer	Hr	-	-	-	-	-	-	-
01-3	B/Dozer	Hr	252	-	4,965	45	-	-	9
01-5	B/Dozer	Hr	-	-	-	-	-	-	-
01-6	B/Dozer	Hr	279.5	-	2,920	100	-	-	-
01-7	S/Dozer	Hr	341	-	2,965	23	-	-	13
	Total	Hr	872.5	-	10,850	168	-	-	22
-	Back Hoe	Hr	-	-	-	-	-	-	-
02-2	Back Hoe	Hr	63.5	-	695	3	10	20	6
02-5	Back Hoe	Hr	255	-	2,040	29	-	-	10
	Total	Hr	318.5	-	2,735	32	10	20	16
03-3	W/Loader	Hr	271.5	2	1,980	36	3	10	6
03-4	W/Loader	Hr	-	-	-	-	-	-	-
	Total	Hr	271.5	2	1,980	36	3	10	6
06-1	D/Truck	Km	-	-	-	-	-	-	-
06-4	D/Truck	Km	-	-	-	-	-	-	-
06-5	D/Truck	Km	-	-	-	-	-	-	-
06-6	D/Truck	Km	5,206	1	1,437	35	-	-	4
06-7	D/Truck	Km	2,349	-	1,322	3	5	-	-
06-8	D/Truck	Km	690	-	770	3	-	1	4
06-9	D/Truck	Km	2,889	-	1,385	7	-	-	3
06-11	D/Truck	Km	4,215	-	1,891	31	2	-	2
	Total	Km	15,349	1	6,805	79	7	1	13

Cont. no.	Equipment Name of Equipment	Unit	Operat.	Consumption Petrol (lit)	D- Oil (lit)	E- Oil (lit)	C- Oil (lit)	H- Oil (lit)	Grease (kg)
07-1	C/Crane	Hr	203.5	10	895	26	20	5	8
-	T/Crane	Hr	-	-	-	-	-	-	-
07-2	T/Crane	Hr	160.5		1,045	46	2	10	12
	Total	Hr	364	10	1,940	72	22	15	20
11-2	B/Plant	Hr	260	2	-	-	-	-	12
14-6	M/Truck	Hr	279.5	-	1,160	16	-	8	3
14-7	M/Truck	Hr	-	-	-	-	-	-	-
14-8	M/Truck	Hr	303.5	-	1,390	5	-	-	3
	Total	Hr	583	-	2,550	21	-	8	6
21-2	A/Compressor	Hr	112	-	1,235	32	-	-	-
23-2	V/Hammer	Hr	-	-	-	-	-	-	-
24-1	S/Plant	Hr	-	-	-	-	-	-	-
24-2	S/Plant	Hr	208.5	-	-	-	-	-	6
	Total	Hr	208.5	-	-	-	-	-	6
26-4	Generator	Hr	374	15	9,970	114	-	-	1
26-5	Generator	Hr	58	-	410	4	-	-	-
26-6	Generator	Hr	388	-	2,550	36	-	-	-
26-7	Generator	Hr	10	-	65	-	-	-	-
26-8	Generator	Hr	58	-	160	-	-	-	-
26-9	Generator	Hr	328	-	7,490	88	-	-	-
	Total	Hr	1,166	-	20,645	242	-	-	1
27-15	S/Pump	Hr	192	-	-	-	-	-	-
27-16	S/Pump	Hr	-	-	-	-	-	-	-
27-17	S/Pump	Hr	30	-	-	-	-	-	-
27-18	S/Pump	Hr	-	-	-	-	-	-	-
	Total	Hr	222	-	-	-	-	-	-

Table 5.3.2 Monthly Working Records of Construction Plant and Equipment(14/15) Year: 1985 Month: April

Cont. no.	Equipment Name of Equipment	Unit	Operat.	Consumption Petrol (lit)	D-Oil (lit)	E-Oil (lit)	C-Oil (lit)	H-Oil (lit)	Grease (kg)
0-1	Water Pump	Hr	47	6	5	3	-	-	-
0-2	Water Pump	Hr	314	-	175	20	-	-	-
0-3	Water Pump	Hr	151	-	175	10.5	-	-	-
0-4	Water Pump	Hr	181	-	224	3.5	-	-	-
0-5	Water Pump	Hr	349	-	432	13	-	-	-
0-6	Water Pump	Hr	17	-	35	5	-	-	-
	Total	Hr	1,059	6	1,046	55	-	-	-
01-2	B/Dozer	Hr	-	-	-	-	-	-	-
01-3	B/Dozer	Hr	187.5	-	3,480	18	-	20	6
01-5	B/Dozer	Hr	8	-	170	-	-	-	-
01-6	B/Dozer	Hr	136.5	-	1,360	42	-	-	-
01-7	S/Dozer	Hr	187.5	-	1,725	11	-	-	2
	Total	Hr	519.5	-	6,735	71	-	20	8
-	Back Hoe	Hr	-	-	-	-	-	-	-
02-2	Back Hoe	Hr	277	-	1,785	47	7	22	12
02-5	Back Hoe	Hr	242	-	1,755	22	-	-	4
	Total	Hr	519	-	3,540	69	7	22	16
03-3	W/Loader	Hr	394.5	-	4,030	84	2	99	9
03-4	W/Loader	Hr	-	-	-	-	-	-	-
	Total	Hr	394.5	-	4,030	84	2	99	9
06-1	D/Truck	Km	-	-	-	-	-	-	-
06-4	D/Truck	Km	-	-	-	-	-	-	-
06-5	D/Truck	Km	-	-	-	-	-	-	-
06-6	D/Truck	Km	6,854	-	1,756	71	-	-	5
06-7	D/Truck	Km	1,566	-	1,048	35	6	-	2
06-8	D/Truck	Km	584	-	880	8	-	-	-
06-9	D/Truck	Km	1,003	-	1,020	1	-	-	-
06-11	D/Truck	Km	1,643	-	1,585	5	1	-	1
	Total	Km	11,650	-	6,289	120	7	-	8

Cont. no.	Equipment Name of Equipment	Unit	Operat.	Consumption Petrol (lit)	D-Oil (lit)	E-Oil (lit)	C-Oil (lit)	H-Oil (lit)	Grease (kg)
07-1	C/Crane	Hr	137	-	575	24	-	54	13
-	T/Crane	Hr	-	-	-	-	-	-	-
07-2	T/Crane	Hr	204	-	1,235	11	-	10	6
	Total	Hr	341	-	1,810	35	-	64	19
11-2	B/Plant	Hr	410.5	5	-	-	-	-	-
14-6	M/Truck	Hr	425	-	1,786	27	-	8	2
14-7	M/Truck	Hr	-	-	-	-	-	-	-
14-8	M/Truck	Hr	435.5	-	2,195	28	2	-	-
	Total	Hr	860.5	-	3,981	55	2	8	2
21-2	A/Compressor	Hr	54	-	690	27	-	90	-
23-2	V/Hammer	Hr	-	-	-	-	-	-	-
24-1	S/Plant	Hr	-	-	-	-	-	-	-
24-2	S/Plant	Hr	342.5	-	-	-	-	-	4
	Total	Hr	342.5	-	-	-	-	-	4
26-4	Generator	Hr	369	-	11,255	148	-	-	-
26-5	Generator	Hr	-	-	-	-	-	-	-
26-6	Generator	Hr	390	-	2,950	20	-	-	1
26-7	Generator	Hr	-	-	-	-	-	-	-
26-8	Generator	Hr	48.5	-	120	4	-	-	-
26-9	Generator	Hr	332.5	-	7,900	24	-	-	-
	Total	Hr	1,140	-	22,225	196	-	-	1
27-15	S/Pump	Hr	501	-	-	-	-	-	-
27-16	S/Pump	Hr	-	-	-	-	-	-	-
27-17	S/Pump	Hr	525	-	-	-	-	-	-
27-18	S/Pump	Hr	449	-	-	-	-	-	-
	Total	Hr	1,475	-	-	-	-	-	-

Table 5.3.2 Monthly Working Records of Construction Plant and Equipment(15/15)

Year: 1985 Month: May

Cont. no.	Equipment Name of Equipment	Unit	Operat.	Petrol (lit)	Consumption D- Oil (lit)	E- Oil (lit)	C- Oil (lit)	H- Oil (lit)	Grease (kg)
0-1	Water Pump	Hr	-	-	-	-	-	-	-
0-2	Water Pump	Hr	168.5	-	85	11	-	5	-
0-3	Water Pump	Hr	72	-	78	1	-	-	-
0-4	Water Pump	Hr	-	-	-	-	-	-	-
0-5	Water Pump	Hr	72	-	82	-	-	-	-
0-6	Water Pump	Hr	3	-	15	-	-	-	-
	Total	Hr	315.5	-	260	12	-	5	-
01-2	B/Dozer	Hr	-	-	-	-	-	-	-
01-3	B/Dozer	Hr	181.5	-	3,430	46	-	12	8
01-5	B/Dozer	Hr	-	-	-	-	-	-	-
01-6	B/Dozer	Hr	-	-	-	-	-	-	-
01-7	S/Dozer	Hr	-	-	-	-	-	-	-
	Total	Hr	181.5	-	3,430	46	-	12	8
-	Back Hoe	Hr	-	-	-	-	-	-	-
02-2	Back Hoe	Hr	73	-	455	4	8	160	9
02-5	Back Hoe	Hr	149	-	1,190	1	-	12	6
	Total	Hr	222	-	1,645	5	8	172	15
03-3	W/Loader	Hr	230	-	2,435	42	-	74	7
03-4	W/Loader	Hr	-	-	-	-	-	-	-
	Total	Hr	230	-	2,435	42	-	74	7
06-1	D/Truck	Km	-	-	-	-	-	-	-
06-4	D/Truck	Km	-	-	-	-	-	-	-
06-5	D/Truck	Km	-	-	-	-	-	-	-
06-6	D/Truck	Km	6,920	-	2,353	47	-	-	3
06-7	D/Truck	Km	2,028	-	1,220	42	3	-	12
06-8	D/Truck	Km	794	-	560	31	1	-	4
06-9	D/Truck	Km	1,295	-	845	37	12	2	2
06-11	D/Truck	Km	2,743	-	1,615	34	41		8
	Total	Km	13,780	-	6,593	191	57	2	29

Cont. no.	Equipment Name of Equipment	Unit	Operat.	Petrol (lit)	Consumption D- Oil (lit)	E- Oil (lit)	C- Oil (lit)	H- Oil (lit)	Grease (kg)
07-1	C/Crane	Hr	113	-	550	5	5	13	7
-	T/Crane	Hr	-	-	-	-	-	-	-
07-2	T/Crane	Hr	121	-	850	26	-	15	5
	Total	Hr	234	-	1,400	31	5	28	12
11-2	B/Plant	Hr	202	-	-	-	11	-	-
14-6	M/Truck	Hr	115	-	720	30	-	-	3
14-7	M/Truck	Hr	-	-	-	-	-	-	-
14-8	M/Truck	Hr	93.5	-	500	2	-	-	5
	Total	Hr	208.5	-	1,220	32	-	-	8
21-2	A/Compressor	Hr	220.5	-	2,405	18	-	55	-
23-2	V/Hammer	Hr	-	-	-	-	-	-	-
24-1	S/Plant	Hr	-	-	-	-	-	-	-
24-2	S/Plant	Hr	58.5	-	-	-	-	-	-
	Total	Hr	58.5	-	-	-	-	-	-
26-4	Generator	Hr	-	-	-	-	-	-	-
26-5	Generator	Hr	-	3	22	20	-	-	-
26-6	Generator	Hr	402	-	2,910	45	-	-	-
26-7	Generator	Hr	-	-	-	-	-	-	-
26-8	Generator	Hr	17	-	100	2	-	-	-
26-9	Generator	Hr	341	-	7,005	103	-	-	-
	Total	Hr	760	3	10,037	170	-	-	-
27-15	S/Pump	Hr	295	-	-	-	-	-	-
27-16	S/Pump	Hr	-	-	-	-	-	-	-
27-17	S/Pump	Hr	200	-	-	-	-	-	-
27-18	S/Pump	Hr	193	-	-	-	-	-	-
	Total	Hr	688	-	-	-	-	-	-

VI CONSTRUCTION MATERIALS AND MANPOWERS

6.1 General

6.1.1 Construction Materials

All the materials and consumable used for the construction of the Project were imported or purchased locally by KDC except steel sheet piles of 440 m.t provided by the Executing Agency.

Imported materials were cements, reinforcement bars, steel forms for the precast concrete blocks and ply woods for forms works from Korea and steel fibers from USA. Except a part of cements imported at the beginning of the second dry season (October to November 1984), all the imported materials have been delivered timely.

Materials purchased locally including from markets of India were fuel and lubricants, timber and all other miscellaneous consumables. Fuel and lubricants have been generally delivered to the site smoothly except in a few period when oil supply was short in the area in January 1985.

6.1.2 Manpower

There were two kinds of manpower sources available for the construction of the Project, the one was the KDC's expatriate staff and the other local employees. Local employees consisted of the following 3 groups:

i) KDC's permanent staffs, technicians, operators and drivers,
ii) Locally employed labourers in the Project site, and
iii) Skilled labourers recruited mainly from India

The above latter two groups have been generally sufficient for the requirement except in a month period when carpenters from India in March and April 1985 were scarce due to religious festivals.

6.2 Imported Construction Materials

6.2.1 Delivery Records

The monthly delivery record of cements, reinforcement bars, steel fibers, steel forms and ply woods are shown in Table 6.2.1.

Table 6.2.2 shows the chronological records of periods required for the importing cements and reinforcement bars shipped from Korea to those delivery to the site. The average duration from shipping to delivery to the site was 2 months.

Table 6.2.1 Delivery Records of Major Imported Construction Materials

	Cement (t)	Reinforcement Bar (t)	Steel Fiber (t)	Steel Form (set)	*Plywood (sheet)*
1984/Mar	500	-	-	-	-
Apr	-	188	-	15	500
May	700	-	-	-	-
Jun	-	-	-	-	-
Jul	-	-	-	-	-
Aug	-	-	-	-	-
Sep	-	-	-	-	-
Oct	-	-	80	-	-
Nov	-	-	-	-	-
Dec	1,104	68	-	-	-
1985/Jan	458	-	-	-	-
Feb	1,405	-	120	-	-
Mar	929	-	-	-	-
Apr	155	-	-	-	-
May	33	-	-	-	-
Total	5,284	256	200	15	500

* 8' x 4' x 12 mm

Table 6.2.2 Detailed Record of Delivery of Cement and Reinforcement Bars

Description	Date of Shipping from Korea (Pusan/Inchon)	Date of Arrival at Culcutta Port	Date of Starting delivery to the site
Cement			
500 mt	3 Jan. '84	5 Feb. '84	7 Mar. '84
700 "	27 Mar. '84	25 Apr. '84	30 May '84
1,100 "	30 Oct. '84	29 Nov. '84	31 Dec. '84
2,200 "	10 Dec. '84	15 Jan. '85	20 Feb. '85
900 "	3 Feb. '85	5 Mar. '85	30 Mar. '85
Reinforcement Bar			
188 mt	25 Feb. '84	28 Mar. '84	2 May '84
68 "	29 Oct. '84	2 Dec. '84	30 Dec. '84

6.2.2 Consumption Record

The consumption record of the imported construction materials up to June 1985 is summarized below:

Cement	:	5156.35 mt
Reinforcement bar	:	227.35 mt
Steel fiber	:	200 mt
Ply wood	:	500 sheets (4′ x 8′ x 12 mm)

The detailed monthly record of each material is shown in Table 6.2.3.

Table 6.2.3 Monthly Consumption Record of Major Imported Construction Materials

	Cement (t)	Reinforcement Bar (t)	Steel Fiber (t)	Plywood (sheet)
1984/Mar	6.5	-	-	-
Apr	10.6	-	-	5
May	113.4	5.0	-	35
Jun	78.0	5.0	-	30
Jul	138.9	4.5	-	-
Aug	314.2	12.5	-	20
Sep	268.45	13.0	-	15
Oct	10.2	-	-	20
Nov	19.95	2.0	-	20
Dec	500.15	2.0	-	40
1985/Jan	551	36.0	-	50
Feb	867	15.2	3.6	80
Mar	549	19.9	28.4	90
Apr	1,211	112.25	84.3	60
May	421	-	83.7	35
Jun	97	-	-	-
Total	5,156.35	227.35	200	500

6.3 Local Construction Materials

The fuel and lubricants were purchased from Nepal Oil Corporation and in the local market. Timber were purchased from a branch factory of Timber Corporation of Nepal located at 3 km east from the KIP camp.

The monthly record of the delivery and consumption of the fuel, lubricant and timber are shown in Tables 6.3.1 and 6.3.2 respectively.

Table 6.3.1 Delivery Record of Local Construction Materials

Month	Petrol (ℓ)	Diesel Oil (ℓ)	Lubricant Oil (ℓ)	Grease (kg)	Timber (m^3)
1984/Apr	54	19,310	888	635	5.1
May	225	19,570	1,015	100	6.3
Jun	400	16,600	615	-	10.0
Jul	200	28,667	1,946	-	21.8
Aug	470	24,025	820	-	30.4
Sep	418	19,941	545	-	4.2
Oct	200	24,000	1,215	-	9.8
Nov	635	15,000	205	16	4.7
Dec	400	39,000	1,015	58	-
1985/Jan	600	32,705	2,255	48	23.8
Feb	265	44,604	820	48	0.2
Mar	235	48,815	1,645	96	14.3
Apr	830	60,347	1,422	196	-
May	400	36,670	-	-	-
Jun	200	27,480	200	16	-
Total	5,532	456,734	14,606	635	130.6

Table 6.3.2 Consumption Record of Local Construction Materials

Month	Petrol (ℓ)	Diesel Oil (ℓ)	Lubricant Oil (ℓ)	Grease (kg)	Timber (m^3)
1984/Apr	34	19,310	553	45	5.1
May	220	18,725	697	16	6.3
Jun	251	16,758	420	20	10.0
Jul	288	20,858	550	4	21.8
Aug	441	25,339	1,518	8	30.4
Sep	219	21,143	1,183	42	4.2
Oct	328	18,257	350	10	9.8
Nov	444	18,009	796	11	4.7
Dec	534	38,311	1,524	53	-
1985/Jan	623	41,631	1,505	49	23.8
Feb	201	43,177	1,021	77	0.2
Mar	293	49,643	936	98	14.3
Apr	665	50,972	1,050	84	-
May	490	38,530	1,060	83	-
Jun	460	31,470	640	28	-
Total	5,491	452,133	13,803	628	130.6

6.4 Manpower

6.4.1 Contractor's Expatriate Staff

KDC was assigning 7 to 8 Korean staffs at the site throughout the construction period. They consist of 2 civil engineers including a site office chief, 1 mechanic, 1 to 2 foreman and 2 to 3 heavy equipment operators.

The monthly assignment record of contractor's expatriate staffs is shown in Table 6.4.1.

6.4.2 Local Employees

Local employees including the Contractor's permanent staffs of 120 to 280 persons were working at the project site throughout the construction period.

The monthly employment record of local personnel is shown in Table 6.4.2.

Table 6.4.1 Monthly Assignment Record of Contractor's Expatriate Staff

Unit : Man-Day

Job Classification	1984										1985					
	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
Project Manager	20	30	31	30	31	9	9	31	30	31	31	28	31	30	31	30
Chief Engineer	20	30	31	30	31	31	30	4	23	31	31	28	39	30	8	-
Admin. Officer	-	-	20	1	-	-	-	-	-	-	-	-	-	-	-	-
Foreman	20	30	31	30	31	31	30	31	30	31	50	56	62	60	62	30
Mechanic	-	19	31	30	31	31	30	31	30	31	31	28	31	30	31	-
Heavy Equip. Operation	20	49	62	60	84	93	90	93	90	93	93	84	93	90	93	90
Cook	20	30	31	30	31	6	-	-	-	-	-	-	-	-	-	-
Total	100	188	237	211	239	201	189	190	203	217	236	224	256	240	225	150

Table 6.4.2 Employment Records of Contractor's Local Staffs and Labourers

Unit : Man-Day

Job Classification	1984 Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	1985 Jan	Feb	Mar	Apr	May
Staff Personnel	40	74	108	131	170	184	189	136	176	245	275	249	262	268	278
Chief Engineer	29	30	31	30	31	31	10	-	-	22	31	28	31	30	31
Mason	107	107	53	88	86	99	91	66	73	133	173	95	185	185	253
Mason Helper	48	27	-	16	27	66	72	8	24	51	77	85	109	75	31
Mechanic	19	37	74	50	78	93	88	70	75	83	101	84	89	87	87
Mechanic Helper	33	98	105	91	77	147	89	74	65	56	58	44	87	68	31
Equipment Operator	36	158	170	224	229	313	334	270	311	383	425	438	455	429	388
Driver	56	112	167	205	205	209	201	166	190	257	280	278	313	361	370
Carpenter	334	469	265	246	280	254	181	203	239	376	411	342	890	777	558
" helper	129	174	123	103	105	112	78	60	78	92	140	263	495	440	251
Plumber	19	15	-	-	-	-	-	-	-	-	-	-	-	-	-
" helper	21	15	-	-	-	-	-	-	-	-	-	-	-	-	-
Welder	21	80	82	104	115	107	96	63	39	51	59	55	66	86	78
" helper	7	62	119	81	75	58	68	61	55	31	31	55	80	115	115
Steel Bar Worker	-	48	150	161	172	178	174	153	228	309	367	367	308	301	251
Electrician	18	30	31	28	29	26	26	20	30	30	28	26	31	28	23
Electrician Helper	18	39	46	28	30	28	26	24	45	44	60	56	58	76	86
Survey Helper	51	89	69	64	56	57	43	23	41	68	89	78	84	82	83
Blacksmith	17	30	30	25	19	23	26	21	20	29	24	20	15	29	41
Blacksmith Helper	17	30	30	26	18	26	27	23	23	30	30	25	27	24	13

Unit : Man-Day

Job Classification	1984 Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	1985 Jan	Feb	Mar	Apr	May
Common Labourer	899	1,794	1,659	1,084	1,134	1,547	1,277	889	1,170	1,708	1,939	1,925	2,664	2,554	1,901
Store keeper	14	44	34	27	29	31	25	22	59	56	57	29	20	29	14
" helper	15	14	-	-	-	25	28	23	30	33	49	54	62	60	55
Foreman	72	118	115	137	97	113	110	69	83	120	112	117	138	123	112
Sheet piling	-	123	203	-	-	-	-	-	-	-	-	-	-	-	-
Sheet piling helper	-	8	-	-	-	-	-	-	-	-	-	-	-	-	-
Laboratory helper	-	-	-	-	19	29	28	22	30	31	30	36	57	59	51
Screen plant	-	109	228	161	251	459	412	328	604	700	731	559	736	690	584
Batching Plant	-	-	-	-	32	167	380	74	86	113	627	631	693	888	567
Guard	164	297	383	344	302	354	325	324	407	452	423	364	407	388	424
Precast conc. Block	-	-	-	-	-	-	13	-	-	-	-	-	-	-	-
Office Peon	-	47	61	55	56	53	55	43	56	60	55	53	58	57	58
Painter	-	12	-	-	-	-	-	-	-	-	-	-	-	-	-
Fuelman	-	2	29	8	14	29	7	-	-	-	28	21	31	29	30
Timekeeper	-	-	-	-	-	-	25	23	29	31	-	-	-	-	-
Cook helper	40	60	98	89	93	93	90	92	90	59	75	83	93	90	89
Sweeper	27	56	61	50	59	42	58	58	58	57	59	51	61	60	61
Total	2,251	4,408	4,524	3,659	3,888	4,953	4,652	3,408	4,414	5,710	6,844	6,511	8,605	8,488	6,914

VII ENGINEERING SERVICES AND SUPERVISION WORKS

7.1 Engineering Services of Consultant

The engineering services performed by the Consultant (NK) was made for the following items:

I Hydraulic model tests

II Detailed design

III Project implementation supervision

1. Assistance to executing agency in advance action
2. Assistance to executing agency in supervision of sheet piling work
3. Assistance to executing agency in supervision of concrete and earthworks

The detailed engineering services done by NK are mentioned as below:

I Hydraulic Model Tests

1. Construction and run a sectional hydraulic model (scale about 1:25) of the weir, incorporating the proposed depressed stilling basin and the river bed protection downstream of the basin end sill.

2. Run the model to test the proposed stilling basin design for discharges both below and above the design flood of 3,000 cumsec. and also up to 5,200 cumsec.

3. Run the model to test the depressed stilling basin with the provision of baffles or increasing the height of the end sill, or above, with the object of shortening the basin and the downstream protection.

4. Determine on the basis of the tests data the most appropriate size and configuration of the stilling basin.

5. Prepare and submit Hydraulic Model Test report.

II Detailed Design

1. Prepare basic design for the purpose of the Bill of Quantities for Civil Works Contract, steel sheetpile procurement and for hydraulic model tests.

2. Study and analyze the potential problem of uplift on the existing concrete apron slab as a result of the sheetpile line proposed to be installed at the downstream edge of the slab. Also propose and design measures to overcome the problem.

3. Modify the basic design referred to in item 1 above, in accordance with the results of hydraulic model test and related studies.

4. Study and confirm pre-cast concrete block sizes and shapes for downstream protection.

5. Study and prepare details for the work required to be carried out for raising the height of the sluice gates.

6. Prepare detailed drawings for all the remedial works.

7. Finalize construction cost estimates on the basis of the detailed design.

8. Prepare and submit design report, including detailed calculations.

III Project Implementation Supervision

1. Assistance to Executing Agency in Advance Action

   i) Assist in the preparation of prequalification documents for Civil Works Contract.

   ii) Assist in the prequalification of bid invitation document for procurement of steel sheetpiles.

   iii) Assist in the preparation of tender documents, evaluation of the tenders and award of Civil Works Contract.

2. Assistance to Executing Agency in the Supervision of Sheetpiling Work

   i) Review Contractor's program, method statement and equipment, and assist the Project Manager in approving Contractor's proposals.

   ii) Assist the Project Manager in supervising the work of the installation of sheetpiles and monitoring of its progress.

   iii) Provide certifications of contractor's progress in terms of both quality and quantity of the works executed, on monthly basis and assist the Project Manager in dealing with the contractual matters including certificate of monthly payments.

3. Assistance to the Executing Agency in Supervision of Concrete and Earthworks

1. Review construction drawings prepared by the Contractor and assist the Project Manager in the approval of such documents on a timely basis.

2. Review Contractors program, method statement and equipment intended to be used and assist the Project Manager in approving the proposals.

3. Assist the Project Manager in exercising quality control during construction.

4. Assist the Project Manager in monitoring the progress and directing the Contractor to maintain the pace required for the completion of the works by 15 May 1985.

5. Assist the Project Manager in the preparation of the monthly progress and other reports on timely basis.

6. Assist the Project Manager in dealing with contractual matters including certification monthly payments.

7. Assist the Project Manager in certifying completion of the works and also the Maintenance certificate.

The engineering services by NK were started actually from 14 August 1983 and completed on 26 June 1985. The Consultant's staff assignment and the man-month provided during the above service period are shown in Table 7.1.1 and Fig. 7.1.1.

Table 7.1.1 Assignment of Consultants for Engineering Services

Unit : M/M

Assignment	1983 Aug	Sep	Oct	Nov	Dec	1984 Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	1985 Jan	Feb	Mar	Apr	May	Jun	Total
1. Detailed Design																								
1.1 Field Office Work																								
Chief Engineer	-	-	-	0.17	0.46	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.63
Design Engineer (B)	0.6	0.27	0.26	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.13
1.2 Home Office Work																								
Chief Engineer	-	-	0.2	0.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.0
Design Engineer (A)	-	-	0.5	1.5	0.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.0
Design Engineer (B)	-	-	0.8	1.0	0.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.0
2. Supervision																								
Chief Engineer	-	-	-	-	-	-	-	0.8	-	-	-	-	-	-	-	-	0.57	-	-	-	-	-	-	1.37
Construction Engineer (A)	-	-	-	-	-	-	0.77	1.0	1.0	1.0	-	-	0.33	-	0.23	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.7	12.03
Construction Engineer (B)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.7	1.0	1.0	1.0	1.0	0.14	5.84
3. Additional Services for New Stilling Basin																								
Hydraulic Specialist	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.24	0.23	-	-	0.47
4. Additional Services for Kankai Irrigation Extension Project																								
Construction Engineer (A)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.17	0.17
Total	0.6	0.27	1.76	2.97	1.16		0.77	1.8	1.0	1.0			0.33		0.23	1.0	2.27	2.0	2.0	2.24	2.23	2.0	1.01	26.64

FIG. 7.1.1 ASSIGNMENT RECORD OF CONSULTANTS FOR ENGINEERING SERVICES

ASSIGNMENT (NAME)	1983					1984												1985								MAN-MONTHS	
	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	ASSIGNED	TO-DATE
I DETAILED DESIGN																											
I-1 Field Office Work																											
Chief Engineer (T. KawaKatsu)																										1·0	0·63
Design Engineer (B) (Y. Murai)																										0·5	1·13
I-2 Home Office Work																											
Chief Engineer (T. Kawakatsu)																										1·0	1·0
Design Engineer (A) (Y. Kamiya)																										2·0	2·0
Design Engineer (B) (Y. Murai)																										2·0	2·0
II SUPERVISION																											
Chief Engineer (Y. Gotanda / E. Yamauchi)																										1·5	1·37
Construction Engineer (A) (Y. Murai)																										12·0	12·04
Construction Engineer (B) (N. Nagano)																										6·0	5·83
																					TOTAL (I & II)					26·0	26·0
III ADD. SERVICES FOR NEW SETTLING BASIN AND EXTENSION AREA																											
Hydraulic Specialist (E. Yamauchi)																										–	0·47
Irrigation Engineer (Y. MURAI)																										–	0.17
																					GRAND TOTAL					26·0	26.64

SCHEDULED ASSIGNMENT LINE

ACTUAL ASSIGNMENT LINE

7.2 Executing Agencies' Staff for Supervision Work

Executing agencies staffs stationed in the KIP site office under the Project Manager, who was also "the Engineer" on the Contract for the Civil Work, have been actually functioning from the commencement of the construction in March 1984. Under the Project Manager, a Divisional Engineer, a Site Engineer, two to three Overseas and other supporting staffs were designated as supervisory staffs for the construction of the Project.

The supervisory works have been done with the assistance of the Consultant in accordance with a manual of supervisory works as shown in Table 7.2.1. Those staffs assignment and the man-month engaged in the supervisory works during the construction period are shown in Table 7.2.2.

Table 7.2.1 Manual of Supervision Work

1. Duties and Limit of Rights of Engineer's Representatives

For assisting the Engineer (Project Manager), the following staffs are designated as the Engineer's Representatives :

Party	Staff Designation	Staff Classification
HMG Staffs:	1) Divisional Engineer	A
	2) Site Engineer	A
	3) Overseer	B
Nippon Koei: (Consultant)	4) Resident Engineer	A
	5) Construction Engineer	A

Duties and limit of rights of the above Engineer's Representatives are classified as follows:

Description/Staff Classification	Staff to supervise during whole works		Staff to inspect and give approval to Contractor 1/	
	A	B	A	B
1. Inspect setting-out and excavation	*	**	**	-
2. Inspect elevation of foundation	*	**	*	**
3. Inspect filter laying & found. gravel or concrete	*	**	*	**
4. Inspect shuttering and re-bar setting	*	**	**	-
5. Inspect concrete casting	*	**	**	-
6. Sampling concrete specimen	*	**	-	-
7. Labo. and field tests	*	**	-	-
8. Inspect curing concrete	*	**	-	-
9. Inspect shuttering removal	*	**	-	-
10. Inspect contractor's labo. tests	*	**	-	-
Earthworks				
11. Inspect setting out	*	**	**	-
12. Inspect embankment & excavation	*	**	**	-
13. Labo. and field tests	*	**	-	-
14. Inspect elevation of embankment	*	**	*	**

Remarks : 1/ Approval means to give approval to the Contractor for each work item to be inspected and to give approval to proceed next work

* : Duties to take action

** : Staff at least who has to take action.

2. Procedure of Supervising Works

1) The Contractor shall submit to the Engineer a Weekly Schedule for the next week by the 1st half of every Friday.

2) The weekly staff meeting including the Contractor's staff shall be held on 2nd half of Friday. In this meeting, duty distribution to each staff for the next week and other related matter shall be discussed.

3) The Contractor shall submit to both the Site Engineer (HMG) and the Resident Engineer (Consultant) slips of the "Request for Inspection" at least half day before the work to be inspected. The works to be inspected are :

   a) Setting-out
   b) Preparation of foundation
   c) Setting shuttering, re-bar and waterstop and subsequent concrete casting.

   The siteengineer shall be responsible to give all the information in this context to the Engineer and the Divisional Engineer.

4) The Site Engineer and the Resident Engineer shall dispatch himself consultant staff and/or Overseers for inspection and supervision in accordance with the preceding duty classification chart and with the work distribution discussed at weekly meeting.

5) Staffs dispatched for supervision shall inspect and watch the Contractor's works in accordance with the technical specification and special instruction discussed at weekly staff meeting. When the Contractor's works are properly prepared for the next stage of works, the Site Engineer, the Resident Engineer or Overseer shall give the approval to the Contractor with signing in the slip of "Request for Inspection" in accordance with the proceding duty classification chart. One slip of "Request for Inspection" with signed shall be retained by the Site Engineer and the other be returned to the Contractor.

6) When the Contractor's works are not properly prepared for the next stage of work or not carried out, the following action shall be taken:

a) Order the Contractor to reform or to stop the works.

b) Slip of "Request for Inspection" shall not be signed as approved until the preparatory works are made to the satisfactory or shall be returned to the Contractor with signature as disapproved.

c) The Engineers Representatives shall issue the instruction slips to the Contractor on which the stop order and its reason with Engineer's representative signature of the Contractor's site representative on this slip. One slip shall be retained by the Site Engineer and the other by the Contractor.

d) The Engineer's Representative taking the above actions shall immediately inform to both the Engineer and the Resident Engineer.

Table 7.2.2 HMG Staffs for Supervision Work

Unit : M/M

Assignment	1984										1985						Total
	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	
Project Manager	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	16
Divisional Engineer	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	16
Site Engineer	-	-	1	1	1	1	1	1	1	1	1	1	1	1	1	1	14
Overseer	3	3	4	4	4	4	4	4	4	3	3	3	3	3	3	3	55
Supervisor	-	-	-	1	1	1	1	1	1	2	2	2	2	2	2	2	20
Driver	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	16
Administrative Officer	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	16
Accountant	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	16
Total	8	8	10	11	11	11	11	11	11	11	11	11	11	11	11	11	169

VIII CONSTRUCTION COST AND PAYMENT
(As of 30 June 1985)

8.1 Summary of Project Cost

The financial cost of the Project as of 30 June 1985 is Rs. 49,904,000 in total consisting of Rs. 36,103,000 in foreign component and Rs. 13,801,000 in local component required for the following five items.

Table 8.1.1 Summary of Construction Cost (Unit: Rs. 1000)

	Description	Total	F.C.	L.C.
1.	Supply of steel sheet piles (Final)	2,650	2,248	312
2.	Supply of vehicles (Final)	462	450	12
3.	Contract for civil work including price escalation (Not final)	41,671	28,670	13,001
4.	Consulting Services (To be final)	4,788	4,735	53
5.	Executing agency 's administrative expenditure (Final)	423	-	423
	Total	49,904	36,103	13,801

The details for each item are described in the succeding sub-section.

8.2 Supply of Steel Sheet Piles

Steel sheet piles of 440 mt were procured through international shopping. The supplier was Kanematsu-Gosho Ltd, Japan and the following amount was paid as contracted:

Foreign currency US $ 149,865.40 (Rs. 2,248,000 eqiv.)

Local currency Rs. 312,476

8.3 Supply of Vehicles

Two units of off-road type vehicles, one was a station wagon type and the other normal short chasis one, were procurred through international shopping. The supplier was United Traders SYndicate (P) Ltd., Nepal, and the following amount was paid as contracted:

Foreign currency	US$ 25,000 (Rs. 450,000 eqiv.)
Local currency	Rs 12,000

8.4 Contract for Civil Works (As of 30 June 1985)

8.4.1 Contract amount

The contract for the civil works was made with KDC with the amount of Rs. 44,700,000. The amount paid to KDC was composed of two currencies, the one was in US Dollars covers 68.8% of the total payment with a conversion rate of Rs. 15/US$ and the other in Nepalese Rupee covering the rest.

Since the Contract was made on the unit price basis, the contract amount actually payable to KDC was Rs. 41,238,901 due to the variation of work quantities. The following table shows the contract amount payable to KDC , and the Engineer's estimate and accepted tendered amount are also presented for comparison:

(Unit : Rs. 1000)

Description	Engineer's estimate	Accepted Tendered amount	Actual Contract Amount		
			Total	FC	LC
General Items	4,720	2,022	2,022	1,391.1 (US$ 92.7)*	630.9
Construction Item	41,201.1	42,678	39,216.9	26,981.2 (US$ 1,978.7)*	12,235.7
Total	45,921.1	44,700	41,238.9	28,372.3 (US$ 1,891.4)*	12,866.6

Note * : Payable in US Dollar (US$ 1,000)

The detailed breakdown of the above table is shown in Table 8.4.1.

Table 8.4.1 Final Bill of Quantities and Civil Work Cost

(Unit : Rs.)

BOQ No.	Description	Unit	Provisional Work Q'ty	Anticipation before Construction: Engineer's Estimate Unit Price	Engineer's Estimate Amount	KDC's Proposal Unit Price	KDC's Proposal Amount	Actual Contract Amount: Actual Q'ty	Actual Contract Amount: Unit Price	Actual Contract Amount: Amount
SCHEDULE-A GENERAL ITEMS										
A-1	Insurance of works	L.S	-	-	700,000	-	162,000	-	-	162,000
A-2	Third party insurance	L.S	-	-	300,000	-	126,000	-	-	126,000
A-3	Insurance against accident to workmen	L.S	-	-	120,000	-	96,000	-	-	96,000
A-4	Contrator's site facilities	L.S	-	-	3,000,000	-	1,600,000	-	-	1,600,000
A-5	First aid facilities	L.S	-	-	600,000	-	38,000	-	-	38,000
	A - Total				4,720,000		2,022,000			2,022,000
SCHEDULE-B CONSTRUCTION ITEMS										
B-1	River diversion and care of water	L.S	-	-	3,330,000	-	3,460,000	-	-	3,460,000
B-2	Site clearing	ha	0.5	5,800	2,900	18,000	9,000	-	18,000	-
B-3	Removal of existing concrete blocks	cu.m	2,000	80	160,000	135	270,000	3,985	135	537,975
B-4	Excavation - Common	cu.m	51,000	38	1,938,000	45	2,295,000	60,471	45	2,721,195
B-5	Excavation - Rock	cu.m	2,000	145	290,000	120	240,000	-	120	-
B-6	Earthfill to raise height of intake embankment	cu.m	3,200	26	83,200	45	144,000	6,721	45	302,445
B-7	Backfill behind side walls	cu.m	1,500	26	39,000	45	67,500	5,308	45	238,860
B-8	Driving steel sheet piles	mt	400	4,300	1,720,000	1,170	468,000	354	1,170	414,180
B-9	Concrete Type-A for side walls	cu.m	2,500	1,250	3,125,000	1,065	2,662,500	1,552	1,065	1,652,880
B-10	Concrete Type BB for stilling basin slab	cu.m	11,000	1,050	11,550,000	1,020	11,220,000	11,080	1,020	11,301,600

BOQ No.	Description	Unit	Provisional Work Q'ty	Anticipation before Construction: Engineer's Estimate Unit Price	Engineer's Estimate Amount	KDC's Proposal Unit Price	KDC's Proposal Amount	Actual Contract Amount: Actual Q'ty	Actual Contract Amount: Unit Price	Actual Contract Amount: Amount
B-11A	Concrete Type AA for fiber reinforced concrete	cu.m	2,500	1,350	3,375,000	1,170	2,925,000	2,545	1,170	2,977,650
B-11B	Steel fiber for fiber reinforced concrete	mt	200	20,000	4,000,000	25,500	5,100,000	200	25,500	5,100,000
B-12	Concrete Type B for concrete blocks including form for concrete	cu.m	4,000	1,250	5,000,000	1,725	6,900,000	2,802	1,725	4,833,450
B-13	Form for concrete of stilling basin slab and side walls	cu.m	8,000	165	1,320,000	150	1,200,000	8,440	150	1,266,000
B-14	Reinforcement bars	kg	250,000	10	2,500,000	8	2,000,000	227,351	8	1,818,808
B-15	Water stop W = 300 mm	m	300	185	55,500	300	90,000	134	300	40,200
B-16	Electricity supply to Engineer's Office and quarters during contract period	kwh	400,000	2.5	1,000,000	5	2,000,000	Not Finalized Yet		
B-17	Wet rubble masonry for slop protection	sq.m	300	375	112,500	90	27,000	1,101	90	99,090
B-18	Heightening Scouring Sluice gates	Provisional Sum		-	100,000	-	100,000	Not Finalized Yet		
B-19	Site exploitation	Provisional Sum		-	500,000	-	500,000	-	-	-
B-20	Day work	Provisional Sum		-	1,000,000	-	1,000,000	-	-	-
B-21	Additional work									
B-21-1	Concrete Type C	cu.m	-	-	-	-	-	874	841	735,034
B-21-2	Filter gravel	cu.m	-	-	-	-	-	3,352	335	1,122,920
B-21-3	Laying underdrain pipe	L.S	-	-	-	-	-	-	L.S	106,126
B-21-4	Membrane of jute and plastic	sq.m	-	-	-	-	-	4,354	35	152,390
B-21-5	Weepholes on stilling basin	pc	-	-	-	-	-	142	662	94,004

BOQ No.	Description	Unit	Provisional Work Q'ty	Anticipation before Construction: Engineer's Estimate Unit Price	Engineer's Estimate Amount	KDC's Proposal Unit Price	KDC's Proposal Amount	Actual Contract Amount: Actual Q'ty	Actual Contract Amount: Unit Price	Actual Contract Amount: Amount
B-21-6	Weepholes in side walls	PC	-	-	-	-	-	141	212	29,892
B-21-7	Weepholes in existing apron	PC	-	-	-	-	-	98	312	30,576
B-21-8	Breaking existing baffle wall	cu.m	-	-	-	-	-	40	Not Finalized	Yen
B-21-9	Hand rail	m	-	-	-	-	-	41.5	528	21,912
B-21-10	Sod facing	sq.m	-	-	-	-	-	2,227	6.2	13,807
B-21-11	Gabion	cu.m	-	-	-	-	-	200	362	72,400
B-21-12	Clearing existing weir apron	sq.m	-	-	-	-	-	3,789	19.4	73,507
	B - Total				41,201,100		42,678,000			39,216,901
	Grand Total (A + B)				45,921,100		44,700,000			41,238,901

8.4.2 Price Escalation
(As of 30 June 1985)

The increase in the prices of specified construction materials, i.e., cement, reinforcement bars, petrol and diesel oil, was paid only for the amount incorporated into the works to the KDC. The total amount of price increase payable to KDC was Rs. 432,183.03 consisting of Rs. 297,341.11 (US$ 19,822.79) in foreign component and Rs. 134,841.11 in local component.

The detail breakdown of the price increase is shown in Table 8.4.2.

8.4.3 Pavement to the Contractor
(As of 30 June 1985)

Though the running payment to the Contractor was to be made on monthly basis according to the Contract, the payment was actually divided into 7 times. The detail condition at each payment including advance payment, retention money, recovery of advance payment, etc., is shown in Table 8.4.3.

Table 8.4.2 Price Escalation

The following amount of price increase only for fuel was certified and recommended to be payable to KDC by the Consultant as of the end of June 1985.

Price increase for petrol	Rs. 1,405.94
Price increase for diesel oil	Rs. 430,777.09
Total	RS. 432,183.03

Table 8.4.3 Monthly Payment Record to KDC

(Unit : Rs. 1,000)

Description	1st Payment	2nd Payment	3rd Payment	4th Payment	5th Payment	6th Payment	7th Payment	Total
A.1 Payment								
1 Progress Amount	1,875	783	5,572	5,994	12,915	12,874		40,013
2 Advance Payment for Mobilization	7,152	0	1,341	0	0	0		8,493
3 Partial Advance for materials	2,034	2,223	2,114	3,229	1,189	0		10,789
4 Release of Retention Money	0	0	0	0	0	0		0
5 Bonus for Early Completion	0	0	0	0	0	0		0
A.1 Total (1 to 5)	11,061	3,006	9,027	9,223	14,104	12,874	- NA -	59,295
A.2 Deduction								
6 Retention Money (5% of item 1)	93.75	39.15	278.6	299.7	645.75	643.7		2,000.65
7 Recovery of Advance Payment	0	0	0	1,321	3,228.75	3,943.25		8,493
8 Recovery of Material Advance	80	710	1,129	1,117	4,065	3,688		10,789
9 Liquidated Damage for Delay	0	0	0	0	0	0		0
A.2 Total (6 to 9)	173.75	749.15	1,407.6	2,737.7	7,939.5	8,274.95		21,282.65
Payable Amount (A.1 - A.2)	10,887.25	2,256.85	7,619.4	6,485.3	6,164.5	4,599.05		38,012.35

8.5 Consulting Services

The total amount for the contract of engineering services payable to NK was as follows:

Foreign component	Japanese Yen 66,852,000	(Rs. 4,735,000 eqv.)
Local component	Rs. 52,700	

8.6 Executing Agency's Administrative Expenditure

The executing agencies expenditure was for the administrative cost consisting of salaries for the staffs, fuel and lubricants of vehicles, maintenance of equipment and miscellaneous consumables. The total expenditure from February 1984 until the completion of the construction of the Project was about Rs. 423,000 Its breakdown is shown in Table 8.6.1.

Table 8.6.1 Administrative Expenditure by Executing Agencies

(Unit : Rs)

Description	Amount
1. Salary and allowances for staffs	233,000
2. Travelling and daily allowances	31,400
3. Fuel for vehicles	86,500
4. Office supplies	41,800
5. Repair and maintenances	11,500
6. Incidental	14,500
7. Miscellaneous	4,300
Total	423,000

IX BIBLOGRAPHY

The following reports and documents were referred for the preparation of the completion report of the Project.

1. Reports prepared by Mr. S.F. Hillis, ADB's Staff Consultant

a.	Kankai Irrigation Project	July 1983
b.	Kankai River Diversion Weir	January 1983
c.	Kankai River Diversion Weir, Report on Progress of Remedial Works (Draft)	December 1985

2. Loan Agreement (Special Operations)

Kankai Diversion Structure Remedial Project	19 December 1983

3. NK's Report

a.	Kankai Irrigation Project, Completion Report	October 1979
b.	Recommendation of Improvement Works of Launching Apron	October 1981
c.	Study Report on Improvement Works to Diversion Weir for Kankai Irrigation Project	June 1983
d.	Additional Technical Note on Urgent Implementation of Remedial Works for Kankai Diversion Weir	July 1983
e.	Report on Hydraulic Model Test for Stilling Basin of Kankai Diversion Structure	December 1983
f.	Report on Detailed Design for Stilling Basin of Kankai Diversion Structure	December 1983
g.	Additional Technical Note on Detailed Design for Stilling Basin of Kankai Diversion Structure	January 1984
h.	Kankai Diversion Structure Remedial Project, Monthly Progress Reports No. 1 to No. 12	March 1984 to June 1985
i.	Structural Calculation for Stilling Basin of Kankai Diversion Structure	March 1984
j.	Construction Plan	March 1984
k.	Report on Revised Construction Plan Schedule	December 1984

4. Tender and Contract

a.	Contract for Supply of Steel Sheet Pile	August 1983
b.	Prequalification Documents of Diversion Weir Remedial Works	August 1983
c.	Evaluation on Bids for Supply of Steel Sheet piles for Kankai Diversion Structure Remedial Works	September 1983
d.	Tender Documents for Contract, Construction of Kankai Diversion Structure Remedial Works	August 1983
e.	Evaluation of Qualification of Tenderers for Kankai Diversion Structure Remedial Works	September 1983
f.	Tender Evaluation for Contract for construction of Kankai Diversion Structure Remedial Works	December 1983

ANNEX - 1

CHRONOLOGICAL DESCRIPTION

OF

MAJOR EVENTS

Date		Event
Year: 1983		
March	02	ADB Mission headed by Mr. S.A. Naqvi arrived at KIP Irrigation Project site and discussed weir's remedial works with the Project's Staffs and the Consultant (Left Kankai for Kathmandu 06 March).
	10	DIHM and ADB Mission discussed weir's remedial works.
April	07	Mr. T. Terai, NK's River Hydraulic Specialist, and Mr. T. Kawakatsu, Chief Engineer assigned for Kankai Irrigation Project arrived at Kankai Site and inspected the weir site. They discussed weir's remedial works with the Project Staffs (Mr. T. Terai left Kankai for Kathmandu on 09 April).
	13	Mr. T. Terai submitted a report on Site finding and recommendation for remedial works to DIHM. DIHM Authorities and the Consultant discussed.
June	03	Mr. S.F. Hillis, Staff Consultant of ADB and Mr. T. Terai, NK's River Hydraulic Specialist arrived at Kankai Site and carried out jointly site inspection (Left Kankai for Kathmandu on 05 (June).
June	06	Mr. S.A. Naqvi, ADB mission Leader, arrived in Kathmandu and held discusion jointly with DIHM authorities, Staff Consultant and NK Staffs on 08 June. The basic idea of depressed type stilling basin was plotted at the meeting and the hydraulic model test was proposed to be carried out.
June	09	Memorandum was exchanged between DIHM and ADB mission. Mission left Kathmandu on 10 June.
August	15	ADB appraisal Mission headed by Mr. S.A. Naqvi arrived in Kathmandu.
	16	NK prepared prequalification document for civil work contract and international shopping document for steel sheet pile and submitted 23 August.

Date		Event
	21	Memorandum of Understanding (MOU) for the Project was exchanged between HMGN and ADB Appraisal Mission (Mission left Kathmandu on 22 August)
September	03	NK started preparation of draft tender document for civil works in Tokyo.
	07	Notices of international shopping bid for steel sheet pile and prequalification of tenderers for civil works contract were advertised on Newspaper "Rising Nepal".
	25	The above bid and prequalification were closed. NK started the hydraulic model test.
	30	NK submitted two reports on 1) evaluation of qualification of tenderers for the Project and 2) evaluation of bids for supply of steel sheet piles for the Project to DIHM.
October	01	NK started the detailed design of stilling basin.
	12	DIHM requested three (3) suppliers to submit a quotation of alternative type of sheet piles (Type II). DIHM issued tender documents for civil works to three (3) qualified tenderers.
	25	Quotation of alternative sheet piles were closed.
	30	Mr. S.F. Hillis, ADB's Staff Consultant, visited Tokyo and had a inspection of interim results of model test and a discussion with NK (Left Tokyo on 01 November)
November	07	DIHM contracted the supply of steel sheet piles with Kanematsu-Gosho Ltd, Japan.
	28	Tenders for civil works were closed. Tenders submitted by Korea Development Corporation (KDC) and Sambu Construction (Sambu) were opened.
	29	NK prepared a evaluation report on tenders for Civil Works and submit the report on 05 December.

Date		Events
December	09	DIHM accepted the Tender from KDC and sent documents for contract to ADB for concurrence.
	13	NK submitted report on hydraulic model test.
	19	Loan Agreement for the Kankai Diversion Structure Remedial Works Project was signed between HMGN and ADB.
	27	NK submitted report on detailed design of stilling basin. Kanematsu-Gosho Ltd shipped steel sheet pile.
	29	ADB Mission comprised of Mr. S.A. Naqvi, Leader of Mission and Mr. S.F. Hills, Staff Consultant reviewed the hydraulic model test and discussed the final design of stilling basin with NK staffs (Left Tokyo on 31 December).
YEAR: 1984		
January	05	NK starts finalization of detailed design of stilling basin based on the resulte of discussion with ADB Mission.
	06	Concurrence for the Contract with KDC was given to DIHM from ADB
	13	DIHM issued Letter of Intent to KDC.
	23	KDC started the construction of site facilities.
	31	NK submitted additional technical notes on detailed design of stilling basin, which presented the final design of stilling basin.
February	16	Sheet piles arrived at Calcutta Port.
	28	The Contract for civil works was signed between DIHM and KDC. Sheet piles arrived at Jogbani, Nepal/India border.
March	01	DIHM issued the order of commencement of works to KDC.
	02	NK's Chief Engineer, Mr. Y. Gotanda, arrived in Kathmandu and started the preparation of Construction Plan
	05	Steel sheet piles are delivered to site (Completion of delivery on 06 March).

Date		Event
	09	KDC informed the Engineer of the Contractor's construction plants imported from Bangladesh being still detained at Bangladesh/India border
	15	KDC started the removal of existing concrete blocks of launching apron,where sheet piles would be driven.
		Mr. K.J. Lim, Vice President of KDC and Mr. T.J. Lim, Director of KDC visited the site and discussed the mobilization of construction with the Project and the Consultant.
	19	The Project issued a check amounting to 3% of the Contract Amount of the advance payment for mobilization to KDC
	20	the Engineer issued the Engineer's Drawings of Diversion Structure Remedial Works to KDC
	21	NK submitted a report on construction plan.
April	02	Mr. Eric J.L. Van Der Erst, ADB Mission Leader, visited Kankai Project site and had a inspection and discussion with project staff and NK (left for Kathmandu on 03 April).
	04	Meeting attended the Project Manager, ADB Mission, NK and KDC was held at Kankai Development Board office in Kathmandu to discuss the mobilization of construction.
	09	KDC Delivered a crawler crane (37 ton) and a part of equipment imported from Bangladesh to the site. (KDC delivered all the equipment imported from Bangladesh to the site by 13 April).
	15 16	KDC carried out trial driving of sheet pile at the weir site. KDC started sheet pile driving.
	26	KDC delivered reinforcement bars of 183 tons to the site.
	27	A heavy rain took place for about 2 hours from 3:00 PM to 5:00 PM, and subsequently a flood occurred from 6:00 PM with a peak discharge of about 60 m3/sec. Piling work was interrupted.

Date		Event
May	02	ADB Mission Mr. E.J. Lim (Leader, Manager of Irrigation and Rural Development Department, Division - 3) and Mr. S. Suos (Sr. Project Economist) visited the site and had a inspection and discussion with project staff and NK (left for Kathmandu on 03 May). Concrete works started.
	04	Mr. M.S. Dhakal, Secretary of Ministry of Water Resources, visited the site and had a inspection (left for Kathmandu on 05 May).
	09	Heavy storm occurred in the afternoon and therely all the construction works were halted.
	13	Sheet piling was completed.
	18	KDC made trial concrete casting of precast concrete block for launching apron.
	19	KDC started to operation of screening plant of concrete aggregates.
June	05	Concrete plant was delivered to the site
July	23	Concrete plant was installed for ready use.
September	15	Heavy rainfall of 437 mm was recorded in the Project's Camp. The total rainfall for 5 days from 15 to 19 was 780 mm.
November	05	KDC started coffering work for river diversion
	20	The river water was diverted to the left bank of the Kankai river
	21	KDC started the removal of existing concrete blocks
	22	ADB Review Mission, Mr. Eric J. L. Van Der Elst (Mission Leader) and Ms. Alma O. Francisco visited Kathmandu on 25 and 27 November respectively.)
	23	The Mission had a site inspection and discussion concerning the Kankai Irrigation Extension Project with the Project and NK.
	25	Mr. S.F. Hillis, Staff Consultant of ADB, joined the Mission at Kankai (left for Kathmandu on 28 November).

Date		Event
	26	The Mission had a site inspection and discussion concerning the Kankai Diversion Structure Remedial Works Project with the project staffs
	27	A meeting attended by the Mission, the Project, NK and KDC was held at the site.
	30	A meeting attended by the Director General with concerned staffs of DIHM, the Project and NK was held at the DIHM.
December	04	The delivery of 1,100 tons cement was started.
	07	A meeting with attendance of Director General and concerned staffs of DIHM, the Project Manager, NK and KDC was held in the DIHM.
		A letter to ADB stating the Engineer's certificate of KDC's urgent actions for mobilization was submitted to Mr. K. Matsunami, representative staff of an ADB Mission to Nepal.
	10	A meeting with attendances of Mr. K.Matsunami, the Project Manater, NK and KDC was held in the DIHM.
	12	KDC started the excavation of river bed.
	15	The removal of concrete blocks in the right bank was completed.
	19	A meeting with attendances of the Director General and other concerned staffs of DIHM, the Project Manager, NK and KDC was held.
	22	KDC started the first concrete casting work of stilling basin slab at the deepest portion.
	27	A meeting with attendances of the Director General and other concerned staff of DIHM, the Project Managerr, NK represented by Mr. E. Yamauchi (Chief construction engineer) and KDC represented by both Directors, Mr. T.J.Lim and Mr. Y.H.Kim was held in the DIHM.
		NK submitted a report on revised construction plan and schedule of the Project.

Date		Event
YEAR: 1985		
January	12	KDC started to construct a temporary diversion channel at the left-corner of the Kankai River.
	19	Delivery of 2,200 tons cement to the site was started.
	23	The river water was diverted into the temporary diversion channel constructed at the left corner of the Kankai river.
	24	KDC started the foundation excavation in the river bed of the left-bank area.
February	19	Concrete placing for all the basin slab in the right-half area was completed.
	24	The first placing of SFRC was carried out for the coating on the Scouring sluice bay with about 15 cm thick.
March	08	ADB's progress review mission Mr. E.J. Lim (Leader, Manager of Division-III, IRDD) and Dr. A. Perez (Agronomist) visited the site and had a inspection and discussion with project staffs and NK (left for Kathmandu on 9 March).
	10	Joint meeting attended by the ADB's Mission, DIHM, the Project and NK was held at DIHM in Kathmandu.
	16	The first installation of concrete blocks was done.
	19	The guidewall was totally completed.
	20	KDC started coffering works on the weir crest at the left bank.
	23	KDC started foundation excavation for the remaining portion of the left bank.
	25	Scouring Sluice gates were opened and the river water was diverted to the right bank.
	30	Right-side wall was totally completed.
	31	The foundation excavation at the left bank was completed to the ground level of El. 112.00 meters.

Date		Event
April	05	NK submitted a report on recommendation of construction of New Settling Basin to the Project, and explained the study results in DIHM.
	17	KDC started the concrete placing for the left-side wall.
	23	Placing concrete for all the stilling basin slab was completed except the sump pit portion for dewatering.
	27	Placing concrete for all the Chute blocks was completed.
May	02	KDC's cement store, electric lines and other minor facilities were damaged by a heavy storm.
	03	All the works were hampered on full one day due mainly to stoppage of electric distribution and to recovery of damaged facilities.
	05	Baffle blocks were completed.
	06	The installation of precast concrete blocks of the launching apron was basically completed except the place where a submersible pump was installed for dewatering
	08	SFRC coating on the stilling basin slab, end sill and installation of precast blocks with filling filter gravels were completed.
		The well for dewatering provided in the stilling basin was plugged.
		All the mandatory works to be completed on or before 15 May 1985 under the Contract were completed.
	15	SFRC coating on the apron of the existing weir was started.
	23	The left-side wall was completed.
	25	SFRC coating on the weir's apron was completed.

Date		Event
June	04	All the coffer bank was washed away by the flood.
	05	Slope protective by inclined concrete wall at the upstream left-side hill was completed.
	06	KDC started the construction of gully protection dam at the left bank (completed on 15 June).
	07	KDC started the sheet piling for the outlet structure of escape channel from the settling basin.
	15	KDC started the wet rubble masonry work at the right bank (completed on 23 June).
	17	KDC started casting overlay concrete on the top of backfilling of the left-side wall (completed on 19 June).
	19	Wet rubble masonry work at the left bank was completed.
	26	KDC started the concrete placing for the outlet structure of escape channel of the settling basin.
	30	Wet rubble masonry work at the right bank was completed.

ANNEX - 2

AS BUILT DRAWINGS

KANKAI RIVER

FLOW

B

CREST EL. 121.35

UPPER APRON EL. 119.50

℄ OF WEIR BODY

Retaining Wall for Flood Protection

EL. 123.60

EL. 126.70

EL. 122.70

EL. 129.00

EL. 119.35

BAFFLE WALL TOP EL. 120.00

EL. 119.35

EL. 119.50

END SILL EL. 119.50

EL. 123.00

A

CHUTE BLOCK

BAFFLE BLOCK

EL. 112.50

End Sill

LAUNCHING APRON

EL. 122.00

EL. 119.00

EL. 122.50

EL. 119.00

EL. 121.50

EL. 124.00

EL. 123.70

EL. 126.70

EL. 124.70

EL. 121.50

EL. 124.00

EL. 121.50

EL. 121.50

B

145.605

37000

6000

14000

47000

27000

15,000

PLAN

16.500

126.000

EL. 129.00

EL. 126.70

EL. 122.00

EL. 127.50

12200

12000

EL. 121.35

EL. 119.50

EL. 112.50

EL. 129.00

EL. 126.00

EL. 123.20

EL. 125.00

EL. 122.00

13.650 1200

130.755

145.605

Reverse Filter t=400

SECTION A-A

130

120

EL. 110

Flood at 5200m³/sec WL. 128.4m

Flood at 3000m³/sec WL. 126.3m

Flood at 3000m³/sec WL. 120.7m

Original Ground Surface

Flood at 5,200m³/sec WL. 121.4m

Existing Bed River Bed EL. 118.00

EL. 119.50

EL. 121.35

EL. 119.20

EL. 120.00

EL. 119.50

EL. 114.00

EL. 114.50

EL. 114.00

EL. 112.50

Sheet Pile t=7350ave

Sheet File

Assumed Rock Surface Line

37.000

6000

14.000

27000

47.000

15,735

SECTION B-B

LEGEND

Area to be Constructed

SCALE

0 10 20 30 40 50m

HIS MAJESTY'S GOVERNMENT OF NEPAL

KANKAI DEVELOPMENT BOARD

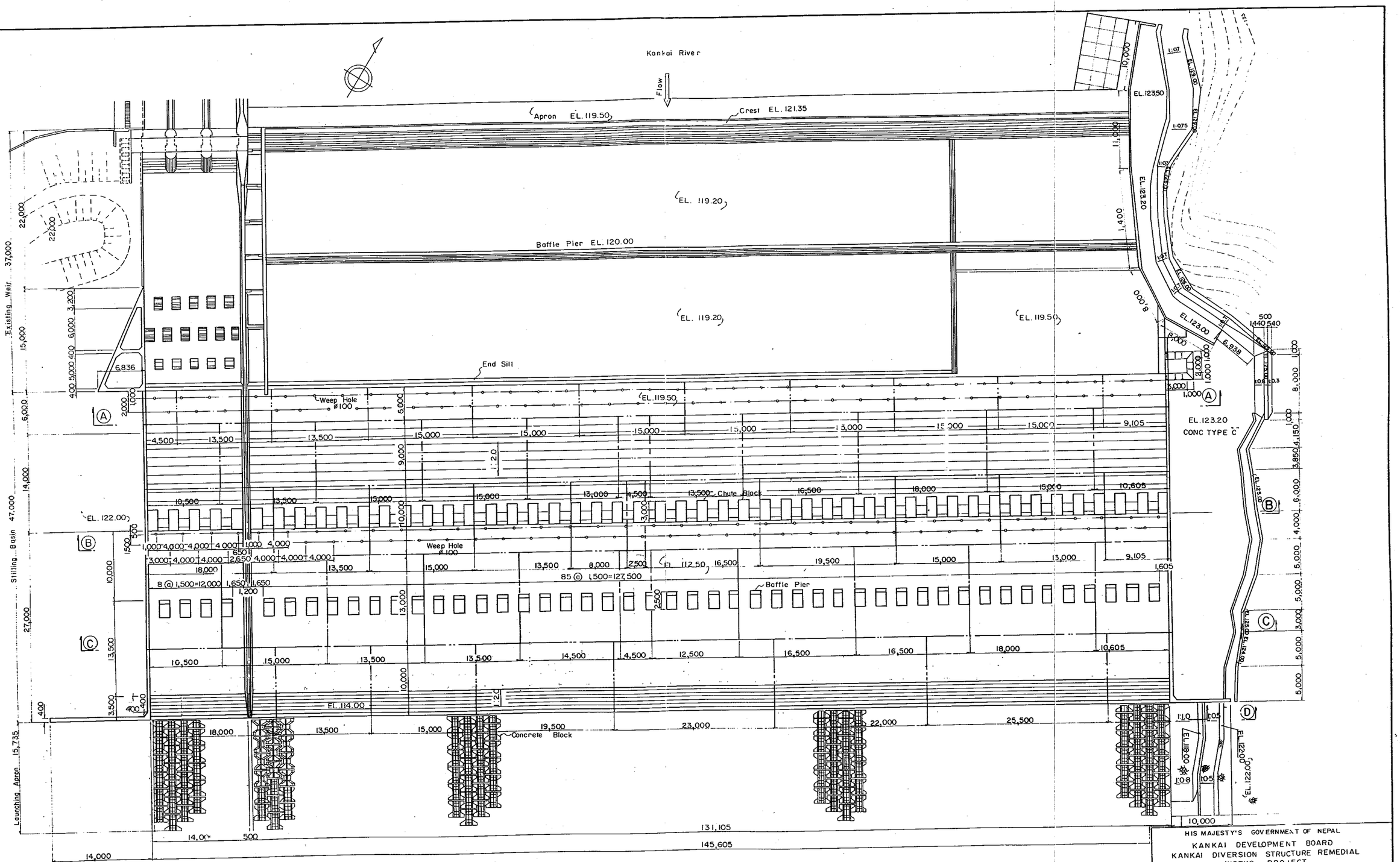
KANKAI DIVERSION STRUCTURE REMEDIAL WORKS PROJECT

AS BUILT DRAWING

GENERAL LAYOUT

DESIGNED BY	CHECKED BY
DRAWN BY	APPROVED BY
DATE 30 JUNE 1985	DWG NO ABD/RW-001

NIPPON KOEI CO., LTD. TOKYO



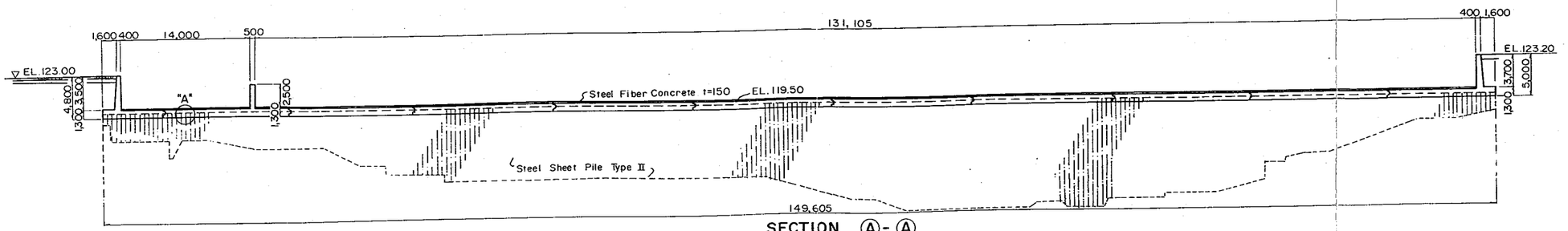
HIS MAJESTY'S GOVERNMENT OF NEPAL
KANKAI DEVELOPMENT BOARD
KANKAI DIVERSION STRUCTURE REMEDIAL WORKS PROJECT

AS BUILT DRAWING

PLAN OF STILLING BASIN

DESIGNED BY	CHECKED BY
DRAWN BY	APPROVED BY
DATE	DWG NO ABD/RW-002

NIPPON KOEI CO., LTD TOKYO



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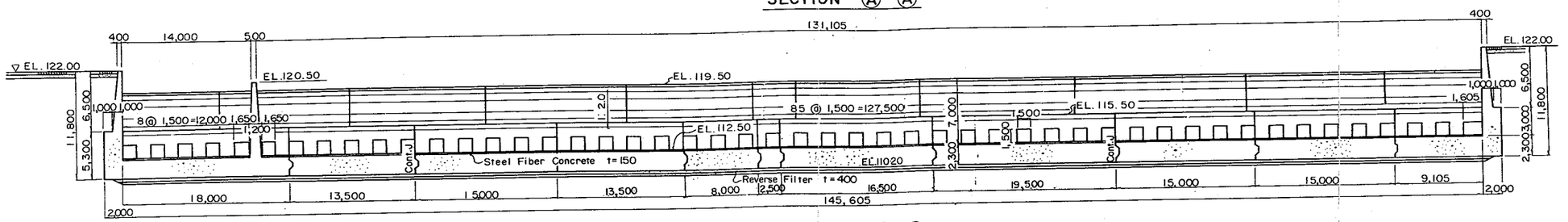

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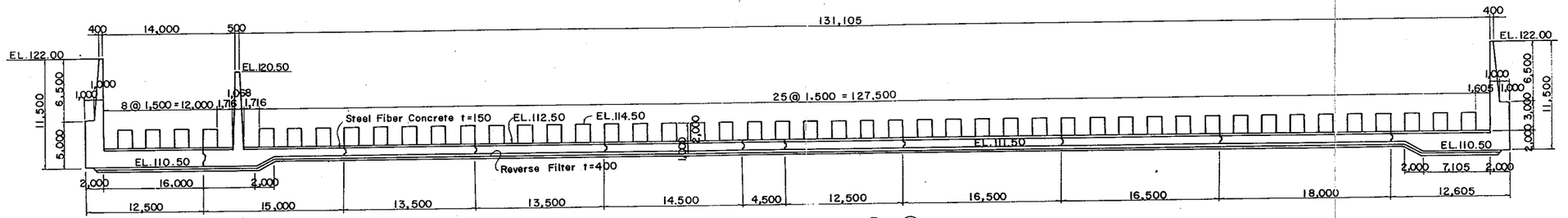

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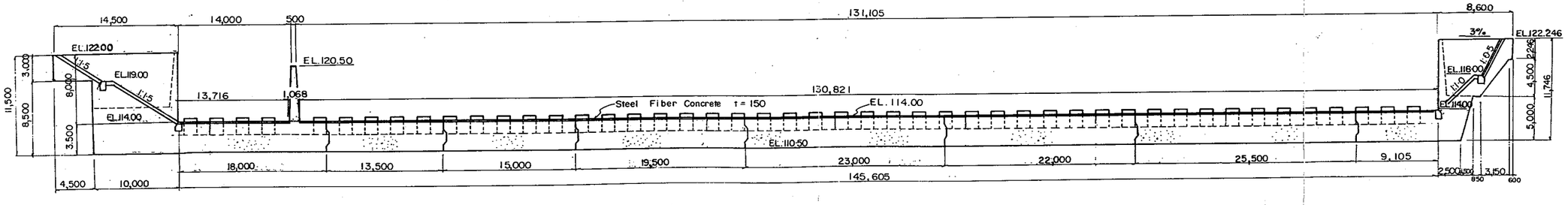
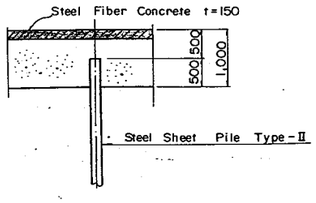


SECTION Ⓓ-Ⓓ



DETAIL "A"
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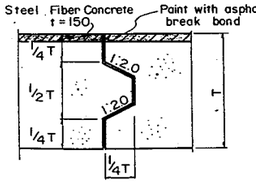
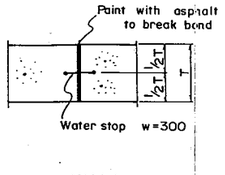


SLAB



WALL

DETAIL OF CONTRACTION JOINT
(Cont. J) NO SCALE

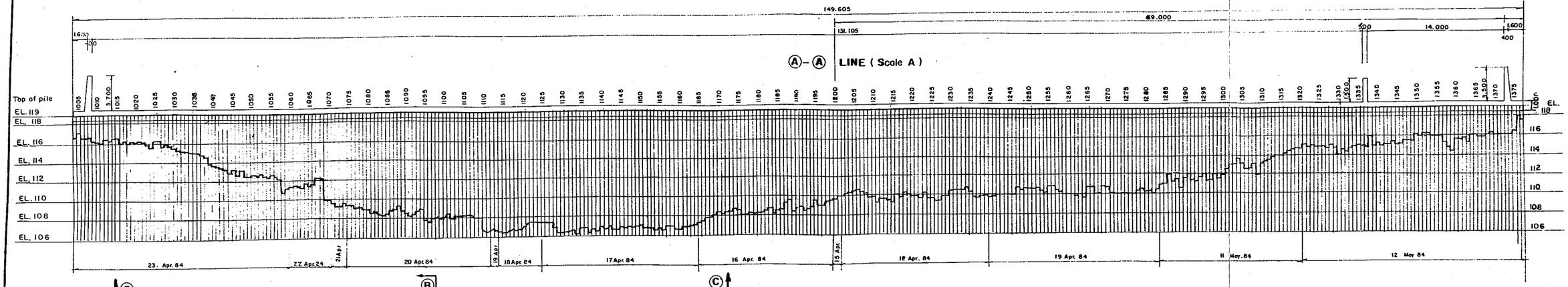
0 10 20m
SCALE

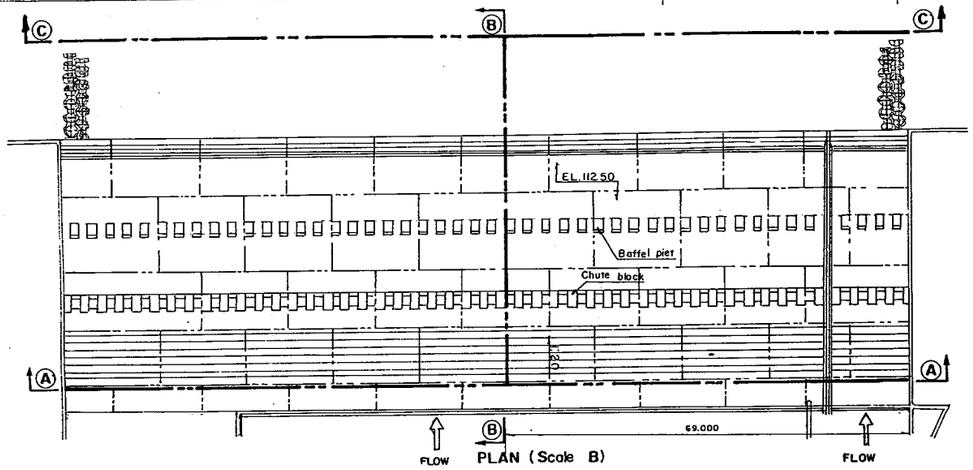
HIS MAJESTY'S GOVERNMENT OF NEPAL
KANKAI DEVELOPMENT BOARD
KANKAI DIVERSION STRUCTURE REMEDIAL WORKS PROJECT

AS BUILT DRAWING
ELEVATION
OF
STILLING BASIN

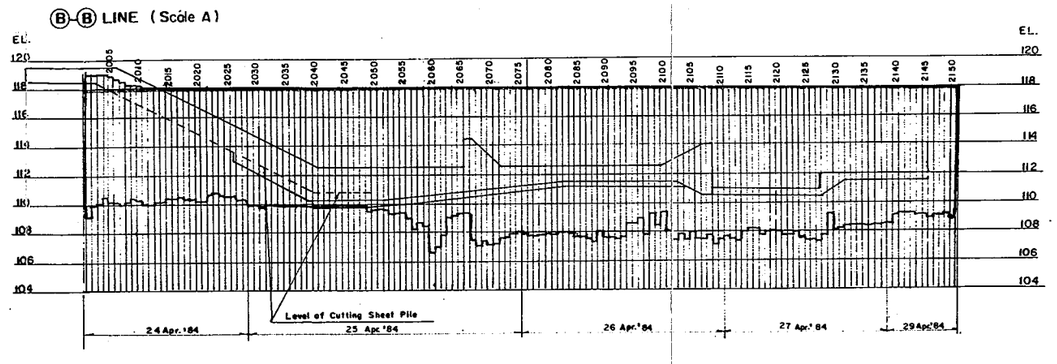
DESIGNED BY	CHECKED BY
DRAWN BY	APPROVED BY
DATE	DWG NO. ABD/RW-003

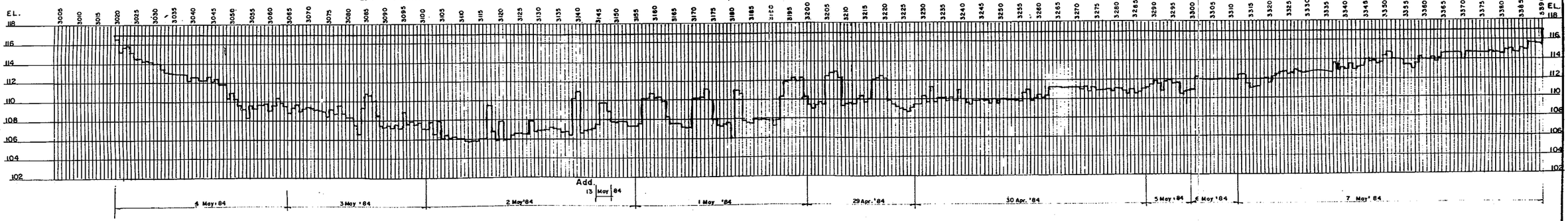
NIPPON KOEI CO., LTD TOKYO





PLAN (Scale B)





PAID QUANTITY OF PILLING WORKS

LINE	PCS	LENGTH (m)	WEIGHT (ton)
A — A	374	2917.7	140.1
B — B	150	1,392.5	66.8
C — C	371	2,396.1	115.0
Total	895	6.706.3	321.9

SCALE A 0 2 4 6 8 10 m.

SCALE B 0 5 10 15 25 25m.

HIS MAJESTY'S GOVERNMENT OF NEPAL
KANKAI DEVELOPMENT BOARD
KANKAI DIVERSION STRUCTURE REMEDIAL WORKS PROJECT

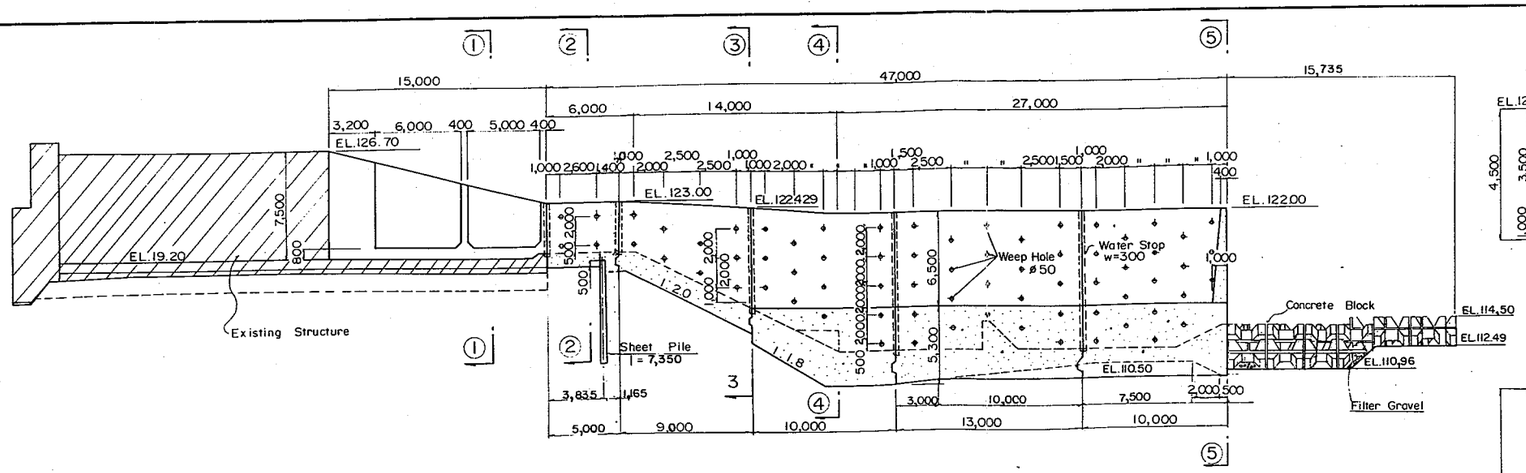
AS BUILT DRAWING

PROGRESS OF SHEET PILLING

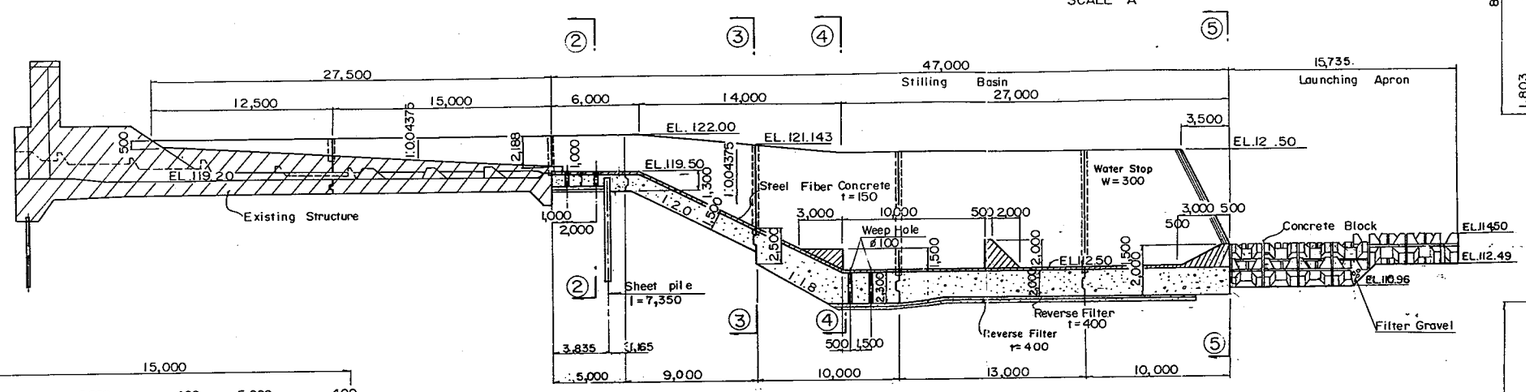
PREPARED	VERIFIED
CHECKED	APPROVED
DATE :- 30 JUNE 1985	DRW. NO. ABD/RW.-004

NIPPON KOEI CO, LTD. TOKYO

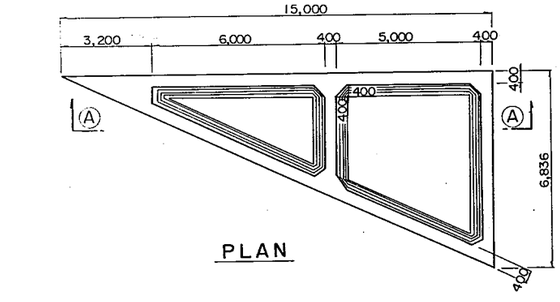
4

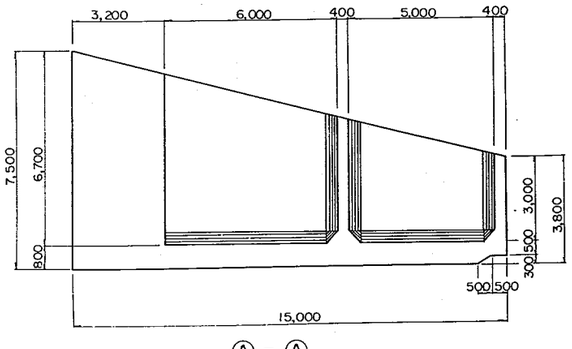


RIGHT SIDE RETAINING WALL
SCALE A

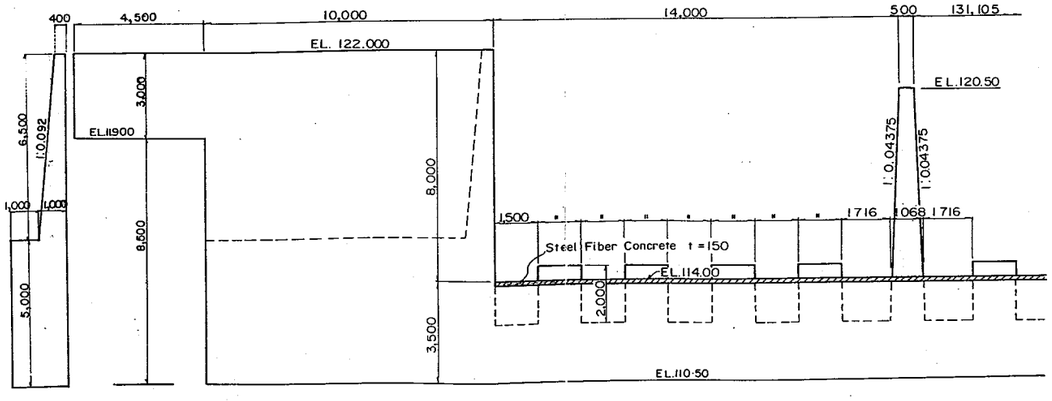


GUIDE WALL
SCALE A





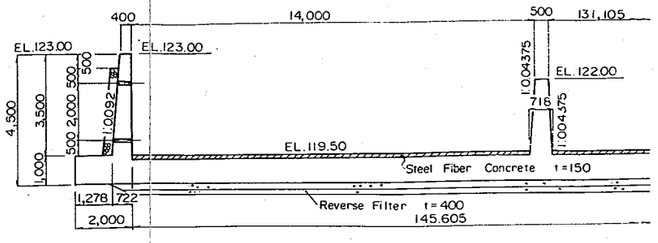
SECTION ①-①
SCALE B



SECTION ⑤-⑤
SCALE B

SCALE. A 0 10M

SCALE B 0 5M



SECTION ②-②
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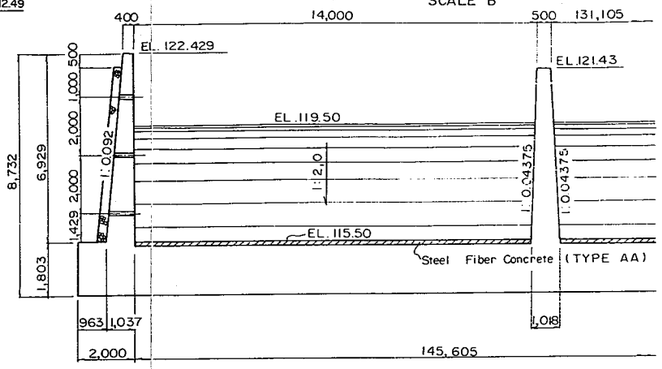
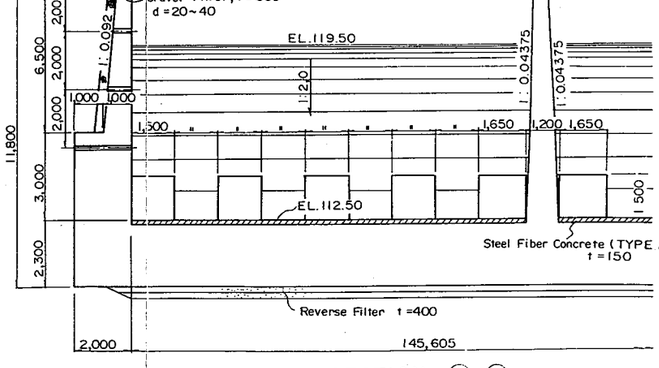


SECTION ③-③
SCALE B



SECTION ④-④
SCALE B

NOTE : 1. Detail of underdrain pipe is shown in DWG. NO. RW-006

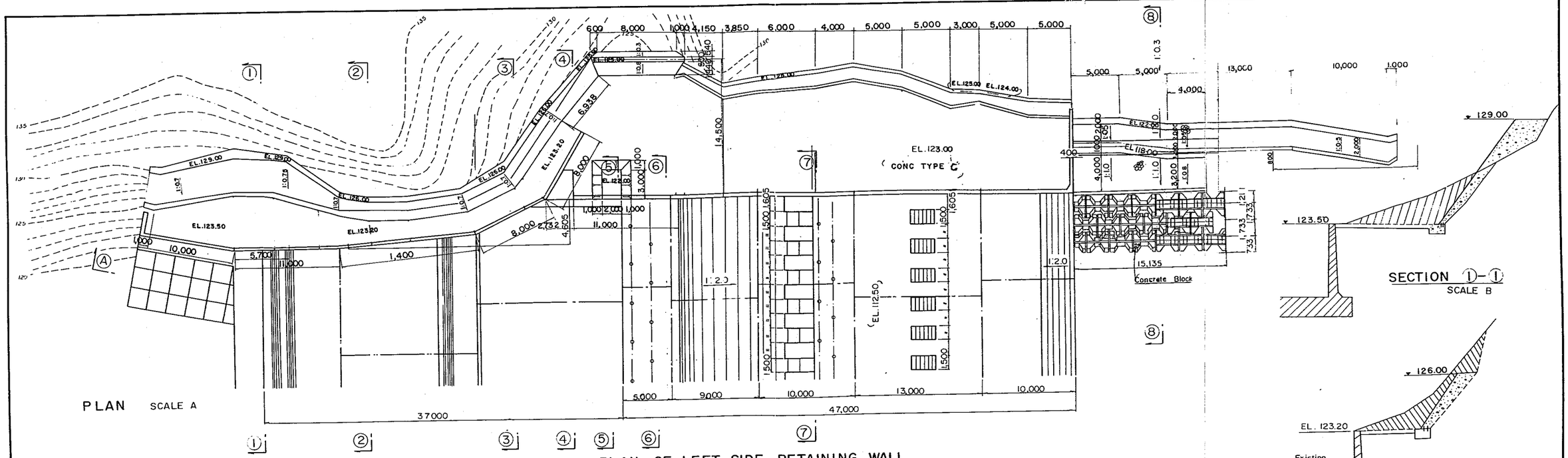
HIS MAJESTY'S GOVERNMENT OF NEPAL
KANKAI DEVELOPMENT BOARD
KANKAI DIVERSION STRUCTURE REMEDIAL WORKS PROJECT

AS BUILT DRAWING

DETAILS OF RIGHT-SIDE & GUIDE WALLS

DESIGNED BY	CHECKED BY
DRAWN BY	APPROVED BY
DATE 30 JUNE 1985	DWG NO. ABD/RW —005.

NIPPON KOEI CO., LTD TOKYO



NOTE:

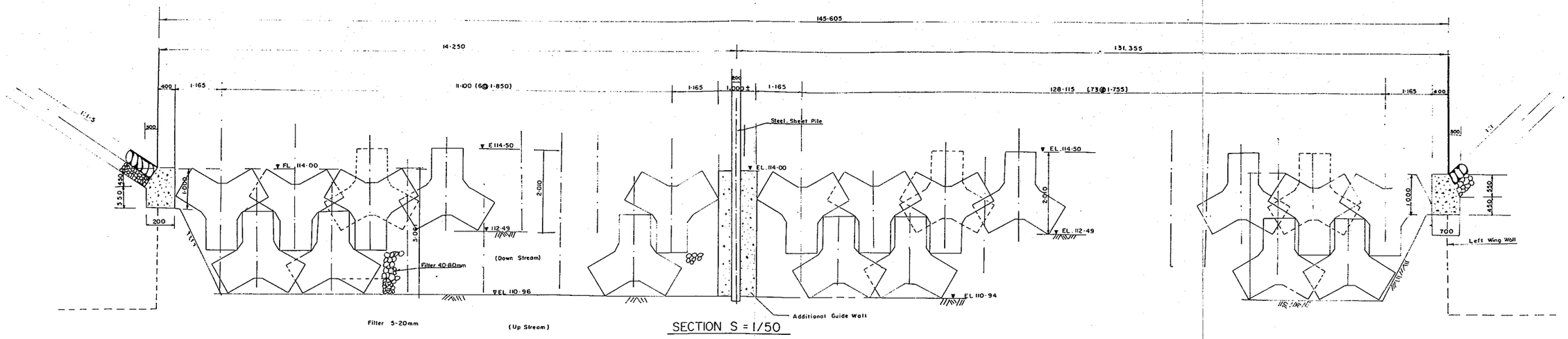
1. Location of weep holes for wall is shown in DWG.NO.RW-004.
2. Detail of underdrain pipe is shown in DWG.NO. RW-006

HIS MAJESTY'S GOVERNMENT OF NEPAL
KANKAI DEVELOPMENT BOARD
KANKAI DIVERSION STRUCTURE REMEDIAL WORKS PROJECT

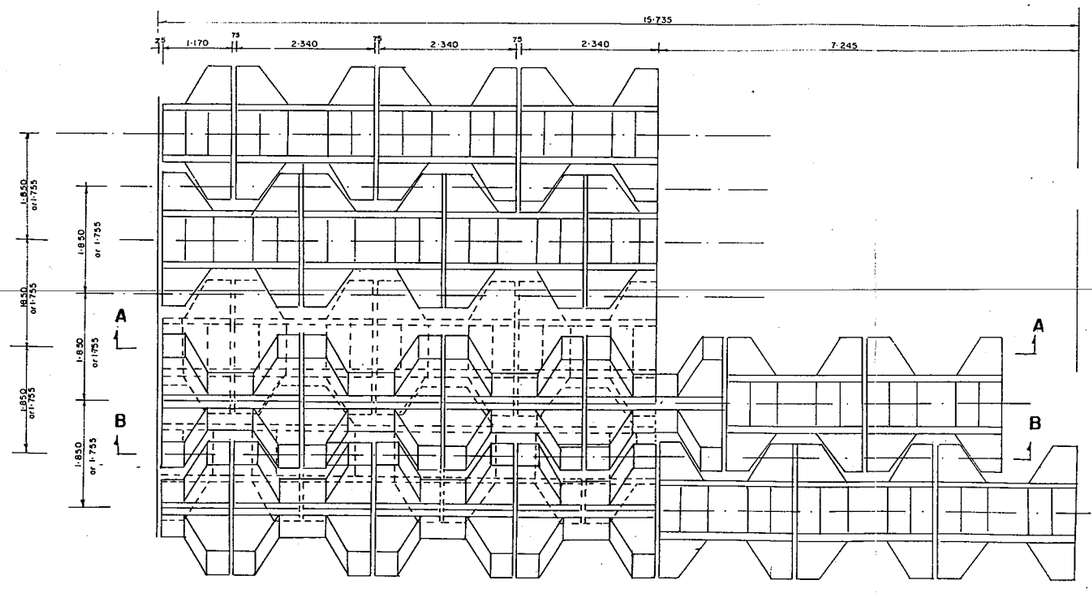
AS BUILT DRAWING
DETAILS OF LEFT SIDE WALL AND SLOPE PROTECTION

DESIGNED BY	CHECKED BY
DRAWN BY	APPROVED BY
DATE 30 JUNE 1985	DWG NO. ABD/RW-006

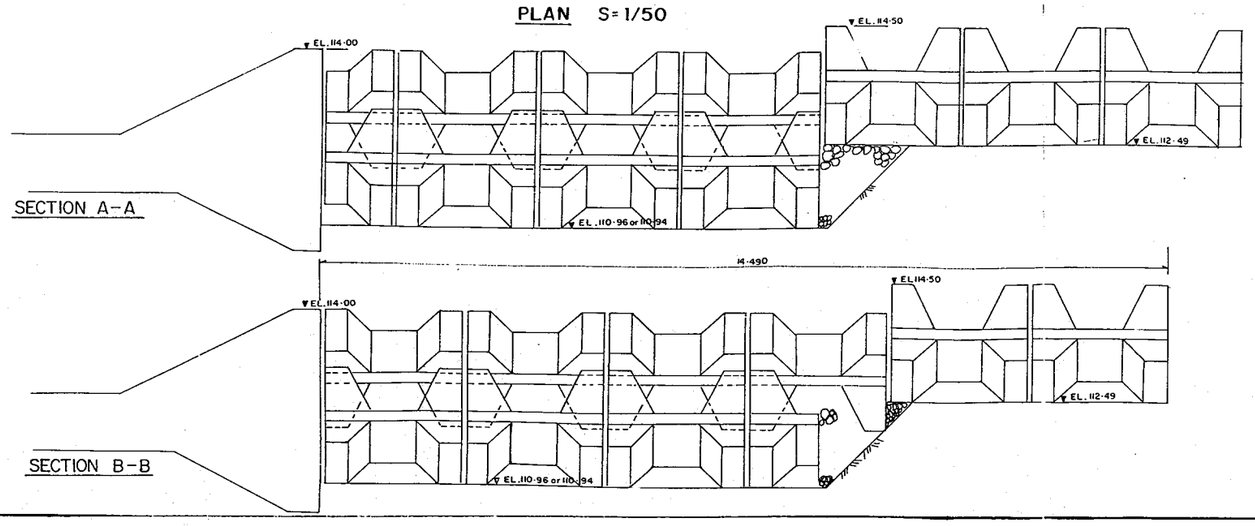
NIPPON KOEI CO., LTD TOKYO

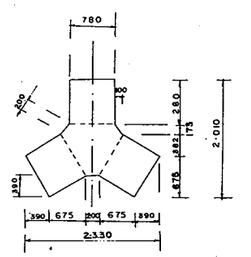


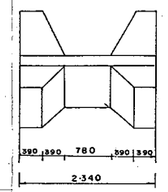
SECTION S = 1/50



PLAN S= 1/50







DIMENSION OF PRECAST CONCRETE BLOCK S= 1/50

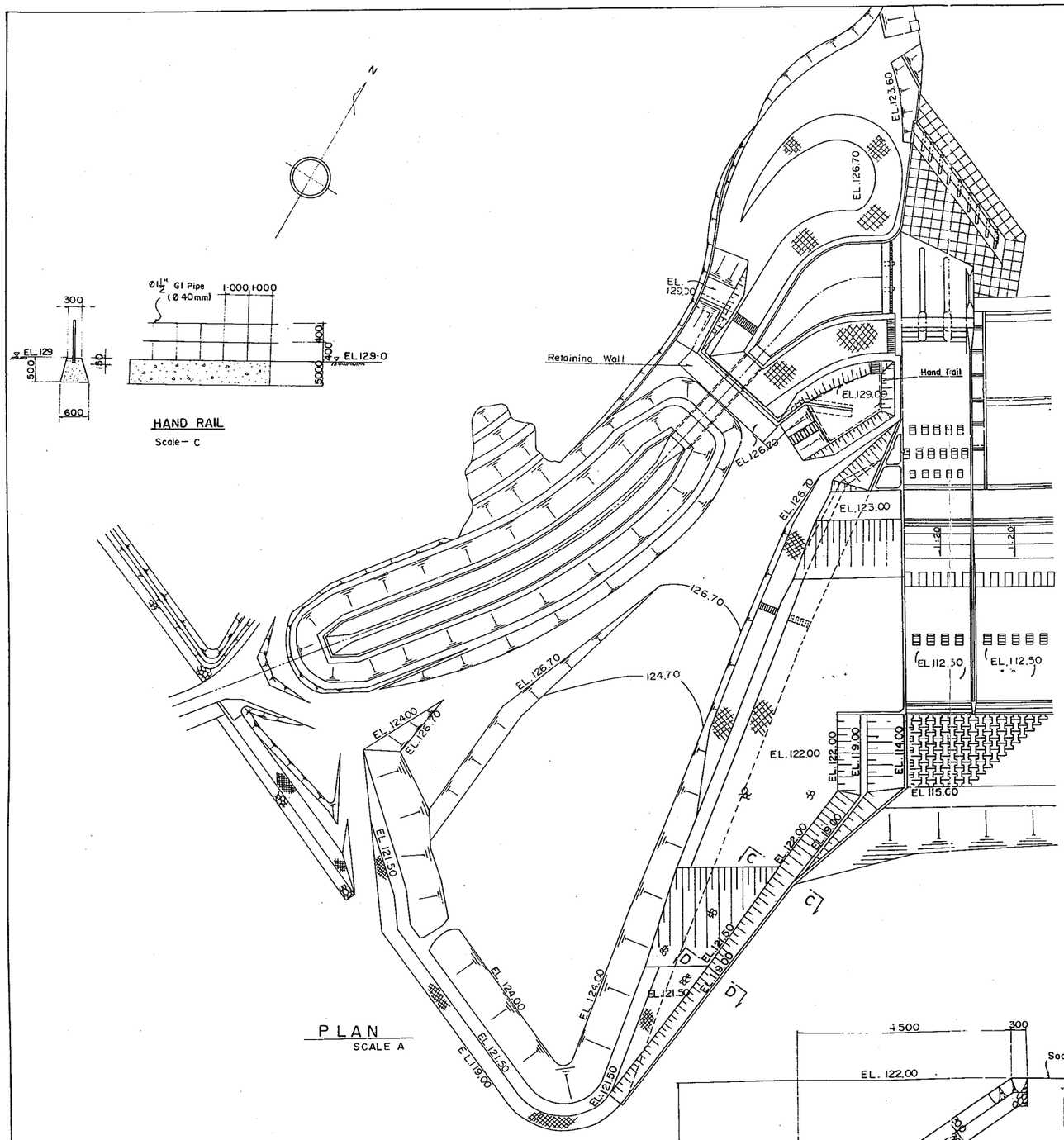
HIS MAJESTY'S GOVERNMENT OF NEPAL
KANKAI DEVELOPMENT BOARD
KANKAI DIVERSION STRUCTURE REMEDIAL WORKS PROJECT

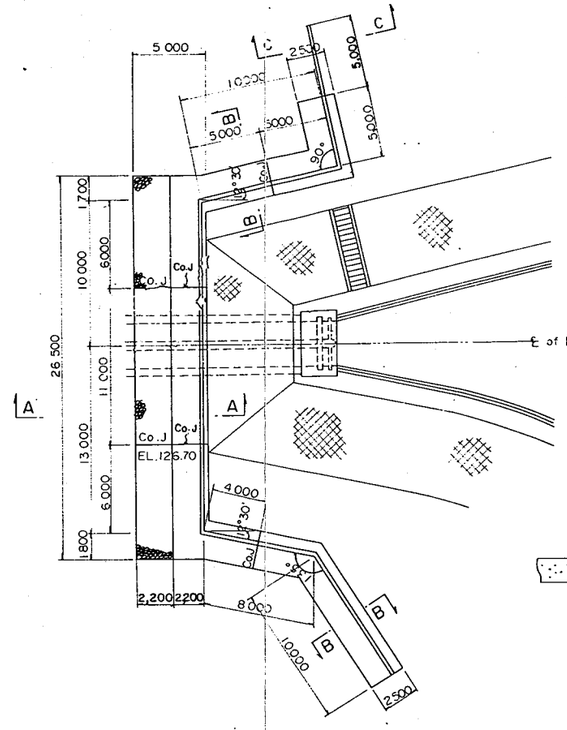
AS BUILT DRAWING

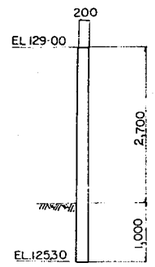
DETAILS OF LAUNCHING APRON

PREPARED	VERIFIED
CHECKED	APPROVED
DATE 30 JUNE 1985	DRW. NO. ABD/RW - 007

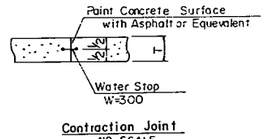
NIPPON KOEI CO, LTD., TOKYO





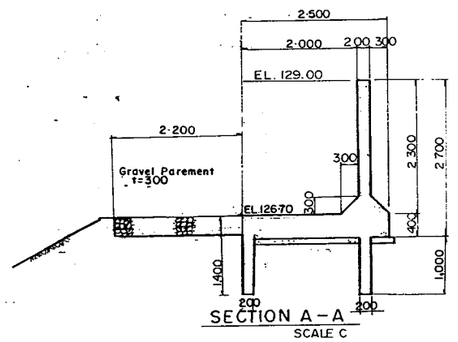


SECTION C–C
Scale– C

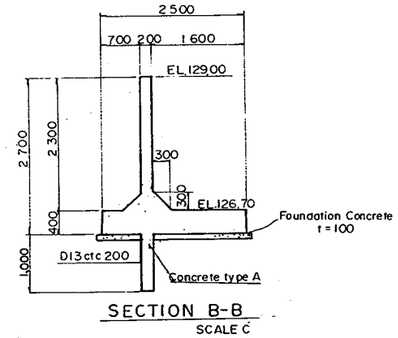


Contraction Joint
NO SCALE

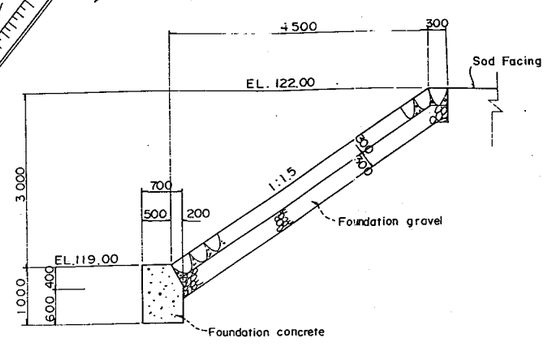
PLAN OF RETAINING WALL
SCALE B



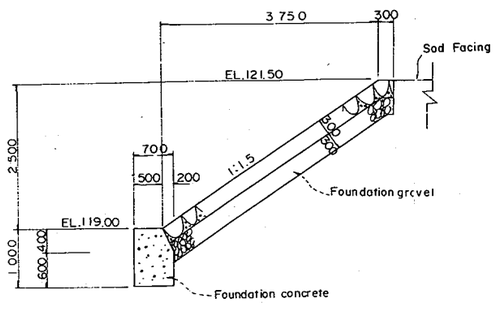
SECTION A–A
SCALE C



SECTION B–B
SCALE C



SECTION C–C
SCALE C



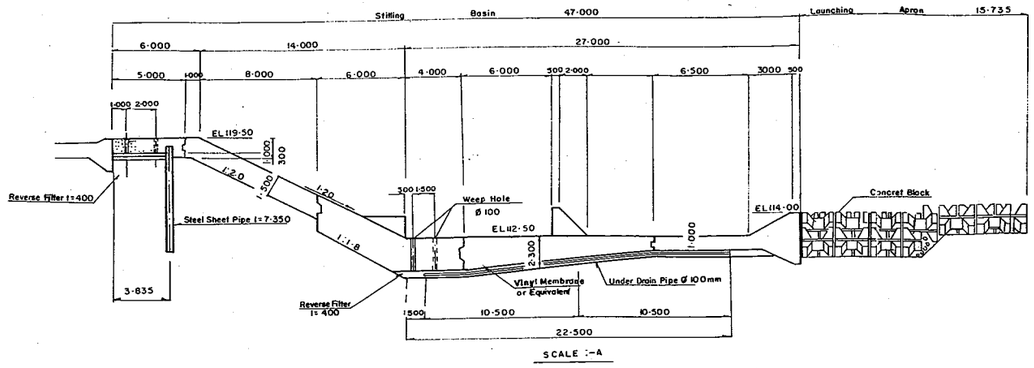
SECTION D–D
SCALE C

HIS MAJESTY S GOVERNMENT OF NEPAL
KANKAI DEVELOPMENT BOARD
KANKAI DIVERSION STRUCTURE REMEDIAL WORKS PROJECT

AS BUILT DRAWING
PROTECTION WORKS OF RIGHT BANK

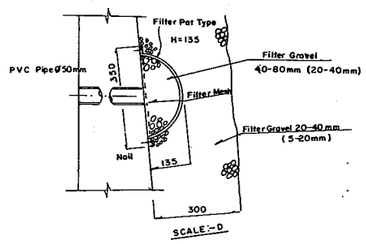
DESIGNED BY	CHECKED BY
DRAWN BY	APPROVED BY
DATE 30 JUNE 1985	DWG NO. ABD/RW-008.

NIPPON KOEI CO., LTD TOKYO



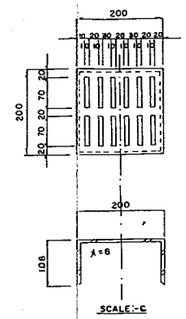
PROFILE

Scale:- **A**



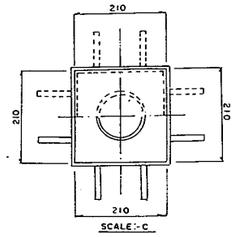
WEEP HOLE FOR VERTICA WALL

Scale : - D



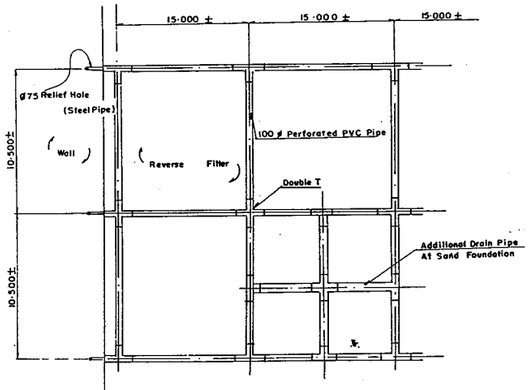
STEEL PLATE WITH SLIT

Scale:- **C**

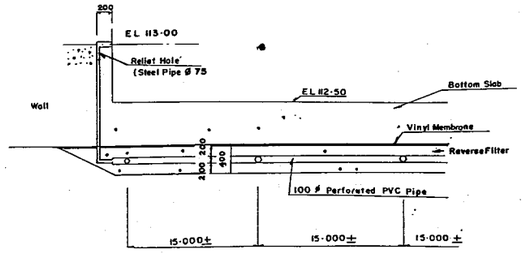


PLAN

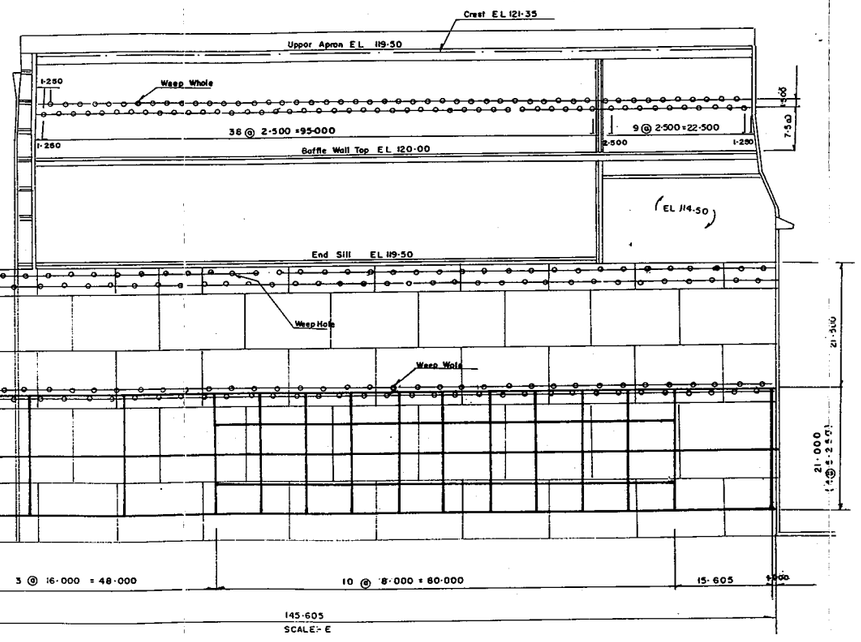
Scale :- C



TYPICAL PIPE ARRANGEMENT

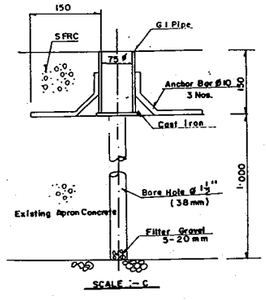


TYPICAL SECTION OF RELIEF PIPE & DRAIN PIPE



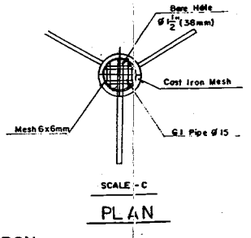
PLAN OF UNDER DRAIN PIPE & WEEP HOLE

Scale :- E

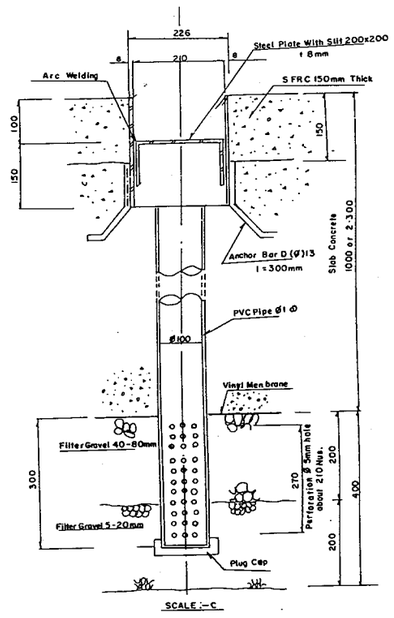


WEEP HOLE FOR EXISTING WEIR APRON

(PROFILE)



PLAN



WEEP HOLE FOR STILLING BASIN SLAB

(PROFILE)

SCALE A 0 10M

SCALE B 0 0·5 1·0 1·5M

SCALE C 0 0·1 0·2 0·3 M

SCALE D 0 0·1 0·2 0·3 0·4 0·5 M

SCALE E 0 5 10 15 20 25 M

HIS MAJESTY'S GOVERNMENT OF NEPAL
KANKAI DEVELOPMENT BOARD
KANKAI DIVERSION STRUCTURE REMEDIAL WORKS PROJECT

AS BUILT DRAWING

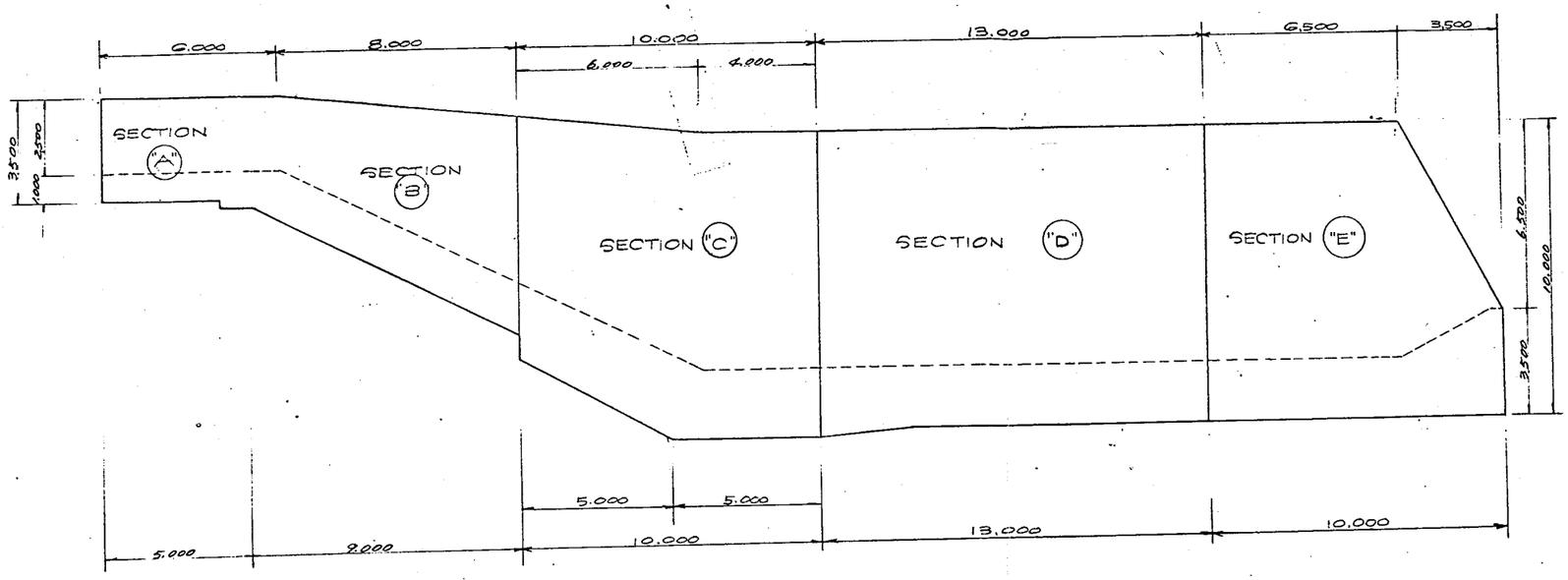
DETAILS OF UNDERDRAIN SYSTEM AND WEEPHOLES

PREPARED	VERIFIED
CHECKED	APPROVED
DATE 30 JUNE 1985	DRW. NO. ABD/RW—009

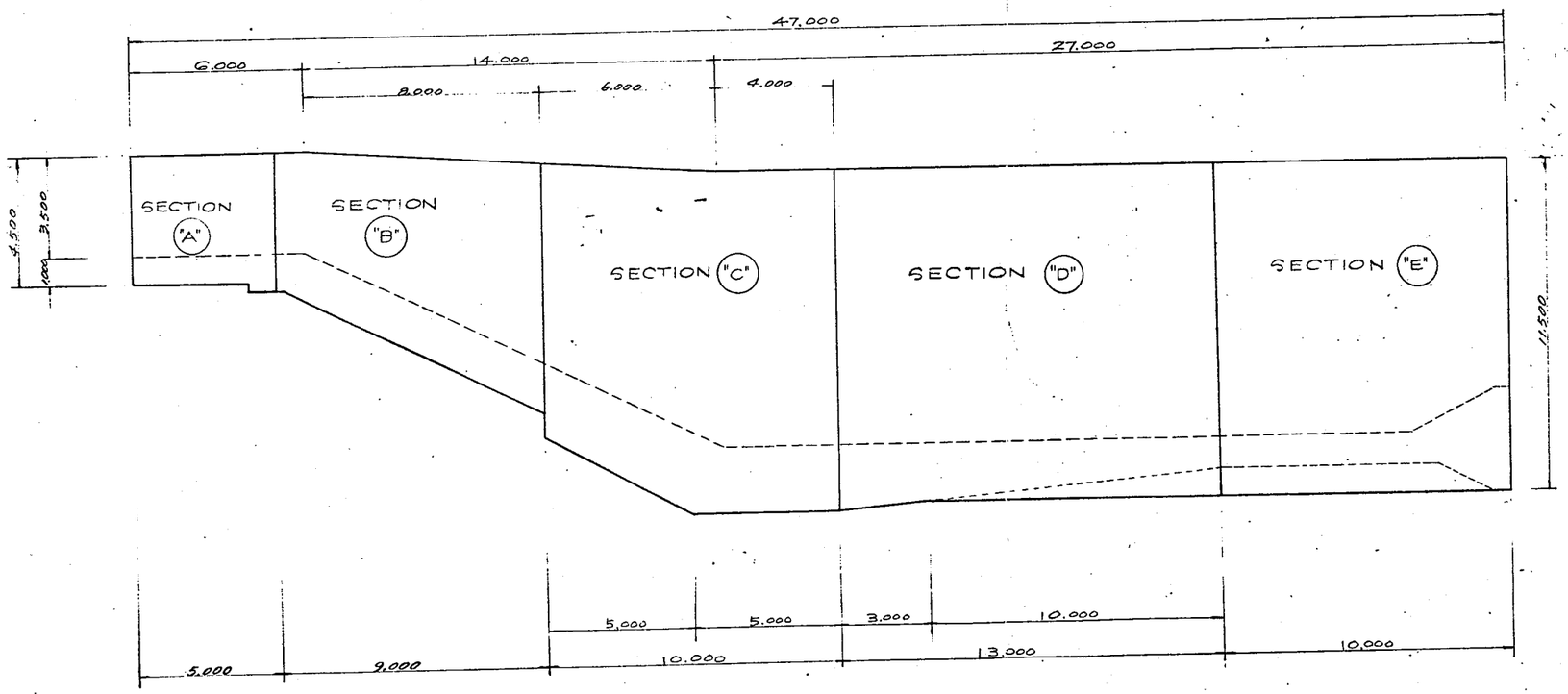
NIPPON KOEI CO, LTD., TOKYO

ANNEX - 3

WORKING DRAWINGS



W2 GUIDE WALL



W1 SIDE WALL FOR RIGHT BANK

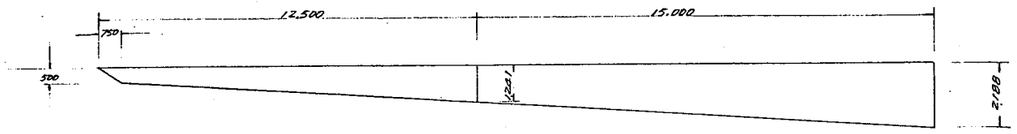
HIS MAJESTY'S GOVERNMENT OF NEPAL
KANKAI DEVELOPMENT BOARD
KANKAI DIVERSION STRUCTURE
REMEDIAL WORKS PROJECT

SHOP DWG.

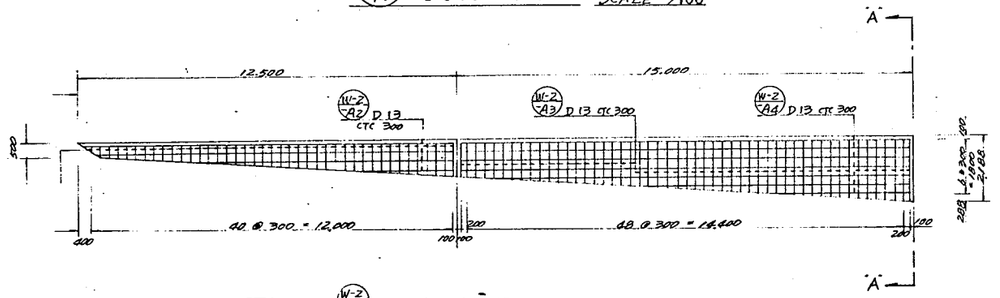
GUIDE WALL & RIGHT BANK PROFILE, PRECAST CONC. BLOCK

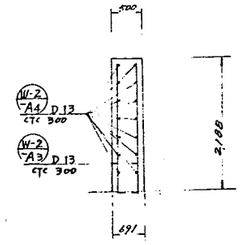
DESIGNED BY:	CHECKED BY:
DRAWN BY: PARK	APPROVED BY:
DATE: 8/7/84	DWG NO: SD.001
KOEI DEVELOPMENT CORP	

Approved by KIP/RRDC/DE on 4 Jan. '85

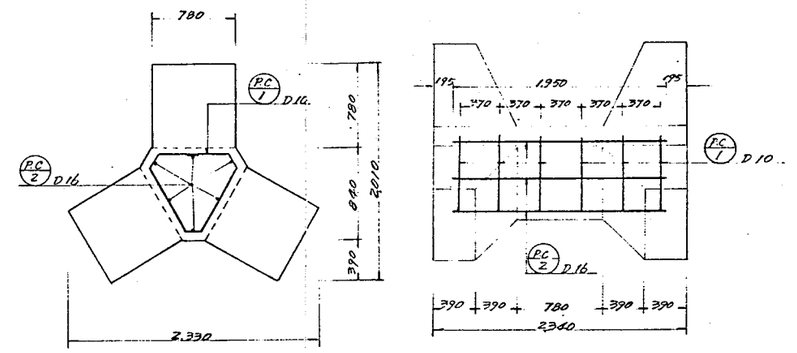


W2 -A GUIDE WALL SCALE 1/100





SECTION A-A SCALE 1/50



PRECAST CONCRETE BLOCK

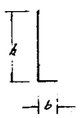
W-2 A1 D 13 L= 65.054

NO	h	b	NOS	T.l
1	167	0.100	2	0.534
2	367	"	2	0.934
3	416	"	2	1.032
4	435	"	2	1.070
5	454	"	2	1.108
6	473	"	2	1.146
7	492	"	2	1.184
8	511	"	2	1.222
9	530	"	2	1.260
10	548	"	2	1.296
11	567	"	2	1.334
12	586	"	2	1.372
13	605	"	2	1.410
14	624	"	2	1.448
15	643	"	2	1.486
16	662	"	2	1.524
17	681	"	2	1.562
18	700	"	2	1.600
19	719	"	2	1.638
20	738	"	2	1.676
21	757	"	2	1.714
22	776	"	2	1.752
23	794	"	2	1.788
24	813	"	2	1.826
25	832	"	2	1.864
26	851	"	2	1.902
27	870	"	2	1.940
28	889	"	2	1.978
29	908	"	2	2.016
30	927	"	2	2.054
31	946	"	2	2.092
32	965	"	2	2.130
33	984	"	2	2.168
34	1003	"	2	2.206
35	1021	"	2	2.242
36	1040	"	2	2.280
37	1059	"	2	2.318
38	1078	"	2	2.356
39	1097	"	2	2.394
40	1116	"	2	2.432
41	1135	"	2	2.470
TOTAL				69.758

-(0.056 × 84) = 65.054

W-2 A3 D 13 L= 169.172

NO	h	b	NOS	T.l
1	1148	0.100	2	2.496
2	1160	"	2	2.520
3	1179	"	2	2.558
4	1198	"	2	2.596
5	1217	"	2	2.634
6	1236	"	2	2.672
7	1255	"	2	2.710
8	1274	"	2	2.748
9	1293	"	2	2.786
10	1312	"	2	2.824
11	1330	"	2	2.860
12	1349	"	2	2.898
13	1368	"	2	2.936
14	1387	"	2	2.974
15	1406	"	2	3.012
16	1425	"	2	3.050
17	1444	"	2	3.088
18	1463	"	2	3.126
19	1482	"	2	3.164
20	1501	"	2	3.202
21	1520	"	2	3.240
22	1539	"	2	3.278
23	1558	"	2	3.316
24	1577	"	2	3.354
25	1596	"	2	3.392
26	1615	"	2	3.430
27	1633	"	2	3.466
28	1652	"	2	3.504
29	1671	"	2	3.542
30	1690	"	2	3.580
31	1709	"	2	3.618
32	1728	"	2	3.656
33	1747	"	2	3.694
34	1766	"	2	3.732
35	1785	"	2	3.770
36	1804	"	2	3.808
37	1823	"	2	3.846
38	1842	"	2	3.884
39	1861	"	2	3.922
40	1880	"	2	3.960
41	1899	"	2	3.998
42	1918	"	2	4.036
43	1936	"	2	4.072



NO	h	b	NOS	T.l
44	1955	0.100	2	4.110
45	1974	"	2	4.148
46	1993	"	2	4.186
47	2012	"	2	4.224
48	2031	"	2	4.262
49	2050	"	2	4.300
50	2069	"	2	4.338
51	2082	"	2	4.364
TOTAL				170.884

-(0.056 × 102) = 169.172

W-2 A2 D 13 L= 73.282

NO	l	Lap	NOS	T.l
1	12250	0390	2	25.280
2	11.800	-	2	23.600
3	8479	-	2	16.958
4	3722	-	2	7.444
TOTAL				73.282

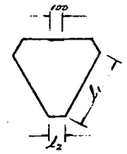
W-2 A4 D 13 L= 177.582

NO	l	Lap	NOS	T.l
1-4	14.800	0390	8	121.520
5	13965	0390	2	28.710
6	9214	-	2	18.428
7	4462	-	2	8.924
TOTAL				177.582

P.C 1 D 10 L= 10,974.288

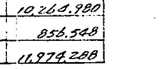
TYPE	l_1	l_2	LAP	NOS	T.l
A	658 × 3	64 × 3	100	6 × 755	10,264.980
B	658 × 3	64 × 3	100	3 × 126	856.548
TOTAL					11,974.288

-(0.005 × (6×755×6 + 3×126×6)) = 10,974.288



P.C 2 D 16 L= 9,638.300

TYPE	l	NOS	T.l
A	1,950	755 × 6	8,833,500
B	0.800	126 × 4	604,800
TOTAL			9,438,300



HIS MAJESTY'S GOVERNMENT OF NEPAL
KANKAI DEVELOPEMENT BOARD
KANKAI DIVERSION STRUCTURE
REMEDIAL WORKS PROJECT

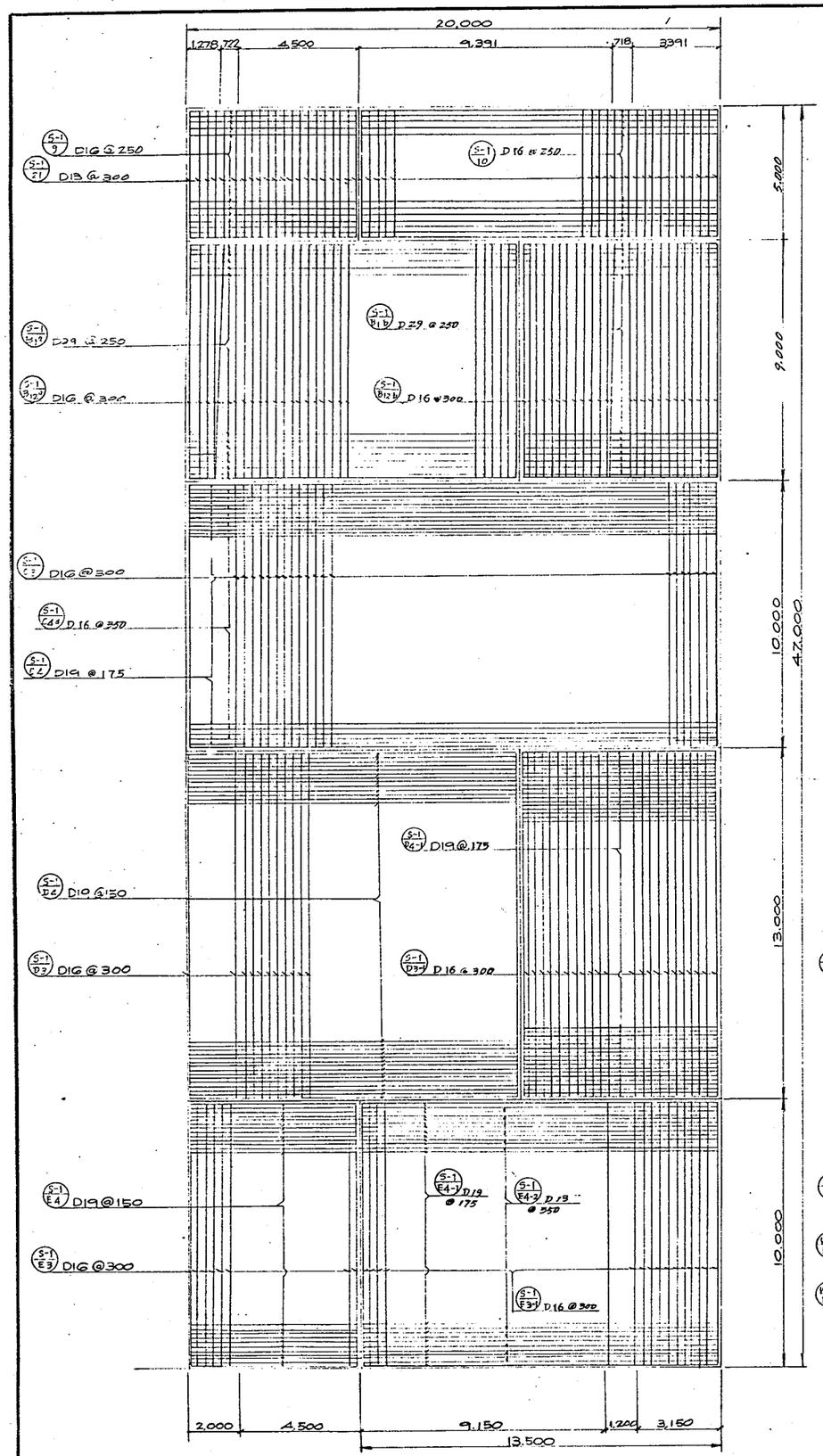
SHOP DWG

REINFORCEMENT BAR FOR
GUIDE WALL AND
PRECAST CONCRETE BLOCK

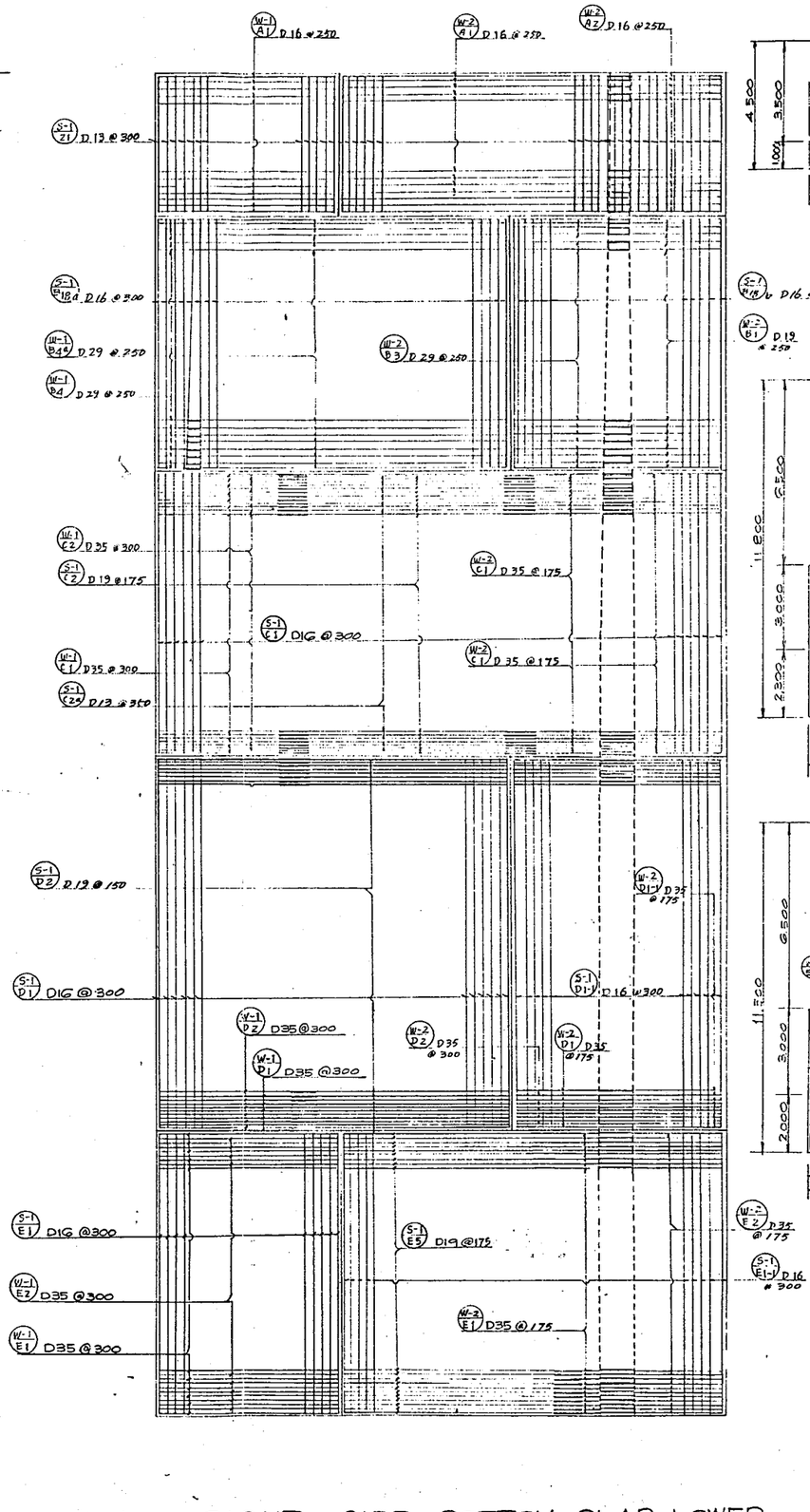
DESIGNED BY:	CHECKED BY:
DRAWN BY:	APPROVED BY:
DATE: 3 NOV 1984	DWG NO: SD. 001 A

KOREA DEVELOPMENT CORPORATION

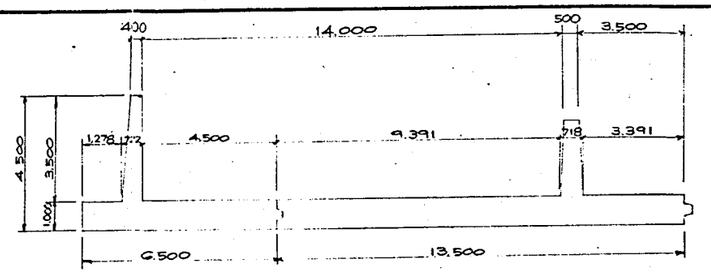
Approved by KIP Unit Office
on 4 Jan '85



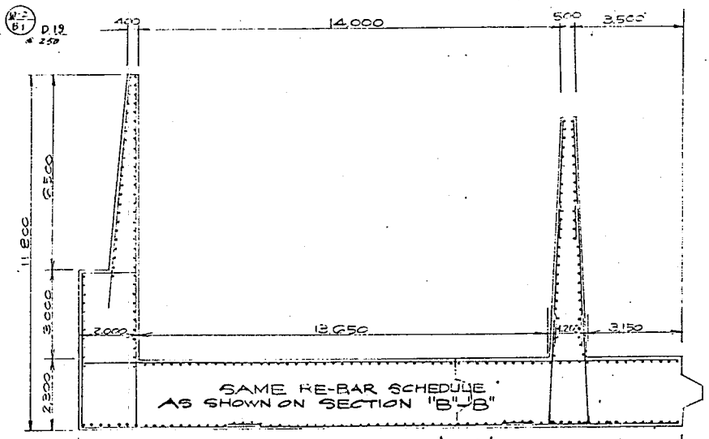
RIGHT SIDE BOTTOM SLAB UPPER



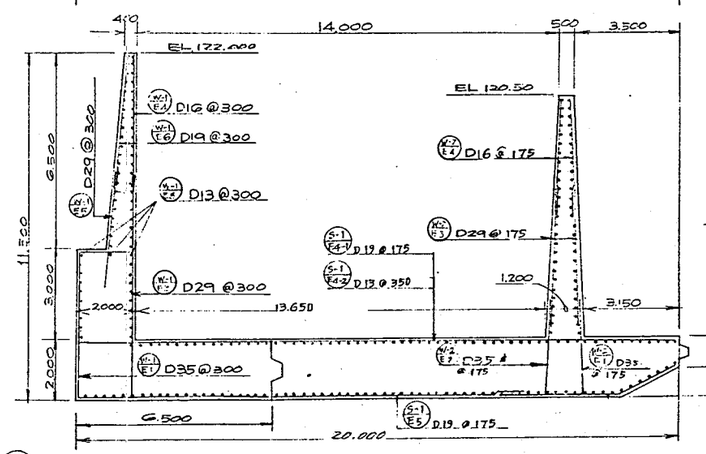
RIGHT SIDE BOTTOM SLAB LOWER



SECTION "A"-"A"



SECTION B'-B'



SECTION "E"-"E"

HIS MAJESTY'S GOVERNMENT OF NEPAL
KANKAI DEVELOPMENT BOARD
KANKAI DIVERSION STRUCTURE REMEDIAL WORKS PROJECT

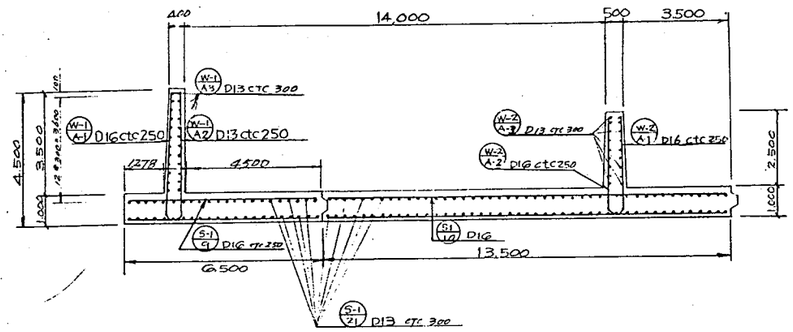
SHOP D.W.G

REINFORCEMENT BAR FOR RIGHT SIDE WALL PLAN

APPROVED BY:	CHECKED BY:
DRAWN BY: G. N. PARK	APPROVED BY:
DATE:	D.W.G. NO: SD 002

KOREA DEVELOPMENT CORP.

Approved by KIP/NKG on 4 Jan. '85



SECTION "A"-"A"

W-1 A1 D16 L= 206.178

NO	b	h	LAP	NOS	T.l
1-21	5.105	4.318	480	21	207.963

-(0.085 × 21) = 206.178

W-1 A2 D13 L= 126.924

NO.	b	h	LAP	NOS	T.l
1~21	1.800	4.360	-	21	128.100

-(a056 × 21) = 126.924

W-1 A3 D13 L= 115.200

NO	l	NOS	T.l
	4.800	12×2	115.200

W-2 A-1 DIG L= 286.755

NO.	b	h	LAP	NOS	T.l
	9.948	3.303	430	21	288.351

-(a076 × 21) = 286.755

W-2 A2 DIG L= 150.675

NO	b	h	LAP	NOS	T.l
	3.948	3.303	-	21	152.271

-(a076 × 21) = 150.675

W-2 A3 D13 L= 86.400

NO	l	NOS	T.l
	4.800	9×2	86.400

S-1 21 DIG L= 132.300

NO.	l	NOS	T.l
	6.300	21	132.300

S-1 10 DIG L= 289.380

NO.	l	LAP	NOS	T.l
	13.300	480	21	289.380

S-1 21 D13 L= 652.800

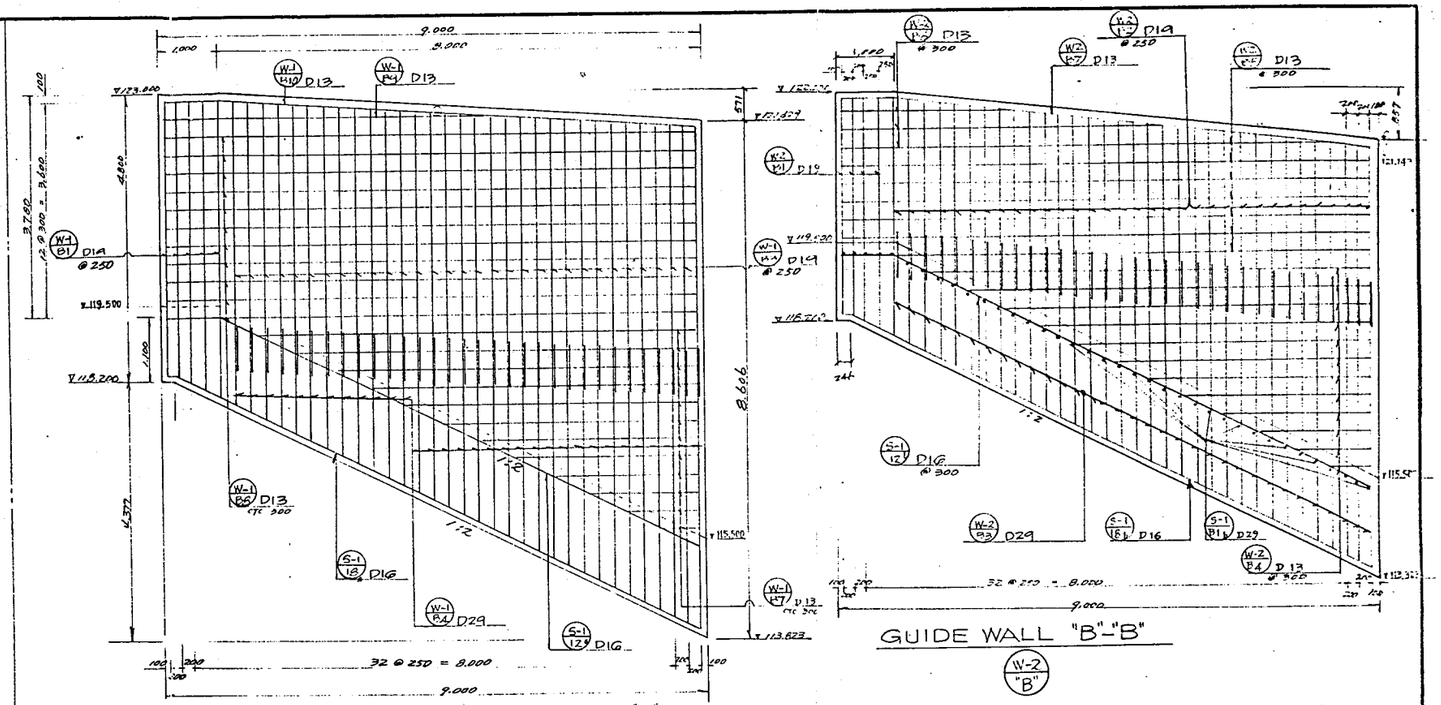
	l	NOS	T.l
	4.800	(22+66)×2	652.800

W-1 B3 D19 L= 144.000

	l	LAP	NOS	T.l
1-32	4.500	-	32	144.000

W-1 B16 D16 L= 144.000

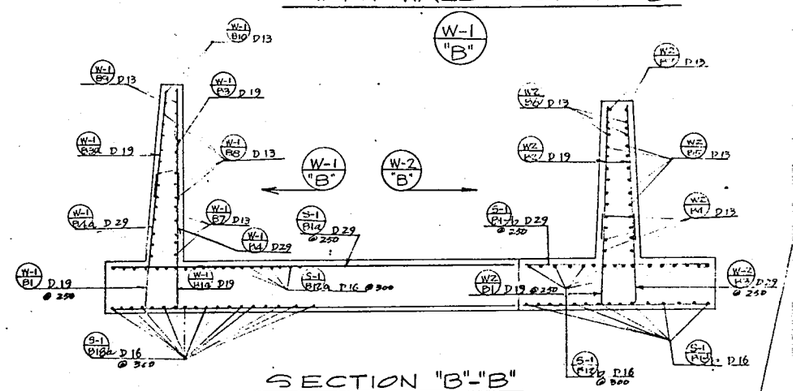
	l	LAP	NOS	T.l
1-32	4.500	-	32	144.000



RIGHT WALL SECTION "B"-"B"

GUIDE WALL "B"-"B"

W-2 "B"



SECTION "B"-"B"

NO.	b	h	LAP	NO	T.l
11	4.800	2.525	-	1	4.325
12	"	2.633	-	1	4.433
13	"	2.740	-	1	4.540
14	"	2.847	-	1	4.647
15	"	2.954	-	1	4.754
16	"	3.061	-	1	4.861
17	"	3.168	-	1	4.968
18	"	3.275	-	1	5.075
19	"	3.383	-	1	5.183
20	"	3.490	-	1	5.290
21	"	3.597	-	1	5.397
22	"	3.704	-	1	5.504
23	"	3.811	-	1	5.611
24	"	3.918	-	1	5.718
25	"	4.025	-	1	5.825
26	"	4.133	-	1	5.933
27	"	4.240	-	1	6.040
28	"	4.347	-	1	6.147
29	"	4.454	-	1	6.254
30	"	4.561	-	1	6.361
31	"	4.667	-	1	6.467
32	"	4.733	-	1	6.533
TOTAL					157.207

-(a124 × 32) = 153.239

W-1 B1 D19 L= 81.965

NO	b	h	LAP	NOS	T.l
1	11.137	4.419	570	1	16.321
2	11.137	4.647	570	1	16.354
3	11.144	4.747	570	1	16.461
4	11.156	4.873	570	1	16.599
5	11.167	4.998	570	1	16.735
TOTAL					82.470

-(a101 × 5) = 81.965

W-1 B16 D16 L= 32.438

No	b	h	LAP	NOS	T.l
1	1.800	4.600	-	1	6.400
2	1.800	4.627	-	1	6.427
3	1.800	4.727	-	1	6.527
4	1.800	4.852	-	1	6.652
5	1.800	4.977	-	1	6.777
TOTAL					32.783

-(a069 × 5) = 32.438

W-1 P1 D29 L= 153.239

NO	b	h	LAP	NOS	T.l
1	1.800	1.451	-	1	3.251
2	"	1.561	-	1	3.361
3	"	1.668	-	1	3.468
4	"	1.775	-	1	3.575
5	"	1.883	-	1	3.683
6	"	1.990	-	1	3.790
7	"	2.097	-	1	3.897
8	"	2.204	-	1	4.004
9	"	2.311	-	1	4.111
10	"	2.418	-	1	4.218

W-1 R49 D29 L= 486.039

NO	b	h	LAP	NOS	T.l
1	11.179	1.475	570	1	13.524
2	11.187	1.583	"	1	13.632
3	11.199	1.690	"	1	13.759
4	11.209	1.798	"	1	13.877
5	11.218	1.905	"	1	13.993
6	11.228	2.013	"	1	14.111
7	11.238	2.121	"	1	14.229
8	11.248	2.228	"	1	14.346
9	11.258	2.336	"	1	14.464
10	11.268	2.444	"	1	14.582
11	11.278	2.551	"	1	14.699

WIDE DWG NO. SD 005

HIS MAJESTY'S GOVERNMENT OF NEPAL
KANKAI DEVELOPMENT BOARD
KANKAI DIVERSION STRUCTURE
REMEDIAL WORKS PROJECT

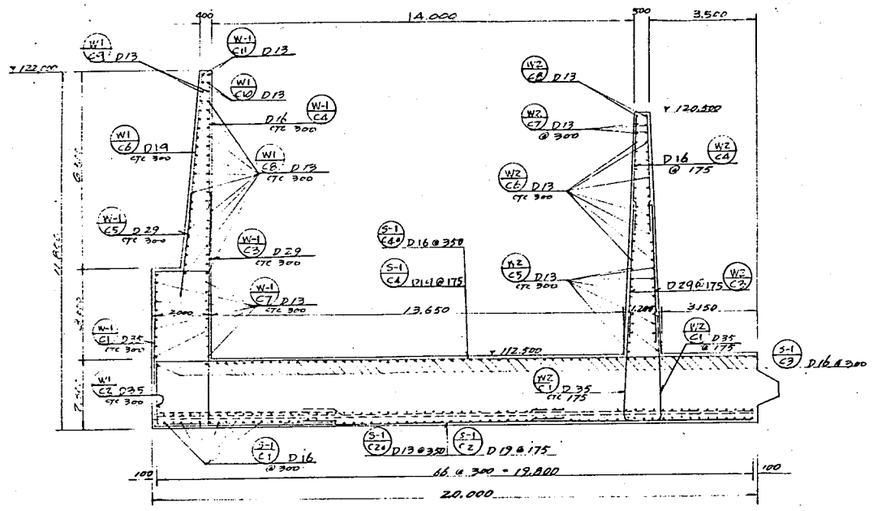
SHOP D.WG.

REINFORCEMENT BAR FOR
RIGHT BANK
SECTION "A"-"A"
SECTION "B"-"B"

DESIGNED BY:	CHECKED BY:
DRAWN BY:	APPROVED BY:
	DWG NO. SD 003

DATE: 4 Jan. '85

KAP/NADC-05/85 DEVELOPMENT CORP.



(W1 C1) D35 L= 444.158

No	l_1	l_2	h	LAP	Nos	T.l
1-14	5.950	1.800	5.100	1.225	14	197.050
15	"	"	"	"	1	14.075
16	"	"	"	"	1	14.075
17	"	"	"	"	1	14.075
18	"	"	5.016	"	1	13.991
19	"	"	4.848	"	1	13.823
20	"	"	4.680	"	1	13.655
21	"	"	4.512	"	1	13.487
22	"	"	4.344	"	1	13.319
23	"	"	4.176	"	1	13.151
24	"	"	4.008	"	1	12.983
25	"	"	3.840	"	1	12.815
26	"	"	3.672	"	1	12.647
27	"	"	3.504	"	1	12.479
28	"	"	3.336	"	1	12.311
29	"	"	3.168	"	1	12.143
30	"	"	3.006	"	1	11.981
31	"	"	2.843	"	1	11.818
32	"	"	2.681	"	1	11.656
33	"	"	2.518	"	1	11.493
34	"	"	2.356	"	1	11.331
TOTAL						454.358

-(0.150 x 2 x 34) = 444.158

(W-1 C2) D35 L= 270.663

No.	b	h	Nos	T.l
1-13	5.950	7.200	13	105.950
14	"	2.250	1	8.200
15	"	2.400	1	8.350
16	"	2.550	1	8.500
17	"	2.700	1	8.650
18	"	2.682	1	8.632
19	"	2.664	1	8.614
20	"	2.646	1	8.596
21	"	2.628	1	8.578
22	"	2.610	1	8.560
23	"	2.592	1	8.542
24	"	2.574	1	8.524
25	"	2.556	1	8.506
26	"	2.538	1	8.488
27	"	2.520	1	8.470
28	"	2.502	1	8.452
29	"	2.485	1	8.435
30	"	2.468	1	8.418
31	"	2.450	1	8.400
32	"	2.433	1	8.383
33	"	2.415	1	8.365
TOTAL				275.613

-(0.150 x 33) = 270.663

(W1 C2) D29 L= 247.808

No	l	Nos	T.l
1-14	8.250	14	112.200
15	8.200	1	8.200
16	8.350	1	8.350
17	8.500	1	8.500
18	7.916	1	7.916
19	7.748	1	7.748
20	7.580	1	7.580
21	7.412	1	7.412
22	7.244	1	7.244
23	7.076	1	7.076
24	6.908	1	6.908
25	6.740	1	6.740
26	6.572	1	6.572
27	6.404	1	6.404
28	6.236	1	6.236
29	6.068	1	6.068
30	5.906	1	5.906
31	5.743	1	5.743
32	5.581	1	5.581
33	5.418	1	5.418
34	5.256	1	5.256
TOTAL			247.808

(W1 C4) D16 L= 156.400

No.	h	Nos	T.l
1-14	4.470	14	62.580
13	4.498	1	4.498
16	4.509	1	4.509
17	4.531	1	4.531
18	4.552	1	4.552
19	4.574	1	4.574
20	4.595	1	4.595
21	4.616	1	4.616
22	4.638	1	4.638
23	4.659	1	4.659
24	4.681	1	4.681
25	4.702	1	4.702
26	4.724	1	4.724
27	4.745	1	4.745
28	4.766	1	4.766
29	4.788	1	4.788
30	4.809	1	4.809
31	4.830	1	4.830
32	4.850	1	4.850
33	4.871	1	4.871
34	4.892	1	4.892
TOTAL			156.400

(W1 C6) D29 L= 120.386

No	h	Nos	T.l
1-34	3.779	34	128.486
			128.486

(W1 C7) D13 L= 124.200

No.	l	Nos	T.l
1	4.550	2	9.000
2	5.100	2	10.200
3	5.700	2	11.400
4	6.300	2	12.600
5	6.900	2	13.800
6	7.500	2	15.000
7	8.100	2	16.200
8	8.700	2	17.400
9	9.300	2	18.600
TOTAL			124.200

(W1 C8) D19 L= 157.051

	h	Nos	T.l
1-14	4.489	14	62.846
15	4.509	1	4.509
16	4.530	1	4.530
17	4.550	1	4.550
18	4.571	1	4.571
19	4.592	1	4.592
20	4.614	1	4.614
21	4.635	1	4.635
22	4.657	1	4.657
23	4.678	1	4.678
24	4.700	1	4.700
25	4.721	1	4.721
26	4.743	1	4.743
27	4.764	1	4.764
28	4.786	1	4.786
29	4.807	1	4.807
30	4.828	1	4.828
31	4.849	1	4.849
32	4.869	1	4.869
33	4.890	1	4.890
34	4.911	1	4.911
TOTAL			157.051

(W1 C9) D13 L= 11.800

No.	l	Nos	T.l
	5.900	1x2	11.800
TOTAL			11.800

(W1 C10) D13 L= 3.408

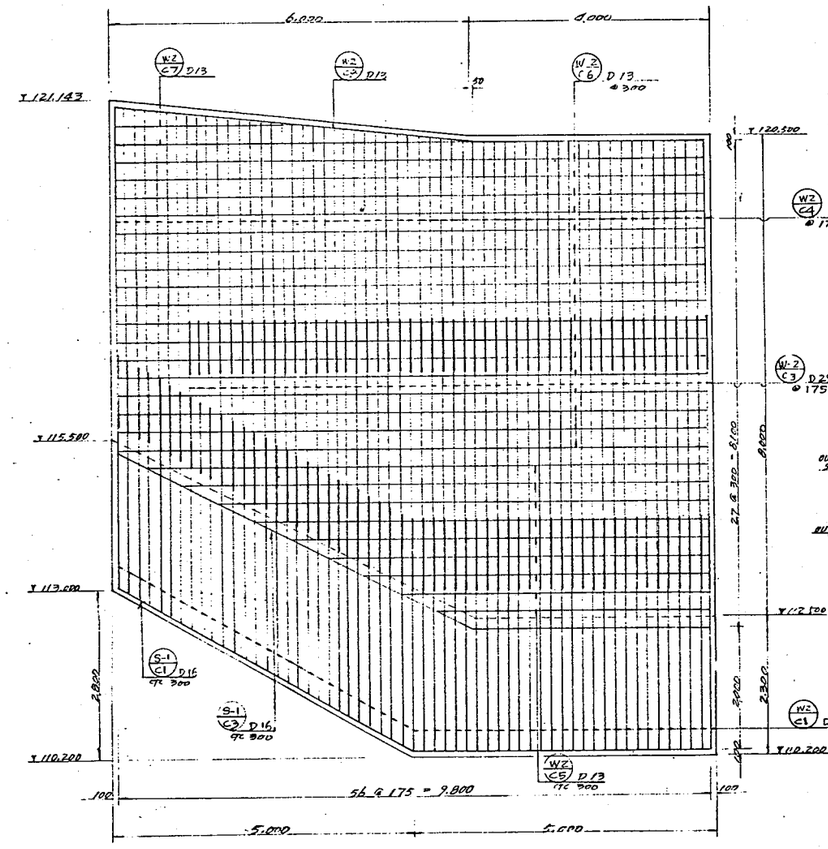
No	l	Nos	T.l
	1.704	1x2	3.408
TOTAL			3.408

(W1 C4) D13 L= 441.800

No	l	Nos	T.l
1	9.800	3	29.400
2-22	9.800	21x2	411.600
TOTAL			441.800

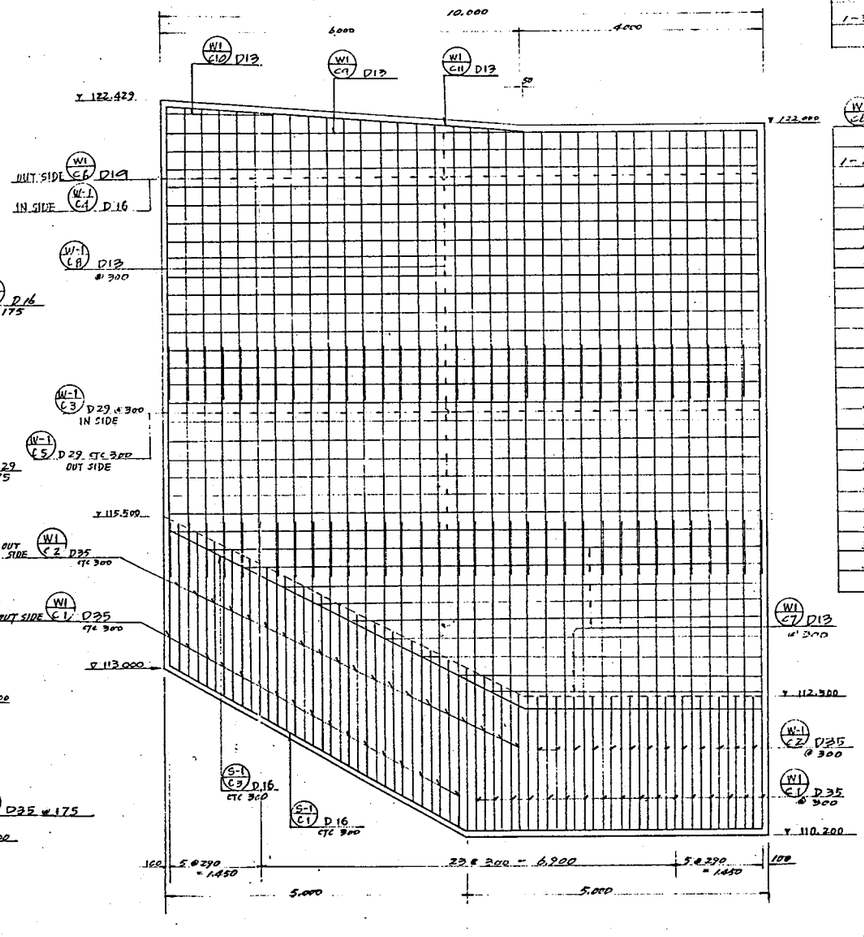
(W-1 C1) D13 L= 19.130

No	l_1	l_2	Nos	T.l
	5.915	3.700	1x2	19.630
TOTAL				19.630



GUIDE WALL

W2 C



RIGHIT BANK "C"-"C"

W1 C

Approved by HIP/NKDC-05/85
on 4 Jan. '85

HIS MAJESTY'S GOVERNMENT OF NEPAL
KANKAI DEVELOPMENT BOARD
KANKAI DIVERSION STRUCTURE
REMEDIAL WORKS PROJECT

SHOP DWG

REINFORCEMENT BAR FOR
RIGHT BANK

SECTION "C"-"C"

DESIGNED BY:	CHECKED BY:
DRAWN BY:	APPROVED BY:
DATE:	DWG NO: SD 004

KORIEA DEVELOPMENT CORP.

W-1 A4 D 29

No	b	h	LAP	Nos	T.l
12	11287	2659	.870	1	14.816
13	11297	2766	"	1	14.933
14	11307	2874	"	1	15.051
15	11317	2982	"	1	15.169
16	11327	3089	"	1	15.284
17	11337	3197	"	1	15.404
18	11347	3305	"	1	15.522
19	11357	3412	"	1	15.639
20	11366	3520	"	1	15.756
21	11376	3627	"	1	15.873
22	11386	3735	"	1	15.991
23	11396	3843	"	1	16.109
24	11406	3950	"	1	16.226
25	11416	4058	"	1	16.344
26	11426	4166	"	1	16.462
27	11435	4273	"	1	16.578
28	11445	4381	"	1	16.696
29	11455	4488	"	1	16.813
30	11465	4596	"	1	16.931
31	11473	4682	"	1	17.025
32	11481	4768	"	1	17.119
TOTAL					490.967

-(490.967-(0.154×32))= 486.039

J1 8.654, J2 7.875, 4227

S-1 P10 D16 L= 700.468

	l_1	l_2	LAP	NO	T.l
a	.146	9.675	.420	42	432.642
b	.146	9.675	.420	21	267.826
TOTAL					700.468

J1 7.900, J2 8.832, 3.900

S-1 P12 D16 L= 694.416

	l_1	l_2	LAP	NO	T.l
a	.900	8.532	.480	42	428.904
b	.920	8.932	.480	21	265.512
TOTAL =					694.416

W-1 B8 D13 L= 193.600

	l	NOS	T.l
	8.800	11×2	193.600
TOTAL			193.600

8.800, l

W-1 B7 D13 L= 96.000

	l	NOS	T.l
1	7.300	2	14.600
2	6.700	2	13.400
3	6.100	2	12.200
4	5.500	2	11.000
5	4.900	2	9.800
6	4.300	2	8.600
7	3.700	2	7.400
8	3.100	2	6.200
9	2.500	2	5.000
10	1.900	2	3.800
11	1.300	2	2.600
12	700	2	1.400
TOTAL			96.000

l

W-1 B9 D13 L= 10.204

	l	NOS	T.l
	5.102	2	10.204
TOTAL =			10.204

l

J1 7.900, J2, 3.900

W-1 B10 D13 L= 17.640

	l_1	l_2	NOS	T.l
	.900	7.920	2	17.640
TOTAL				17.640

l

S-1 B1 D29 L= 725.200

	l	NOS	T.l
a	17.350	47	455.100
b	7.300	37	270.100
TOTAL			725.200

l, b

W-2 B1 D17 L= 60.714

No.	b	h	NOS	T.l
1	3.452	3.603	2	15.130
2	3.963	3.630	2	15.186
3	3.917	3.731	2	15.346
4	3.973	3.856	2	15.618
TOTAL				61.370

-(0.082×8)= 60.714

W-2 A3 D29 L= 484.794

h, b

No	b	h	NOS	T.l
1	3.978	1.851	2	11.658
2	3.983	1.749	2	11.864
3	3.987	2.098	2	12.070
4	3.991	2.146	2	12.274
5	3.996	2.244	2	12.480
6	4.000	2.343	2	12.686
7	4.004	2.441	2	12.890
8	4.008	2.539	2	13.094
9	4.013	2.638	2	13.302
10	4.017	2.736	2	13.506
11	4.021	2.834	2	13.710
12	4.025	2.933	2	13.916
13	4.030	3.031	2	14.122
14	4.034	3.129	2	14.326
15	4.039	3.228	2	14.532
16	4.043	3.326	2	14.738
17	4.047	3.424	2	14.942
18	4.051	3.523	2	15.148
19	4.055	3.621	2	15.352
20	4.060	3.719	2	15.558
21	4.064	3.818	2	15.764
22	4.068	3.916	2	15.968
23	4.073	4.014	2	16.174
24	4.077	4.113	2	16.380
25	4.081	4.211	2	16.584
26	4.085	4.309	2	16.788
27	4.090	4.408	2	16.996
28	4.094	4.506	2	17.200
29	4.098	4.604	2	17.404
30	4.103	4.703	2	17.612
31	4.107	4.801	2	17.816
32	4.110	4.880	2	17.980
33	4.114	4.958	2	18.144
TOTAL				492.978

-(0.124×66)= 484.794

W-1 B11 D19 L= 198.000

	h	NOS	T.l
	3.000	33×2	198.000
TOTAL			198.000

h

SECTION "B"-"B"

W-2 B4 D13 L= 96.000

No	l	NOS	T.l
1	7.300	2	14.600
2	6.700	2	13.400
3	6.100	2	12.200
4	5.500	2	11.000
5	4.900	2	9.800
6	4.300	2	8.600
7	3.700	2	7.400
8	3.100	2	6.200
9	2.500	2	5.000
10	1.900	2	3.800
11	1.300	2	2.600
12	700	2	1.400
TOTAL =			96.000

l

W-2 B5 D13 L= 105.600

No	l	NOS	T.l
1~6	8.800	6×2	105.600
TOTAL			105.600

l

W-2 B6 D13 L= 33.414

	l	NOS	T.l
1	2.370	2	16.740
2	5.569	2	11.138
3	2.768	2	5.536
TOTAL			33.414

l

J1 7.900, J2, 3.900

W-2 B7 D13 L= 17.690

	l_1	l_2	NO	T.l
	.900	7.945	2	17.690
TOTAL				17.690

W-2 (1) D 75 L= 402.094

No	l	h	Nos	T.l
1-23	4.216	3.855	46	372.696
24	4.247	"	2	16.204
25	4.248	"	2	16.206
26	4.249	"	2	16.208
27	4.249	"	2	16.208
28	4.250	"	2	16.210
29	4.251	"	2	16.212
30	4.248	"	2	16.206
31	4.244	"	2	16.198
32	4.241	"	2	16.192
33	4.237	"	2	16.184
34	4.234	"	2	16.178
35	4.230	"	2	16.170
36	4.227	"	2	16.164
37	4.223	"	2	16.156
38	4.220	"	2	16.150
39	4.216	"	2	16.142
40	4.213	"	2	16.136
41	4.209	"	2	16.128
42	4.206	"	2	16.122
43	4.203	"	2	16.116
44	4.199	"	2	16.108
45	4.196	"	2	16.102
46	4.192	"	2	16.094
47	4.189	"	2	16.088
48	4.185	"	2	16.080
49	4.182	"	2	16.074
50	4.178	"	2	16.066
51	4.175	"	2	16.060
52	4.171	"	2	16.052
53	4.168	"	2	16.046
54	4.164	"	2	16.038
55	4.161	"	2	16.032
56	4.157	"	2	16.024
57	4.154	"	2	16.018
TOTAL				921.018

-(0.166×114)= 902.094

SECTION "C"-"C"

W-2 C3 D 29 L= 404.680

No	h	Nos	T.l
1-29	4.520	58	261.000
30	4.402	2	8.804
31	4.304	2	8.608
32	4.206	2	8.412
33	4.108	2	8.216
34	4.010	2	8.020
35	3.911	2	7.822
36	3.813	2	7.626
37	3.715	2	7.430
38	3.617	2	7.234
39	3.519	2	7.038
40	3.421	2	6.842
41	3.323	2	6.646
42	3.225	2	6.450
43	3.127	2	6.254
44	3.029	2	6.058
45	2.930	2	5.860
46	2.832	2	5.664
47	2.734	2	5.468
48	2.636	2	5.272
49	2.538	2	5.076
50	2.440	2	4.880
TOTAL			404.680

W-2 C4 D16 L= 477.338

No.	h	Nos	T.l
1-23	3.850	46	177.100
24	3.863	2	7.726
25	3.882	2	7.764
26	3.901	2	7.802
27	3.919	2	7.838
28	3.938	2	7.876
29	3.957	2	7.914
30	3.976	2	7.952
31	3.995	2	7.990
32	4.013	2	8.026
33	4.032	2	8.064
34	4.051	2	8.102
35	4.070	2	8.140
36	4.088	2	8.176
37	4.107	2	8.214
38	4.126	2	8.252
39	4.145	2	8.290
40	4.163	2	8.326
41	4.182	2	8.364
42	4.201	2	8.402
43	4.220	2	8.440
44	4.239	2	8.476
45	4.257	2	8.514
46	4.276	2	8.552
47	4.295	2	8.590
48	4.313	2	8.626
49	4.332	2	8.664
50	4.351	2	8.702
51	5.842	2	11.684
52	5.763	2	11.526
53	5.683	2	11.366
54	5.604	2	11.208
55	5.525	2	11.050
56	5.445	2	10.890
57	5.366	2	10.732
TOTAL			477.338

S-1 C2 D16 L= 735.392

l_1	l_2	LAP	Nos	T.l
6.596	3.900	480	67	735.392

6.596, 480, 5.900, 3.900, 3.900

W-2 C5 D13 L= 124.200

No	l	Nos	T.l
1	4.500	2	9.000
2	5.100	2	10.200
3	5.700	2	11.400
4	6.300	2	12.600
5	6.900	2	13.800
6	7.500	2	15.000
7	8.100	2	16.200
8	8.700	2	17.400
9	9.300	2	18.600
TOTAL			124.200

W-2 C6 D13 L= 333.200

NO.	l	Nos	T.l
	9.800	17×2	333.200

W-2 C7 D13 L= 18.000

No	l	Nos	T.l
-1	5.900	2	11.800
-2	3.100	2	6.200
TOTAL			18.000

W-2 C8 D13 L= 19.668

l_1	l_2	Nos	T.l
5.934	3.900	2	19.668

5.700, 3.900, 5.934, 3.900

S-1 C2 D19 L= 1193.580

l	LAP	Nos	T.l
19.300	570×2	57	1193.580

S-1 C4 D16 L= 602.040

l	LAP	Nos	T.l
19.800	480×2	29	602.040

S-1 C1 D16 L= 736.732

l_1	l_2	LAP	Nos	T.l
5.616	4.900	480	67	736.732

5.616, 4.900, 4.900, 4.900, 2.744

S-1 C2 D19 L= 513.000

l	Nos	T.l
9.000	57	513.000

S-1 C24 D13 L= 261.000

l	Nos	T.l
9.000	29	261.000

HIS MAJESTY'S GOVERNMENT OF NEPAL
KANKAI DEVELOPMENT BOARD
KANKAI DIVERSION STRUCTURE
REMEDIAL WORKS PROJECT.

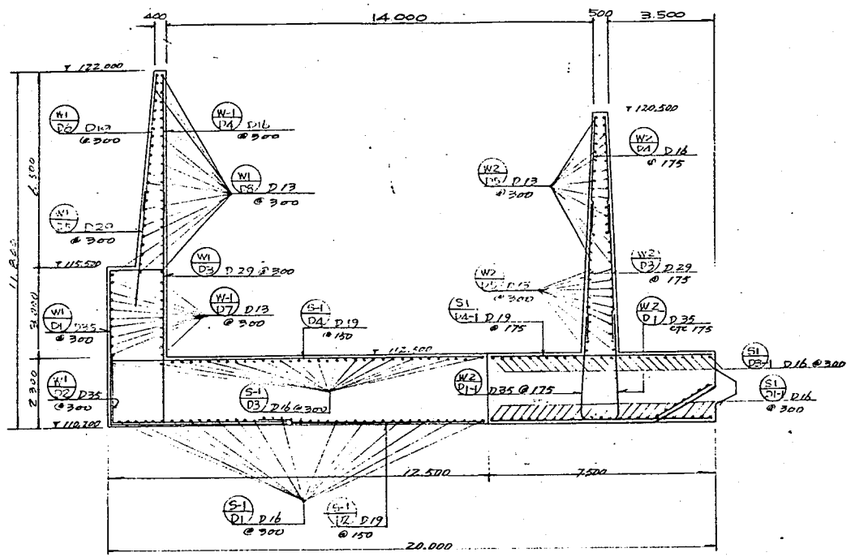
SHOP DWG.

REINFORCEMENT BAR FOR RIGHT BANK
1) SECTION "B"-"B"
2) SECTION "C"-"C"

DESIGNED BY:	CHECKED BY:
DRAWN BY:	APPROVED BY:
	DWG. NO. SD 005

KOREA DEVELOPMENT CORP.

Approved by KDP/NEPAL-05/85 on 4 Sep. '85



SECTION 'D'-'D'

S-1 D3 D16 L= 491.360

NO	l	LAP	NOS	T.l
	12.800	490	37	491.360
TOTAL				491.360

S-1 D4 D19 L= 1119.690

NO	l	LAP	NOS	T.l
	12.300	370	87	1119.690
TOTAL				1119.690

W-1 D6 D19 L= 197.516

	h	NOS	T.l
1-44	4489	44	197.516

W-1 D8 D13 L= 619.730

NO	l	LAP	NOS	T.l
1	12.800	390	3	39.570
2-23	12.800	390	22×2	580.360
TOTAL				619.930

W-1 D1 D35 L= 586.840

NO	l1	h	l2	LAP	NOS	T.l
1-34	1800	4.800	5775	1225	34	462.600
35	"	4.830	"	"	1	13.630
36	"	4.860	"	"	1	13.660
37	"	4.890	"	"	1	13.690
38	"	4.920	"	"	1	13.720
39	"	4.950	"	"	1	13.750
40	"	4.980	"	"	1	13.780
41	"	5.010	"	"	1	13.810
42	"	5.040	"	"	1	13.840
43	"	5.070	"	"	1	13.870
44	"	5.090	"	"	1	13.890
TOTAL						600.040

-(0.150×2×44) = 586.840

W-1 D3 D29 L= 340.440

NO	h	NOS	T.l
1-34	7.700	34	261.800
35	7.730	1	7.730
36	7.760	1	7.760
37	7.790	1	7.790
38	7.820	1	7.820
39	7.850	1	7.850
40	7.880	1	7.880
41	7.910	1	7.910
42	7.940	1	7.940
43	7.970	1	7.970
44	7.990	1	7.990
TOTAL			340.440

W-1 D2 D35 L= 325.070

NO	l	h	NOS	T.l
1-33	5.775	1.900	33	253.275
34	"	1.915	1	7.690
35	"	1.945	1	7.720
36	"	1.975	1	7.750
37	"	2.005	1	7.780
38	"	2.035	1	7.810
39	"	2.065	1	7.840
40	"	2.095	1	7.870
41	"	2.125	1	7.900
42	"	2.155	1	7.930
43	"	2.180	1	7.955
TOTAL				331.520

-(0.150 × 43) = 325.070

W1 D5 D29 L= 166.276

	h	NOS	T.l
1-44	3.779	44	166.276

W-1 D7 D13 L= 237.420

NO	l	LAP	NOS	T.l
1-2	12.800	390	2×2	237.420

S-1 D1 D16 L= 558.348

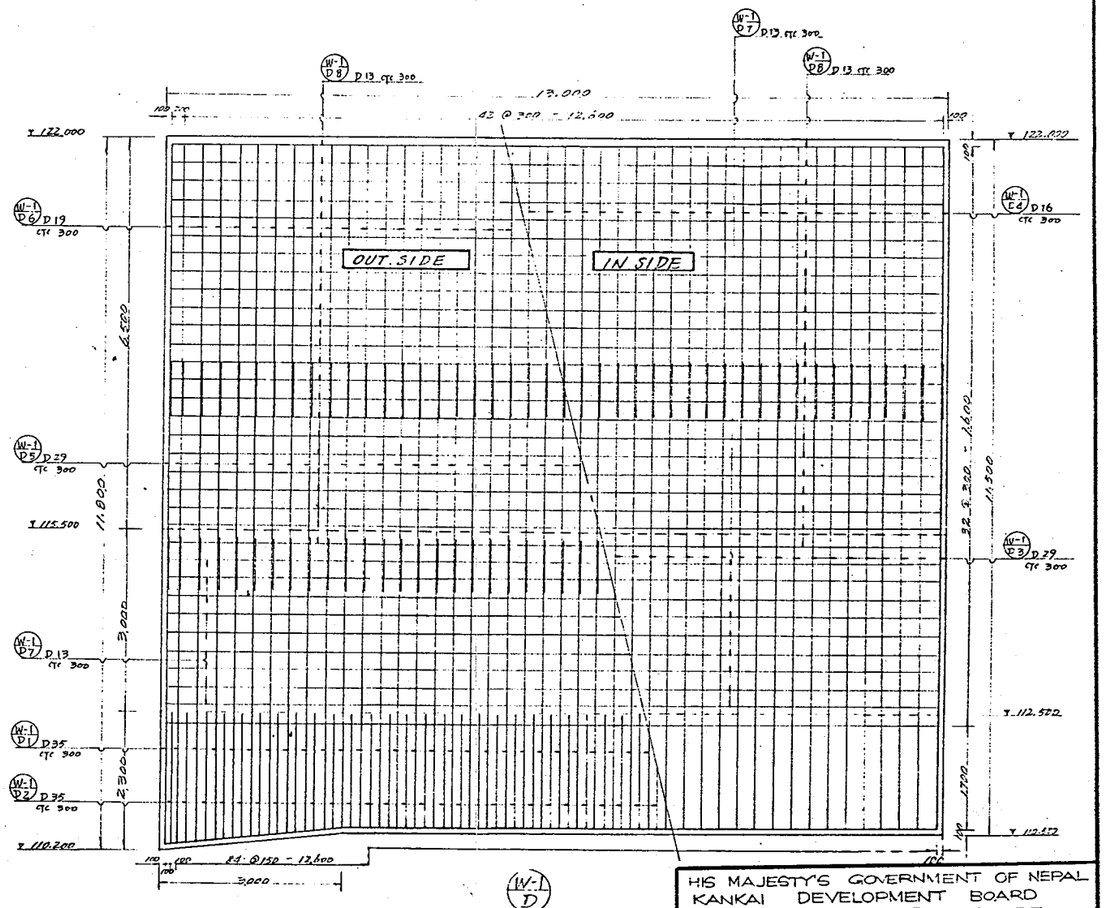
NO	l1	l2	LAP	NOS	T.l
1-42	2.918	9.900	490	42	558.348

W-1 D4 D16 L= 176.680

	h	NOS	T.l
1-44	4.070	44	176.680

S-1 D2 D19 L= 674.250

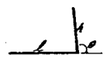
NO	l	NOS	T.l
1-87	7.750	87	674.250



Approved by KIP/NEDC-05/85 on 4 Jan. '85

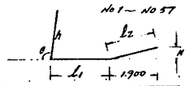
W-2 / D1 — D 35 L= 566.780

NO	l	h	NOS	T.l
1-56	4233	3554	56	436.072
57	4233	3564	1	7.797
58	4234	3591	1	7.825
59	4235	3597	1	7.832
60	4235	3614	1	7.849
61	4236	3630	1	7.866
62	4237	3647	1	7.884
63	4238	3663	1	7.901
64	4238	3680	1	7.918
65	4239	3696	1	7.935
66	4240	3713	1	7.953
67	4241	3729	1	7.970
68	4241	3746	1	7.987
69	4242	3762	1	8.004
70	4243	3779	1	8.022
71	4244	3795	1	8.039
72	4244	3812	1	8.056
73	4245	3828	1	8.073
74	4246	3845	1	8.091
TOTAL				579.064
-(0.166 × 74) =				566.780

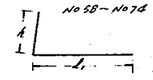


θ = 92°-30'-18"

W-2 / D1-1 — D. 35 L= 570.948



NO	H	h	l_1	l_2	LAP	NOS	T.l
1	941	3554	2.333	2.120	-	1	8.007
2	922	"	"	2.112		1	7.999
3	905	"	"	2.105		1	7.992
4	888	"	"	2.097		1	7.984
5	872	"	"	2.091		1	7.978
6	855	"	"	2.084		1	7.971
7	838	"	"	2.077		1	7.964
8	822	"	"	2.070		1	7.957
9	805	"	"	2.063		1	7.950
10	789	"	"	2.057		1	7.944
11	772	"	"	2.051		1	7.939
12	755	"	"	2.045		1	7.932
13	739	"	"	2.039		1	7.926
14	722	"	"	2.033		1	7.920
15	705	"	"	2.027		1	7.914
16	689	"	"	2.021		1	7.908
17	672	"	"	2.015		1	7.902
18	656	"	"	2.010		1	7.897
19	639	"	"	2.005		1	7.892
20	622	"	"	1.999		1	7.886
21	606	"	"	1.994		1	7.881
22	589	"	"	1.989		1	7.876
23	572	"	"	1.984		1	7.871
24	556	"	"	1.980		1	7.867
25	539	"	"	1.975		1	7.862



NO	H	h	l_1	l_2	LAP	NOS	T.l
26	523	3.554	2.333	1.971	-	1	7.858
27	506	"	"	1.966		1	7.853
28	489	"	"	1.962		1	7.849
29	473	"	"	1.958		1	7.845
30	456	"	"	1.954		1	7.841
31	439	"	"	1.950		1	7.837
32	423	"	"	1.947		1	7.834
33	406	"	"	1.943		1	7.830
34	390	"	"	1.940		1	7.827
35	373	"	"	1.936		1	7.823
36	356	"	"	1.933		1	7.820
37	340	"	"	1.930		1	7.817
38	323	"	"	1.927		1	7.814
39	306	"	"	1.924		1	7.811
40	290	"	"	1.922		1	7.809
41	273	"	"	1.920		1	7.807
42	257	"	"	1.917		1	7.804
43	240	"	"	1.915		1	7.802
44	233	"	"	1.914		1	7.801
45	207	"	"	1.911		1	7.798
46	190	"	"	1.909		1	7.796
47	173	"	"	1.908		1	7.795
48	157	"	"	1.906		1	7.793
49	140	"	"	1.905		1	7.792
50	124	"	"	1.904		1	7.791
51	107	"	"	1.903		1	7.790
52	90	"	"	1.902		1	7.789
53	74	"	"	1.901		1	7.788
54	57	"	"	1.901		1	7.788
55	40	"	"	1.900		1	7.787
56	24	"	"	1.900		1	7.787
57	7	"	"	1.900		1	7.787
58	-	3.564	4.233	-		1	7.797
59	-	3.582	4.234	-		1	7.816
60	-	3.600	4.235	-		1	7.835
61	-	3.617	4.236	-		1	7.853
62	-	3.634	4.236	-		1	7.870
63	-	3.652	4.237	-		1	7.889
64	-	3.669	4.238	-		1	7.907
65	-	3.687	4.239	-		1	7.926
66	-	3.705	4.240	-		1	7.945
67	-	3.722	4.240	-		1	7.962
68	-	3.740	4.241	-		1	7.981
69	-	3.757	4.242	-		1	7.999
70	-	3.775	4.243	-		1	8.018
71	-	3.792	4.244	-		1	8.036
72	-	3.810	4.244	-		1	8.054
73	-	3.827	4.245	-		1	8.072
74	-	3.845	4.246	-		1	8.091
TOTAL							583.232
-(0.166 × 74) =							570.948

W-2 / D3 — D 29 L= 666.000

No	h	NOS	T.l
1-74	4.500	74×2	666.000

W-2 / D3 — D 16 L= 569.800

No	h	NOS	T.l
1-74	3.850	74×2	569.800

W-2 / D5 — D 13 L= 712.260

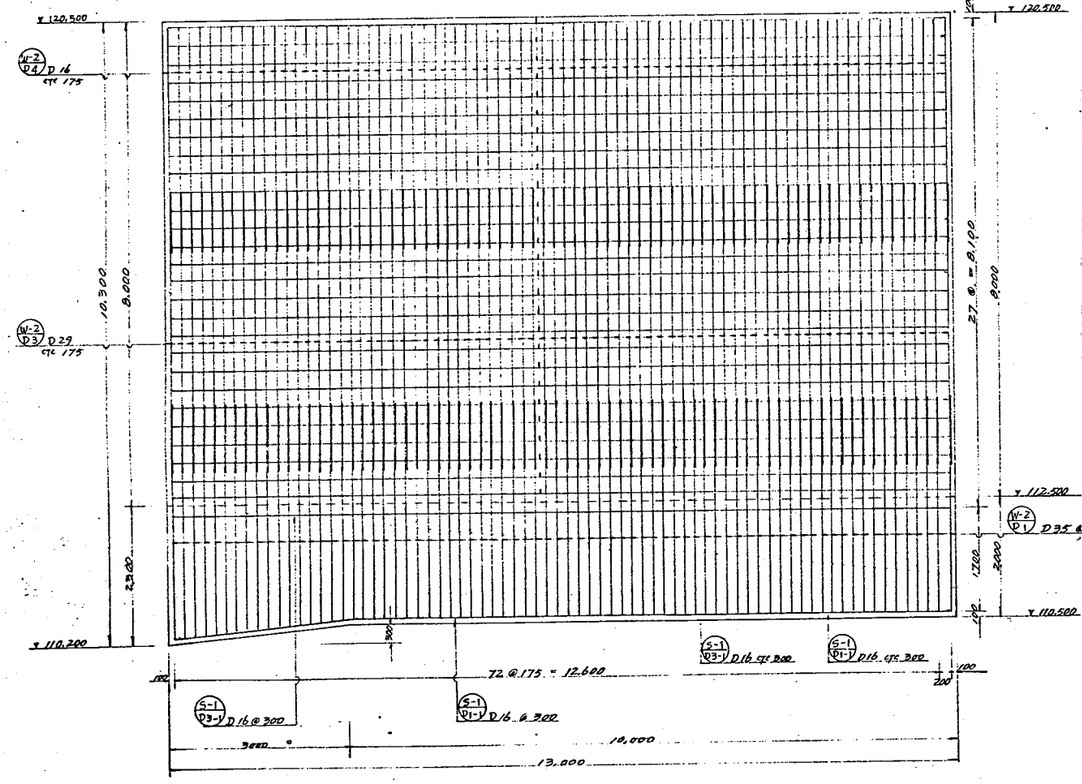
No	l	LAP	NOS	T.l
1-27	12.800	330	27×2	712.260

S-1 / D4-1 — D 19 L= 540.200

No	l	NOS	T.l
1-74	7.300	74	540.200

S-1 / D4-1a — D 13 L= 277.400

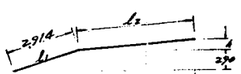
No	l	NOS	T.l
1-38	7.300	38	277.400



W-2 / D

S-1 / D1-1 — D 16 L= 345.762

NO	h	l_1	l_2	LAP	NOS	T.l
1-19	0	2.914	9.900	480	19	252.586
20	50	"	9.900	"	1	13.294
21	198	"	9.902	"	1	13.296
22	347	"	9.906	"	1	13.300
23	495	"	9.912	"	1	13.306
24	644	"	9.921	"	1	13.315
25	792	"	9.932	"	1	13.326
26	941	"	9.945	"	1	13.339
TOTAL						345.762



S-1 / D3-1 — D 16 L= 345.280

No.	l	LAP	NOS	T.l
1-26	12.800	480	26	345.280

Approved by KIP/NLOC 05/85 on 4 Jan. '85

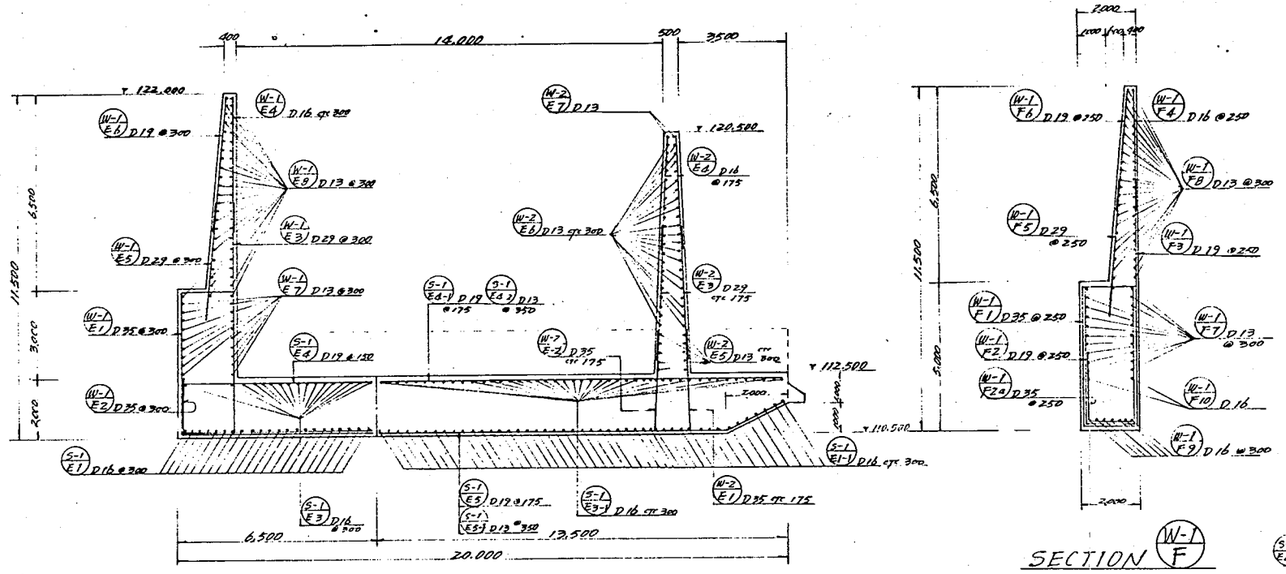
HIS MAJESTY'S GOVERNMENT OF NEPAL
KANKAI DEVELOPMENT BOARD
KANKAI DIVERSION STRUCTURE
REMEDIAL WORKS PROJECT

SHOP DWG

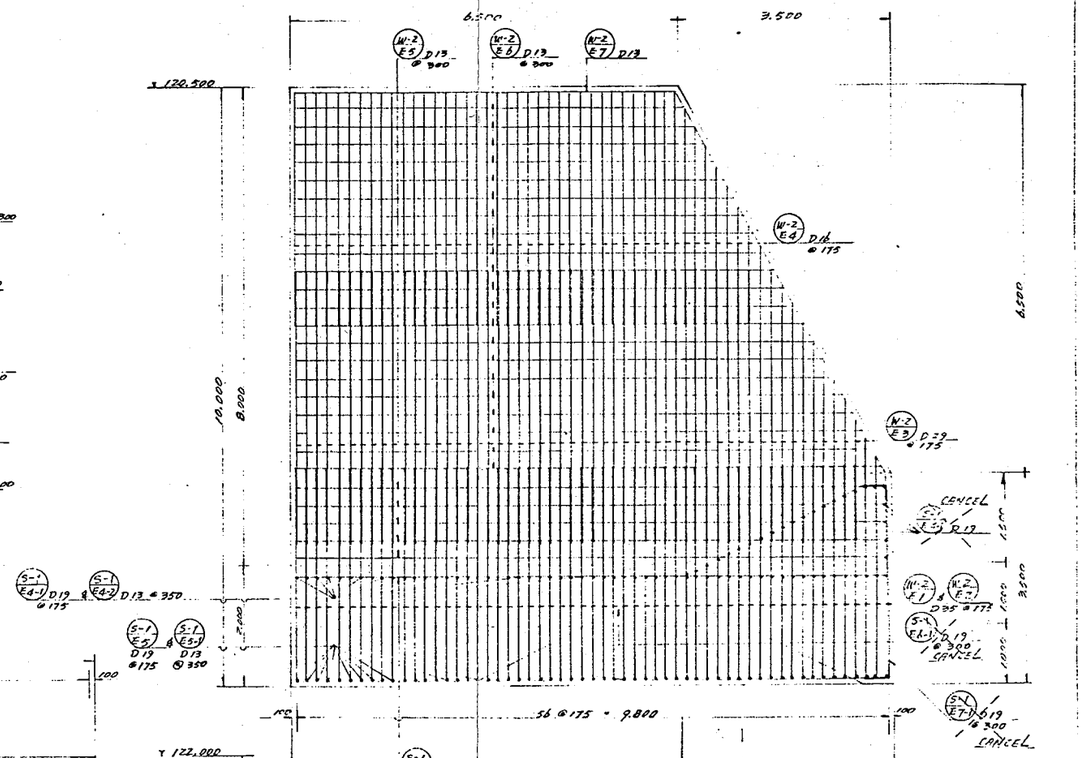
REINFORCEMENT BAR FOR RIGHT BANK

SECTION "D"-"D"

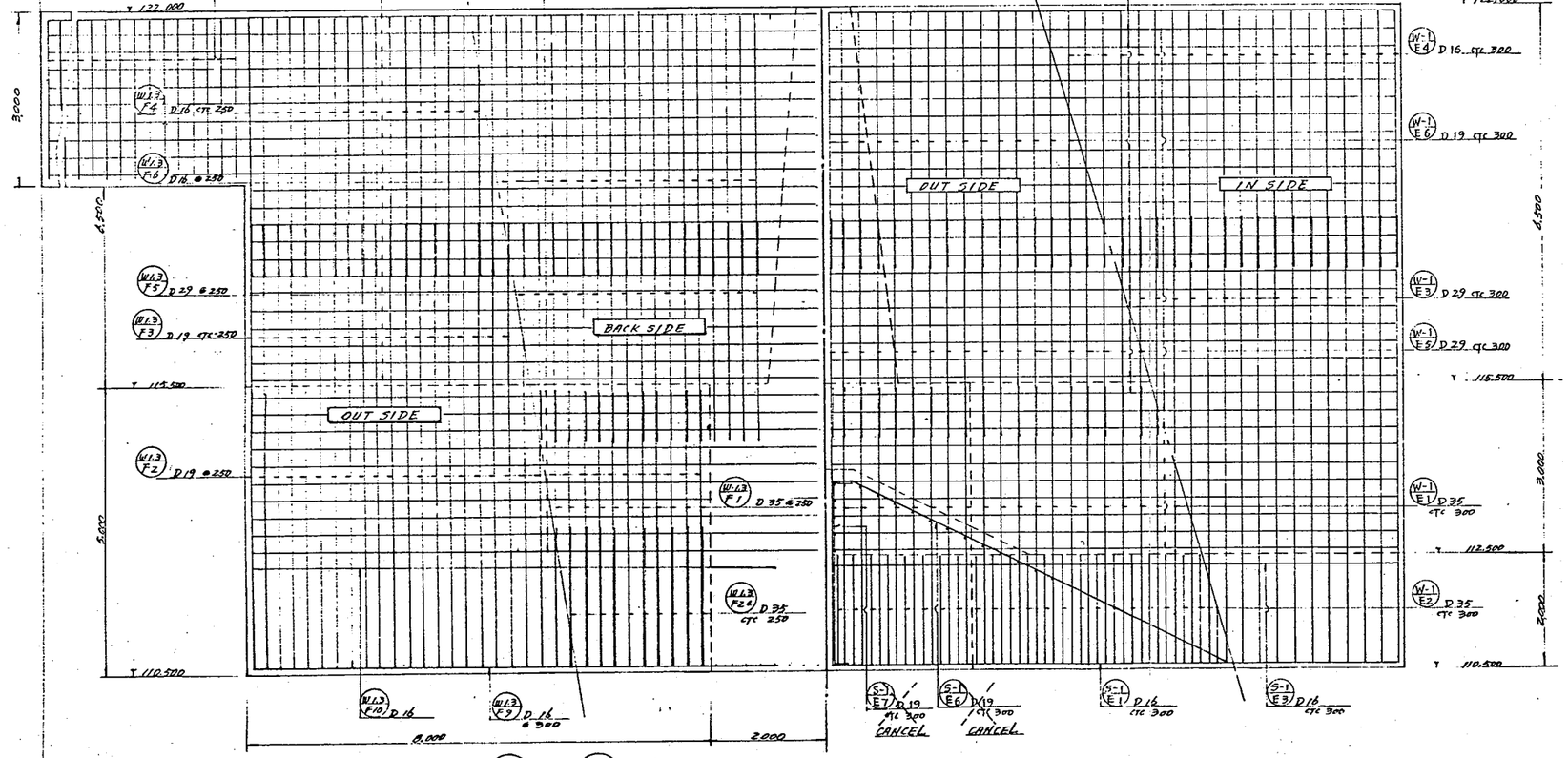
DESIGNED BY:	CHECKED BY:
DRAWN BY:	APPROVED BY:
DATE:	DWG NO. SD 006 A
KOREA DEVELOPMENT CORP.	



SECTION W-1 / F



W-2 / E



W-1 / F & W-3 / F

W-1 / E

HIS MAJESTY'S GOVERNMENT OF NEPAL
KANKAI DEVELOPMENT BOARD
KANKAI DIVERSION STRUCTURE
REMEDIAL WORKS PROJECT

SHOP DWG

REINFORCEMENT BAR FOR RIGHT BANK
1) SECTION "E"-"E" & "F"-"F"

DESIGNED BY:	CHECKED BY:
DRAWN BY:	APPROVED BY:
DATE:	DWG NO: SD 007

Approved by KIP/NKDCC 05/85 on 4 Jan. '85

KOREA DEVELOPMENT CORP.

92

9

W-1/E1 D35 L= 470.500

No	b1	b2	h	LAP	Nos	T.l
1-34	1.900	6.300	4.800	1.225	34	480.250

-(0.15 x 2 x 34) = 470.050

W-1/E2 D35 L= 265.650

No	l	h	Nos	T.l
1-33	6.300	1.900	33	270.600
TOTAL				270.600

-(0.150 x 33) = 265.650

W-1/E3 D29 L= 261.800

No	h	Nos	T.l
1-34	7.700	34	261.800

W-1/E4 D16 L= 151.980

No	h	Nos	T.l
1-34	4.470	34	151.980

W-1/E5 D29 L= 117.149

No	h	Nos	T.l
1-31	3779	31	117.149

W-1/E6 D19 L= 139.159

No	h	Nos	T.l
1-31	4489	31	139.159

W-1/E7 D13 L= 176.400

No	l	LAP	Nos	T.l
1-9	9.800	-	9x2	176.400

W-1/E8 D13 L= 460.600

No	l	LAP	Nos	T.l
1-23	9.800	-	22x2+3	460.600

S-1/E1 D16 L= 226.160

No	l	LAP	Nos	T.l
1-22	9.800	480	22	226.160

S-1/E3 D16 L= 174.760

No	l	LAP	Nos	T.l
	9.800	480	17	174.760

S-1/E4 D19 L= 422.100

No.	l	Nos	T.l
a	6.300	67	422.100
~~b~~	~~6.300~~	~~18~~	~~113.400~~
TOTAL			422.100

CANCEL (row b)

CANCEL

S-1/E6 D19 L= 113.325

No	l1	l2	Nos	T.l
1-15	7.155	400	15	113.325

CANCEL

S-1/E7 D19 L= 57.540

No	l1	l2	Nos	T.l
	3.200	400x2	15	60.000

-(0.082 x 2 x 15) = 57.540

W-2/E1 D35 L= 434.845

No	b	h	Nos	T.l
1-54	4.233	3554	54	420.498
55	〃	4.029	1	8.262
56	〃	3703	1	7.936
57	〃	3378	1	7.611
TOTAL				444.307

-(0.166 x 57) = 434.845

θ = 92°-30'-18"

W-2/E2 D35 L= 445.301

No	H	h	b1	b2	Nos	T.l
1-43	950	3.554	2.333	2.124	43	344.473
44	891	〃	〃	2.099	1	7.986
45	808	〃	〃	2.065	1	7.952
46	724	〃	〃	2033	1	7.920
47	641	〃	〃	2005	1	7.892
48	558	〃	〃	1.980	1	7867
49	475	〃	〃	1.958	1	7.845
50	392	〃	〃	1.940	1	7.827
51	309	〃	〃	1.925	1	7.812
52	226	〃	〃	1.913	1	7.800
53	143	〃	〃	1.905	1	7.792
54	59	〃	〃	1.901	1	7788
55	-	4029	4.233	-	1	8262
56	-	3.703	〃	-	1	7936
57	-	3378	〃	-	1	7611
TOTAL						454.763

-(0.166 x 57) = 445.301

W-2/E3 D29 L= 465.774

No	h	Nos	T.l
1-44	4.500	44x2	396.000
45	4953	2	9.906
46	4627	2	9.254
47	4.302	2	8.604
48	3977	2	7.954
49	3651	2	7.302
50	3326	2	6.652
51	3001	2	6.002
52	2675	2	5.350
53	2350	2	4.700
54	2025	2	4.050
TOTAL			465.774

W-2/E4 D16 L= 321.636

No	h	Nos	T.l
1-37	3.850	37x2	284.900
38	3600	2	7.200
39	3275	2	6.550
40	2949	2	5.890
41	2624	2	5.248
42	2299	2	4.598
43	1.973	2	3.946
44	1.648	2	3.296
TOTAL			321.636

W-2/E5 D13 L= 98.000

No	l	Nos	T.l
1-5	9.800	5x2	98.000

W-2/E6 D13 L= 340.928

No	l	Nos	T.l
1	9.733	2	19.466
2	9.571	2	19.142
3	9.410	2	18.820
4	9.248	2	18.496
5	9.087	2	18.174
6	8.925	2	17.850
7	8.763	2	17.526
8	8.602	2	17.206
9	8.440	2	16.880
10	8279	2	16.558
11	8.117	2	16.234
12	7.956	2	15.912
13	7.794	2	15.588
14	7.633	2	15.266
15	7.471	2	14.942
16	7.310	2	14.620
17	7.148	2	14.296
18	6.987	2	13.974
19	6.825	2	13.650
20	6.663	2	13.326
21	6.502	2	13.004
TOTAL			340.928

W-2/E7 D13 L= 28.048

l1	l2	LAP	Nos	T.l
6.340	7297	390	2	28.054

-(0.003 x 2) = 28.048

S-1/E1-1 D16 L= 473.454

No	h	l1	l2	l3	LAP	Nos	T.l
1-39	-	9.800	-	-	480	39	400.920
40	50	7.400	2.000	400	〃	1	10.281
41	200	〃	2.010	〃	〃	1	10.290
42	350	〃	2.030	〃	〃	1	10.310
43	500	〃	2.062	〃	〃	1	10.342
44	650	〃	2.103	〃	〃	1	10.383
45	800	〃	2.154	〃	〃	1	10.434
46	950	〃	2.214	〃	〃	1	10.494
TOTAL							473.454

S-1/E3-1 D16 L= 472.880

No	l	LAP	Nos	T.l
1-46	9.800	480	46	472.880

S-1/E4-1 D19 L= 790.59

No	l	LAP	Nos	T.l
	13.300	570	57	790.590

S-1/E4-2 D13 L= 397.010

No	l	LAP	Nos	T.l
	13.300	390	29	397.010

S-1/E5 D19 L= 411.825

No	l	Nos	T.l
1-57	7225	57	411.825

S-1/E5-1 D13 L= 209.525

	l	Nos	T.l
	7.225	29	209.525

CANCEL

S-1/E6-1 D19 L= 317.310

No	l1	l2	Nos	T.l
1-42	7.155	400	42	317.310

CANCEL

S-1/E7-1 D19 L= 161.112

No	l1	l2	Nos	T.l
1-42	3.200	400	42	169.000

-(0.082 x 2 x 42) = 161.112

W-1/F2 D19 L= 377.792

No	h	b	LAP	Nos	T.l
1-32	4.800	1.800	570	32	383.040

-(0.082 x 2 x 32) = 377.792

W-1/F2a D35 L= 129.600

No	h	b	Nos	T.l
1-32	2.400	1.800	32	134.400

-(0.150 x 32) = 129.600

W-1/F1 D35 L= 259.200

l1	l2	h	Nos	T.l
1.800	1.800	4.800	32	268.800

-(0.150 x 2 x 32) = 259.200

W-1/F3 D19 L= 300.300

h	Nos	T.l
7.700	39	300.300

W-1/F4 D16 L= 226.930

h	Nos	T.l
4.170	39	162.630
2.900	22	63.800
TOTAL		226.930

W-1/F5 D29 L= 136.044

h	Nos	T.l
3.779	36	136.044

W-1/F6 D19 L= 225.800

h	Nos	T.l
4.499	36	161.604
2.912	22	64.064
TOTAL		225.668

W-1/F7 D13 L= 205.800

l	Nos	T.l
9.800	21	205.800

W-1/F8 D13 L= 529.000

No	l	LAP	Nos	T.l
a	9.800	-	12x2	235.200
b	14.300	390	10x2	293.800
TOTAL				529.000

W-1/F9 D16 L= 63.000

l	LAP	Nos	T.l
9.000	-	7	63.000

W-1/F10 D16 L= 18.000

l	LAP	Nos	T.l
9.000	-	2	18.000

HIS MAJESTY'S GOVERNMENT OF NEPAL
KANKAI DEVELOPMENT BOARD
KANKAI DIVERSION STRUCTURE
REMEDIAL WORKS PROJECT

SHOP DWG.

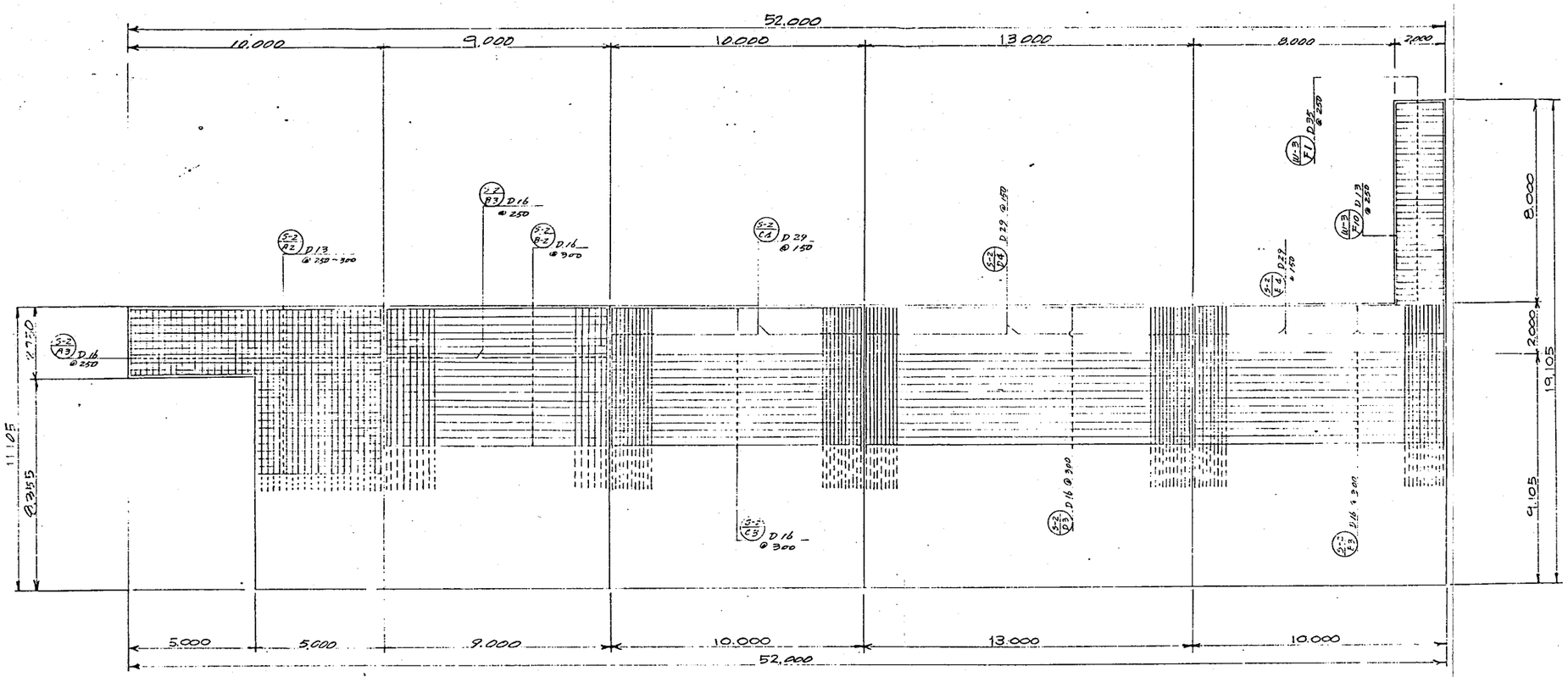
REINFORCEMENT BAR FOR RIGHT BANK

SECTION "E"-"E"

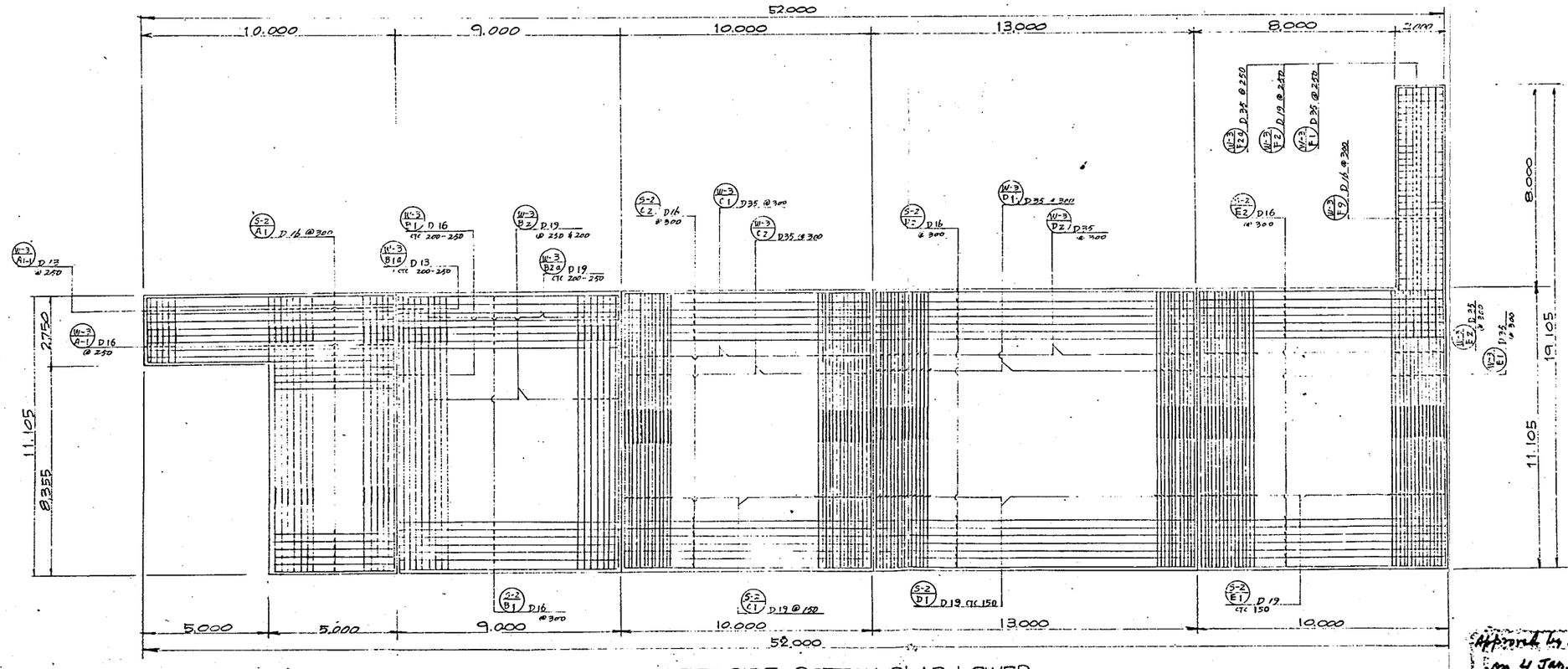
DESIGNED BY:	CHECKED BY:
DRAWN BY:	APPROVED BY:
DATE :	DWG NO. SD. 007A

KOREA DEVELOPMENT CORP.

Approved by KIP/NKSC-05/85 on 4 Jan. '85



LEFT SIDE BOTTOM SLAB UPPER



LEFT SIDE BOTTOM SLAB LOWER

HIS MAJESTY'S GOVERNMENT OF NEPAL
KANKAI DEVELOPMENT BOARD
KANKAI DIVERSION STRUCTURE REMEDIAL WORKS PROJECT

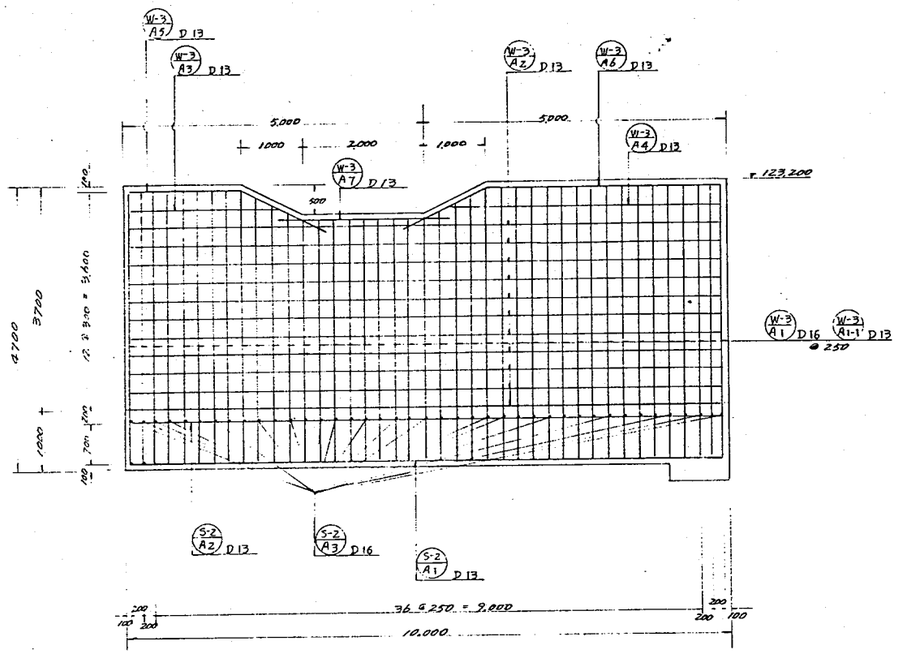
SHOP D.W.G.

REINFORCEMENT BAR FOR LEFT SIDE WALL

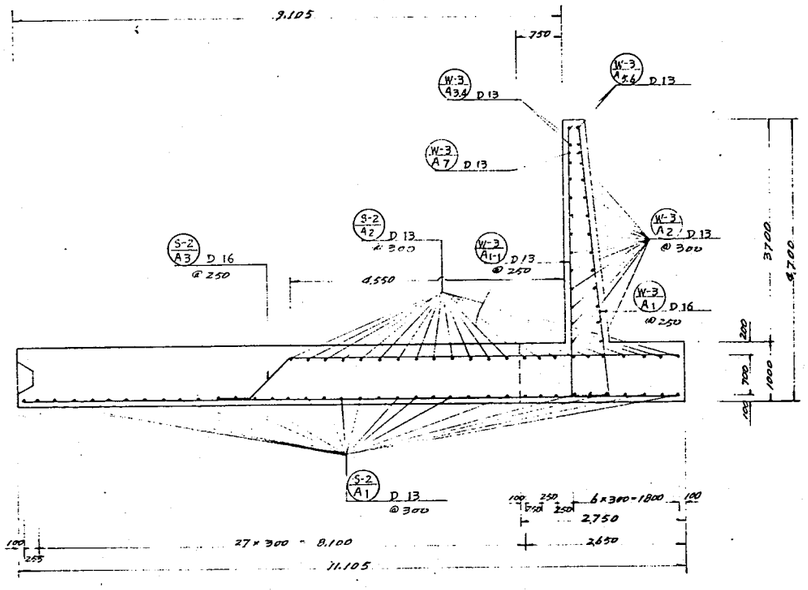
Approved by KIPMCO/85 on 4 Jan. '85

DESIGNED BY: I.E.C.	CHECKED BY:
DRAWN BY: G.N. PARK	APPROVED BY:
DATE	D.W.G. NO: SD 008.

KOREA DEVELOPMENT CORP.



PROFILE SECTION "A"

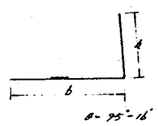


SECTION "A"-"A"

W-3 A1 D 16 L= 408.847

	b	h	LAP	Nos	T.l
1-9	1.375	4.519		9	53.046
10	1.375	4.394		1	5.769
11	1.375	4.268		1	5.643
12	1.375	4.143		1	5.518
13-21	1.375	4.017		9	48.529
22	9.730	4.143	480	1	14.353
23	9.730	4.268	480	1	14.478
24	9.730	4.394	480	1	14.604
25-41	9.730	4.519	480	17	250.393
		TOTAL		41	412.332

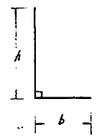
-(0.005 x 41) = 408.847



W-3 A1-1 D 13 L= 250.004

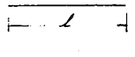
	b	h	Nos	T.l
1-9	1.800	4.500	9	56.700
10	"	4.375	1	6.175
11	"	4.250	1	6.050
12	"	4.125	1	5.925
13-21	"	4.000	9	52.200
22	"	4.125	1	5.925
23	"	4.250	1	6.050
24	"	4.375	1	6.175
25-41	"	4.500	17	107.100
			41	252.300

-(0.036 x 41) = 250.004



W-3 A2 D 13 L= 215.600

	l	Nos	T.l
	9.200	11x2	215.600
	TOTAL		215.600

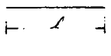


W-3 A3 D 13 L= 5.000

	l	Nos	T.l
	2.500	2	5.000
	TOTAL		5.000

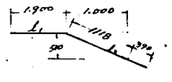
W-3 A4 D 13 L= 9.000

	l	Nos	T.l
	4.500	2	9.000
	TOTAL		9.000



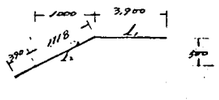
W-3 A5 D 13 L= 6.816

	l_1	l_2	Nos	T.l
	4.900	1.508	2	6.816
	TOTAL			6.816



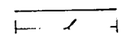
W-3 A6 D 13 L= 10.816

	l_1	l_2	Nos	T.l
	3.900	1.508	2	10.816
	TOTAL			10.816



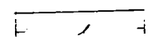
W-3 A7 D 13 L= 5.560

	l	Nos	T.l
	2.780	2	5.560
	TOTAL		5.560



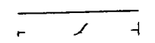
S-2 A1 D 13 L= 23.400

	l	Nos	T.l
1-10	9.800	10	98.000
11-38	4.800	28	134.400
	TOTAL		232.400



S-2 A2 D 13 L= 160.400

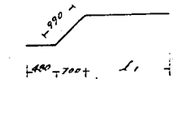
	l	Nos	T.l
1-10	9.800	10	98.000
11-23	4.800	13	62.400
	TOTAL		160.400



S-2 A3 D 16 L= 211.830

	l_1	l_2	l_3	Nos	T.l
1-21	7.550	-	-	21	158.550
22-41	6.450	990	990	20	53.280
	TOTAL				211.830

-(0.003 x 2 x 20) = 211.830



HIS MAJESTY'S GOVERNMENT OF NEPAL
KANKAI DEVELOPMENT BOARD
KANKAI DIVERSION STRUCTURE
REMEDIAL WORKS PROJECT

SHOP DWG

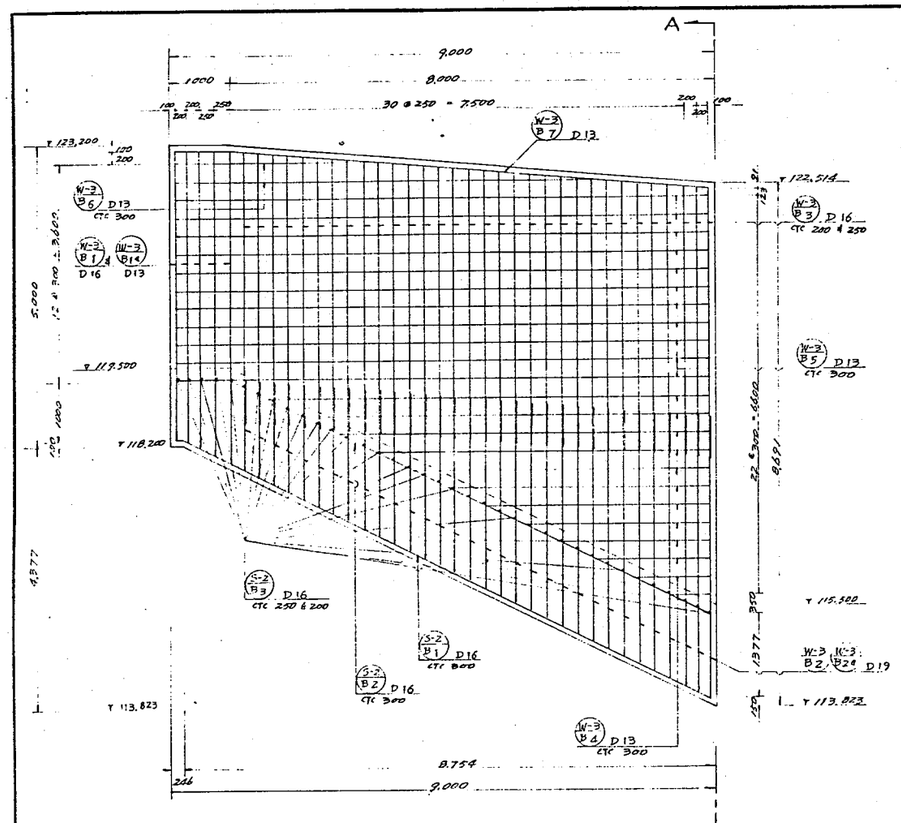
REINFORCEMENT BAR FOR LEFT BANK

SECTION "A"-"A"

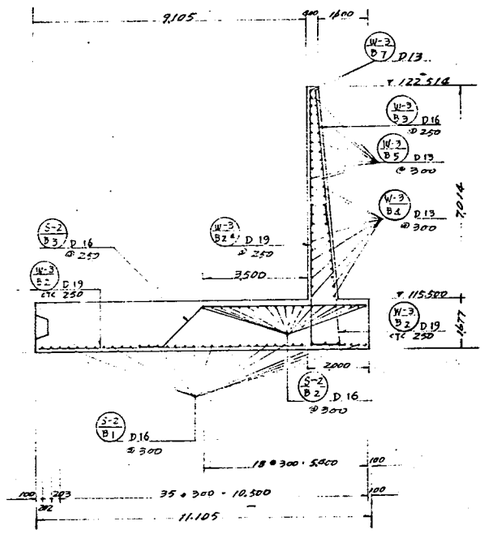
DESIGNED BY:	CHECKED BY:
DRAWN BY:	APPROVED BY:
DATE 3/7/85	DWG NO SD 009
KOEI A DEVELOPMENT CORP.	

Approved by KIPTNAC on 4 Jan. '85

12



PROFILE SECTION "B"

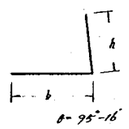


SECTION A-A

W-3 B1 D16 L = 75.724

	h	b	Lap	Nos	T.l
1	4.820	9.757	480	1	15.057
2	4.898	9.760	"	1	15.088
3	4.950	9.769	"	1	15.199
4	5.073	9.781	"	1	15.334
5	5.193	9.782	"	1	15.471
		TOTAL			76.149

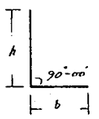
-(0.085 x 5) = 75.724



W-3 B1 D13 L = 33.503

	h	b	Lap	Nos	T.l
1	4.960	1.800	-	1	6.760
2	4.827	"	-	1	6.627
3	4.927	"	-	1	6.727
4	5.052	"	-	1	6.852
5	5.177	"	-	1	6.977
		TOTAL			33.793

-(0.056 x 5) = 33.503



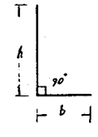
W-3 B2 D19 L = 434.943

	h	b	Lap	Nos	T.l
1	1373	9.802	760	1	11.935
2	1477	9.812	"	1	12.047
3	1581	9.821	"	1	12.162
4	1685	9.831	"	1	12.276
5	1789	9.840	"	1	12.389
6	1893	9.850	"	1	12.503
7	1977	9.859	"	1	12.616
8	2101	9.864	"	1	12.730
9	2205	9.878	"	1	12.843
10	2309	9.885	"	1	12.957
11	2413	9.898	"	1	13.071
12	2517	9.907	"	1	13.186
13	2621	9.917	"	1	13.298
14	2725	9.926	"	1	13.411
15	2829	9.936	"	1	13.525
16	2933	9.945	"	1	13.638
17	3037	9.955	"	1	13.752
18	3141	9.964	"	1	13.865
19	3245	9.974	"	1	13.979
20	3349	9.983	"	1	14.092
21	3453	9.993	"	1	14.206
22	3557	10.003	"	1	14.320
23	3661	10.012	"	1	14.433
24	3765	10.022	"	1	14.547
25	3869	10.031	"	1	14.660
26	3973	10.041	"	1	14.774
27	4077	10.050	"	1	14.887
28	4181	10.060	"	1	15.001
29	4285	10.069	"	1	15.114
30	4389	10.079	"	1	15.228
31	4473	10.087	"	1	15.320
32	4556	10.094	"	1	15.410
		TOTAL			438.175

-(0.101 x 32) = 434.943

W-2 B2a D19 L = 149.508

	h	b	Lap	Nos	T.l
1	1351	1.800	-	1	3.151
2	1455	"		1	3.255
3	1558	"		1	3.358
4	1662	"		1	3.462
5	1765	"		1	3.565
6	1869	"		1	3.669
7	1972	"		1	3.772
8	2076	"		1	3.876
9	2179	"		1	3.979
10	2283	"		1	4.083
11	2387	"		1	4.187
12	2490	"		1	4.290
13	2594	"		1	4.394



	h	b	Lap	Nos	T.l
14	2697	1.800		1	4.497
15	2801	"		1	4.601
16	2904	"		1	4.704
17	3008	"		1	4.808
18	3111	"		1	4.911
19	3215	"		1	5.015
20	3318	"		1	5.118
21	3422	"		1	5.222
22	3526	"		1	5.326
23	3629	"		1	5.429
24	3733	"		1	5.533
25	3836	"		1	5.636
26	3940	"		1	5.740
27	4043	"		1	5.843
28	4147	"		1	5.947
29	4250	"		1	6.050
30	4354	"		1	6.154
31	4457	"		1	6.257
32	4520	"		1	6.320
		TOTAL			152.132

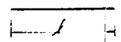
-(0.082 x 32) = 149.508

W-3 B3 D16 L = 288.000

	h	Nos	T.l
1-32	4.500	32 x 2	288.000
	TOTAL		288.000

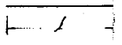
W-3 B4 D13 L = 96.000

	l	Nos	T.l
1	7.00	2	1.400
2	1.300	2	2.600
3	1.900	2	3.800
4	2.500	2	5.000
5	3.100	2	6.200
6	3.700	2	7.400
7	4.300	2	8.600
8	4.900	2	9.800
9	5.200	2	11.000
10	6.100	2	12.200
11	6.700	2	13.400
12	7.300	2	14.600
TOTAL			96.000



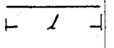
W-3 B5 D13 L = 193.600

	l	Nos	T.l
1-11	8.800	11 x 2	193.600
	TOTAL		193.600



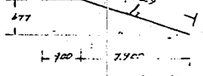
W-3 B6 D13 L = 19.926

	l	Nos	T.l
-1	6.731	2	13.462
-2	3.232	2	6.464
	TOTAL		19.926



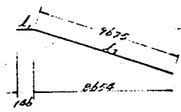
W-3 B7 D13 L = 17.658

	l	Nos	T.l
900	7.229	2	17.658
	TOTAL		17.658



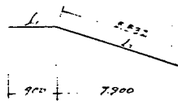
S-2 B1 D16 L = 391.438

	l	l1	Lap	Nos	T.l
1&6	9.675	8.654	480	38	391.438
	TOTAL				391.438



S-2 B2 D16 L = 193.028

	l	l1	Lap	Nos	T.l
9en	8.832	7.900	480	19	193.028
	TOTAL				193.028



S-2 B3 D16 L = 287.820

	H	l	l1	l2	Nos	T.l
1	1mm	1.413	5.400	480	1	7.294
2	1027	1.452	"	"	1	7.332
3	1177	1.574	"	"	1	7.474
4	1252	1.721	"	"	1	7.651
5-37	1377	1.847	"	"	33	258.291
		TOTAL				298.042

-(0.013 x 2 x 37) = 287.820

HIS MAJESTY'S GOVERNMENT OF NEPAL
KANKAI DEVELOPMENT BOARD
KANKAI DIVERSION STRUCTURE
REMEDIAL WORKS PROJECT

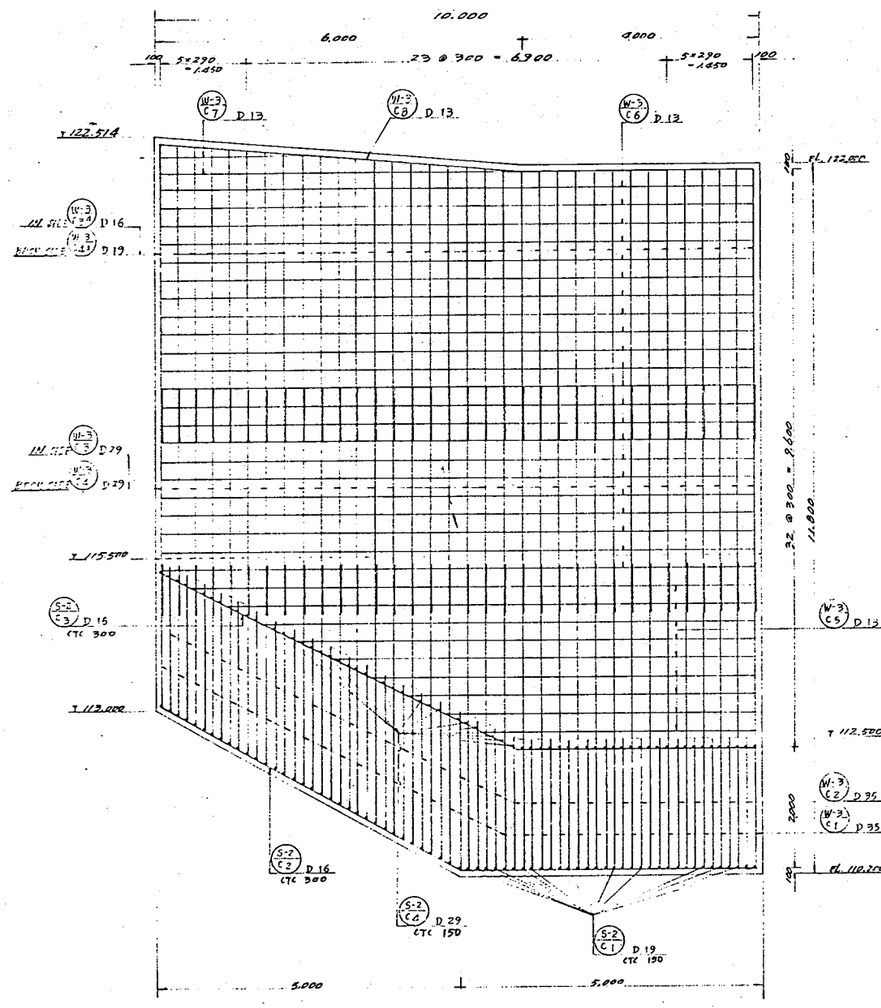
SHOP DWG.

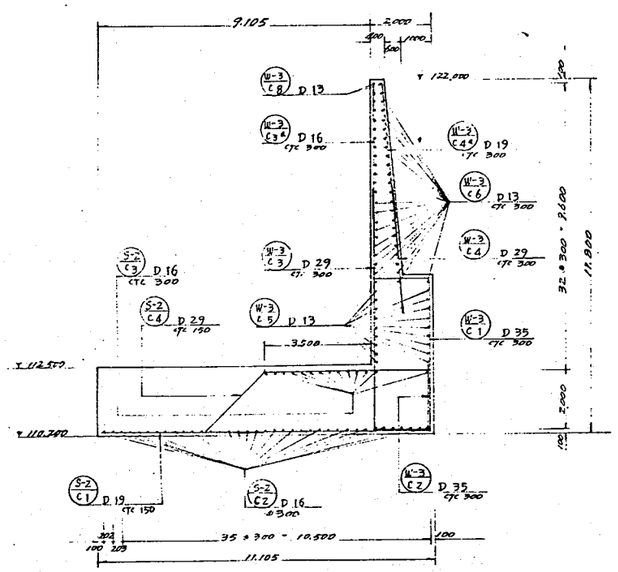
REINFORCEMENT BAR FOR
LEFT BANK

SECTION "B"-"B"

DESIGNED BY:	CHECKED BY:
DRAWN BY:	APPROVED BY:
DATE: 3/11/85	DWG NO. SD 010
KOREA DEVELOPMENT CORP.	

Approved by KIP/NOC-DS/85
on 4 Jan. 85





W-3 C1 D 35 L = 438.208

NO	l1	h	l2	LAP	NOS	T.l
1	1.800	2.356	5.775	1.225	1	11.156
2	"	2.519	"	"	1	11.318
3	"	2.681	"	"	1	11.481
4	"	2.843	"	"	1	11.643
5	"	3.006	"	"	1	11.806
6	"	3.168	"	"	1	11.968
7	"	3.336	"	"	1	12.136
8	"	3.504	"	"	1	12.304
9	"	3.672	"	"	1	12.472
10	"	3.840	"	"	1	12.640
11	"	4.008	"	"	1	12.808
12	"	4.176	"	"	1	12.976
13	"	4.344	"	"	1	13.144
14	"	4.512	"	"	1	13.312
15	"	4.680	"	"	1	13.480
16	"	4.848	"	"	1	13.648
17	"	5.016	"	"	1	13.816
18-33	"	5.100	"	"	17	236.300
TOTAL						448.408

-(0.150 x 2 x 34) = 438.208

W-3 C2 D 35 L = 264.888

NO	h	l	NOS	T.l
1	2.415	5.775	1	8.190
2	2.133	"	1	8.208
3	2.450	"	1	8.225
4	2.468	"	1	8.243
5	2.485	"	1	8.260
6	2.502	"	1	8.277
7	2.520	"	1	8.295
8	2.538	"	1	8.313
9	2.556	"	1	8.331
10	2.574	"	1	8.349
11	2.592	"	1	8.367
12	2.610	"	1	8.385
13	2.628	"	1	8.403
14	2.646	"	1	8.421
15	2.664	"	1	8.439
16	2.682	"	1	8.457
17	2.700	"	1	8.475
18	2.550	"	1	8.325
19	2.400	"	1	8.175
20	2.250	"	1	8.025
21-33	2.200	"	13	103.675
TOTAL				269.838

-(0.150 x 33) = 264.888

W-3 C4 D 29 L = 128.486

NO	h	NOS	T.l
1-34	3.779	34	128.486
TOTAL			128.486

W-3 C4 D 19 L = 157.934

NO	h	NOS	T.l
1	4.796	1	4.996
2	4.971	1	4.971
3	4.946	1	4.946
4	4.921	1	4.921
5	4.896	1	4.896
6	4.871	1	4.871
7	4.845	1	4.845
8	4.819	1	4.819
9	4.794	1	4.794
10	4.768	1	4.768
11	4.742	1	4.742
12	4.716	1	4.716
13	4.691	1	4.691
14	4.665	1	4.665
15	4.639	1	4.639
16	4.613	1	4.613
17	4.587	1	4.587
18	4.562	1	4.562
19	4.536	1	4.536
20	4.510	1	4.510
21-34	4.489	14	4.489
TOTAL			157.934

W-3 C5 D 13 L = 124.200

NO	l	NOS	T.l
1	4.500	2	9.000
2	5.100	2	10.200
3	5.700	2	11.400
4	6.300	2	12.600
5	6.900	2	13.800
6	7.500	2	15.000
7	8.100	2	16.200
9	8.700	2	17.400
9	9.300	2	18.600
TOTAL			124.200

W-3 C6 D 13 L = 441.000

NO	l	NOS	T.l
	9.800	22+22+1 = 45	441.000
TOTAL			441.000

W-3 C7 D 13 L = 16.600

NO	l	NOS	T.l
1	5.900	2	11.800
2	2.400	2	4.800
TOTAL			16.600

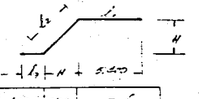
W-3 C8 D 13 L = 19.644

l1	l2	NOS	T.l
5.922	3.900	2	19.644
TOTAL			19.644

S-2 C1 D 19 L = 425.785

NO	l	NOS	T.l
1-67	6.325	67	425.785

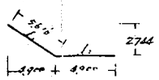
S-2 C4 D 29 L = 686.018



No.	H	l1	l2	l3	Lap	NOS	T.l
1	2206	3120	5.400	970	370	1	10.240
2	2215	3132	"	"	"	1	10.272
3	2223	3145	"	"	"	1	10.295
4	2232	3157	"	"	"	1	10.297
5	2241	3167	"	"	"	1	10.309
6	2250	3182	"	"	"	1	10.332
7	2258	3194	"	"	"	1	10.334
8	2267	3206	"	"	"	1	10.346
9	2276	3218	"	"	"	1	10.355
10	2284	3231	"	"	"	1	10.371
11	2293	3243	"	"	"	1	10.383
12	2302	3255	"	"	"	1	10.396
13	2311	3268	"	"	"	1	10.408
14	2320	3280	"	"	"	1	10.421
15	2329	3294	"	"	"	1	10.434
16	2338	3307	"	"	"	1	10.447
17	2347	3319	"	"	"	1	10.459
18	2356	3332	"	"	"	1	10.472
19	2365	3345	"	"	"	1	10.485
20	2374	3358	"	"	"	1	10.495
21	2383	3370	"	"	"	1	10.510
22	2392	3383	"	"	"	1	10.523
23	2401	3396	"	"	"	1	10.536
24	2410	3409	"	"	"	1	10.549
25	2419	3421	"	"	"	1	10.561
26	2428	3434	"	"	"	1	10.574
27	2437	3447	"	"	"	1	10.587
28	2446	3459	"	"	"	1	10.600
29	2455	3472	"	"	"	1	10.612
30	2464	3485	"	"	"	1	10.625
31	2473	3498	"	"	"	1	10.638
32	2482	3511	"	"	"	1	10.651
33	2491	3523	"	"	"	1	10.663
34	2500	3536	"	"	"	1	10.676
35	2509	3549	"	"	"	1	10.689
36	2518	3563	"	"	"	1	10.703
37	2527	3575	"	"	"	1	10.715
38	2536	3588	"	"	"	1	10.728
39	2545	3602	"	"	"	1	10.742
40	2554	3615	"	"	"	1	10.755
41-67	2563	3628	"	"	"	27	269.136
TOTAL							686.922

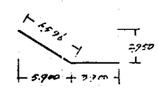
-(0.006 x 2 x 67) = 686.018

S-2 C2 D 16 L = 417.648



l1	l2	LAP	NOS	T.l
5.616	4.900	450	38	417.648
TOTAL				417.648

S-2 C3 D 16 L = 153.664



l1	l2	LAP	NOS	T.l
4.596	3.900	400	19	153.664
TOTAL				153.664

W-3 C3 D 29 L = 247.808

NO	l	NOS	T.l
1	5.256	1	5.256
2	5.418	1	5.418
3	5.581	1	5.581
4	5.743	1	5.743
5	5.906	1	5.906
6	6.068	1	6.068
7	6.236	1	6.236
8	6.404	1	6.404
9	6.572	1	6.572
10	6.740	1	6.740
11	6.908	1	6.908
12	7.076	1	7.076
13	7.244	1	7.244
14	7.412	1	7.412
15	7.580	1	7.580
16	7.748	1	7.748
17	7.916	1	7.916
18-34	8.000	17	136.000
TOTAL			247.808

W-3 C8 D 16 L = 157.272

NO	l	NOS	T.l
1	4.975	1	4.975
2	4.950	1	4.950
3	4.925	1	4.925
4	4.901	1	4.901
5	4.876	1	4.876
6	4.851	1	4.851
7	4.825	1	4.825
8	4.800	1	4.800
9	4.774	1	4.774
10	4.748	1	4.748
11	4.722	1	4.722
12	4.697	1	4.697
13	4.671	1	4.671
14	4.645	1	4.645
15	4.620	1	4.620
16	4.594	1	4.594
17	4.568	1	4.568
18	4.542	1	4.542
19	4.517	1	4.517
20	4.491	1	4.491
21-36	4.470	14	62.580
TOTAL			157.272

HIS MAJESTY'S GOVERNMENT OF NEPAL
KANKAI DEVELOPMENT BOARD
KANKAI DIVERSION STRUCTURE
REMEDIAL WORKS PROJECT

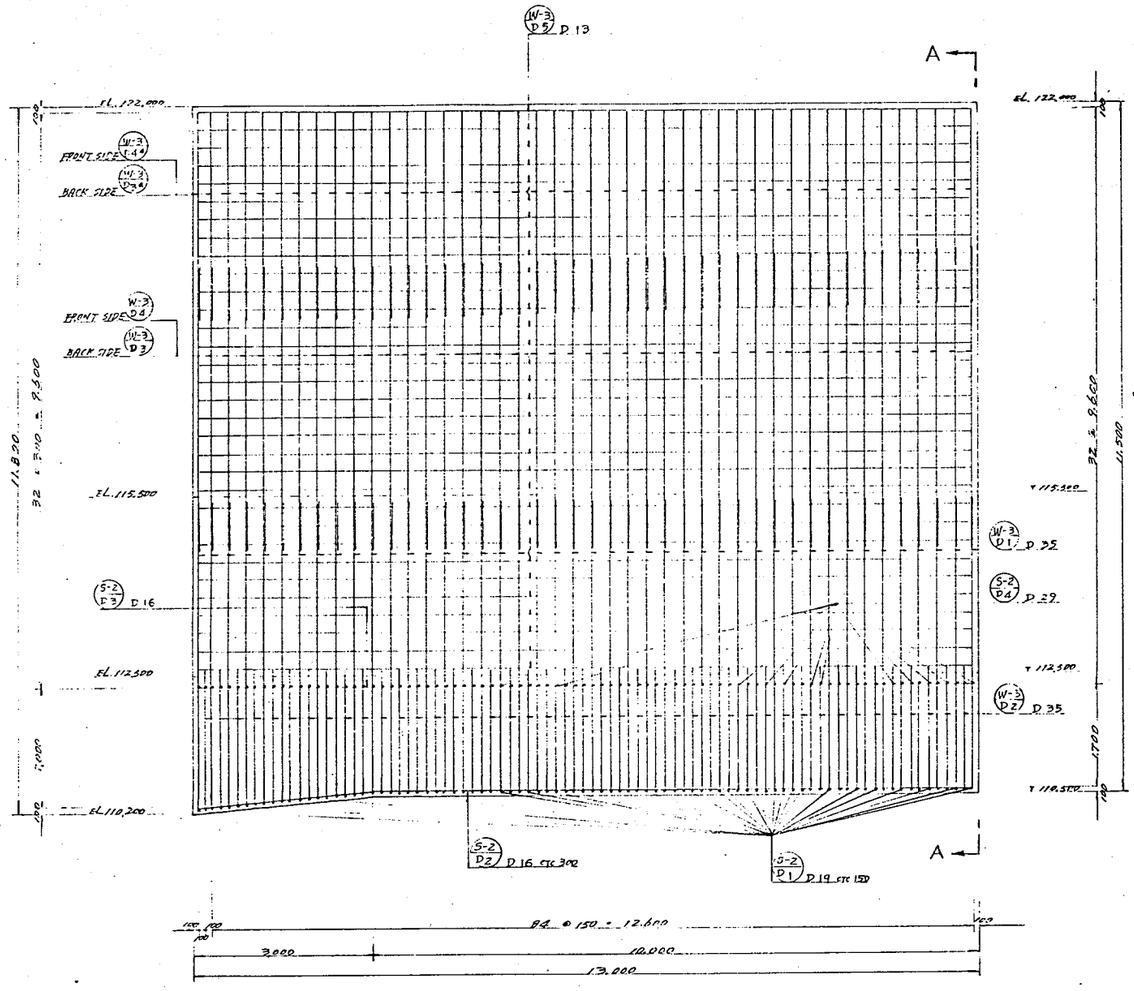
SHOP DWG

REINFORCEMENT BAR FOR LEFT BANK

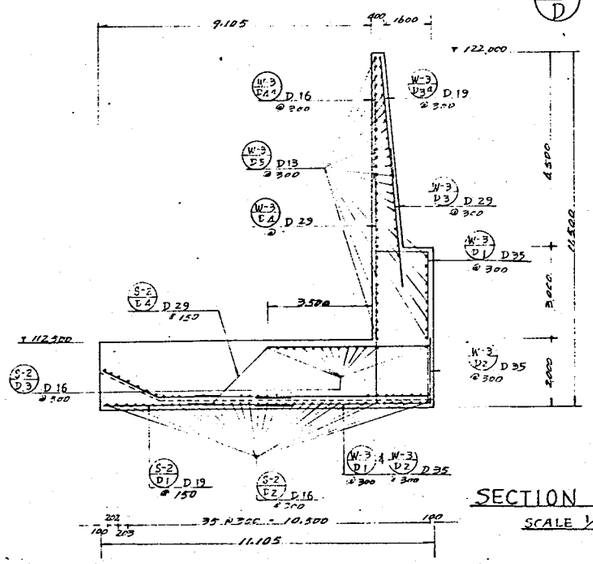
SECTION "C"-"C"

DESIGNED BY:	CHECKED BY:
DRAWN BY:	APPROVED BY:
DATE: 6/7/84	DWG NO. SD 011
KOREA DEVELOPMENT CORP.	

Approved by KIP/NKDC-05/85
on 4 Jan. '85



LEFT BANK "D-D"



SECTION A-A

SCALE 1/100

W-3 D1 D35 L= 586.840

NO	l_1	h	l_2	LAP	NOS	T.l
11-44	1.800	4.800	5.775	1225	34	462.400
10	"	4.830	"	"	1	13.630
9	"	4.860	"	"	1	13.660
8	"	4.890	"	"	1	13.690
7	"	4.920	"	"	1	13.720
6	"	4.950	"	"	1	13.750
5	"	4.980	"	"	1	13.780
4	"	5.010	"	"	1	13.810
3	"	5.040	"	"	1	13.840
2	"	5.070	"	"	1	13.870
1	"	5.090	"	"	1	13.890
		TOTAL				600.040
		-(0.150 x 2 x 44) =				586.840

W-3 D2 D35 L= 325.070

NO	l	h	NOS	T.l
11-43	5.775	1.900	33	253.275
10	"	1.915	1	7.690
9	"	1.945	1	7.720
8	"	1.975	1	7.750
7	"	2.005	1	7.780
6	"	2.035	1	7.810
5	"	2.065	1	7.840
4	"	2.095	1	7.870
3	"	2.125	1	7.900
2	"	2.155	1	7.930
1	"	2.180	1	7.955
		TOTAL		331.520
		-(0.150 x 43) =		325.070

W-3 D3 D29 L= 166.276

NO	h	NOS.	T.l
1-44	3.779	44	166.276

W-3 D3a D19 L= 197.516

NO	h	NOS	T.l
1-44	4.489	44	197.516

W-3 D4 D29 L= 340.440

NO	h	NOS.	T.l
1-34	7.700	34	261.800
35	7.730	1	7.730
36	7.760	1	7.760
37	7.790	1	7.790
38	7.820	1	7.820
39	7.850	1	7.850
40	7.880	1	7.880
41	7.910	1	7.910
42	7.940	1	7.940
43	7.970	1	7.970
44	7.990	1	7.990
	TOTAL		340.440

W-3 D4a D16 L= 196.680

NO	h	NOS.	T.l
1-44	4.470	44	196.680

W-3 D5 D13 L= 857.350

NO	l	LAP	NOS	T.l
	12.800	390	65	857.350

S-2 D1 D19 L= 557.991

NO	h	l_1	l_2	NOS	T.l
1-21	-	6.355	-	21	133.455
22	13	6.355	1.900	1	8.255
23	29	"	1.900	1	8.255
24	43	"	1.900	1	8.255
25	57	"	1.901	1	8.256
26	71	"	1.901	1	8.256
27	86	"	1.902	1	8.257
28	100	"	1.903	1	8.258
29	114	"	1.903	1	8.258
30	128	"	1.904	1	8.259
31	143	"	1.905	1	8.260
32	157	"	1.906	1	8.261
33	171	"	1.908	1	8.263
34	185	"	1.909	1	8.264
35	200	"	1.910	1	8.265
36	214	"	1.912	1	8.267
37	228	"	1.914	1	8.269
38	242	"	1.915	1	8.270
39	257	"	1.917	1	8.272
40	271	"	1.919	1	8.274
41	285	"	1.921	1	8.276
42	299	"	1.923	1	8.278
43	314	"	1.926	1	8.281
44	328	"	1.928	1	8.283
45	342	"	1.931	1	8.286
46	356	"	1.933	1	8.288
47	371	"	1.936	1	8.291
48	385	"	1.939	1	8.294
49	399	"	1.941	1	8.296
50	413	"	1.944	1	8.299
51	428	"	1.948	1	8.303
52	442	"	1.951	1	8.306
53	456	"	1.954	1	8.309
54	471	"	1.957	1	8.312
55	485	"	1.961	1	8.316
56	499	"	1.964	1	8.319
57	513	"	1.968	1	8.323
58	528	"	1.972	1	8.327
59	542	"	1.976	1	8.331
60	556	"	1.980	1	8.335
61	571	"	1.984	1	8.339
62	585	"	1.988	1	8.343
63	599	"	1.992	1	8.347
64	613	"	1.996	1	8.351
65	628	"	2.001	1	8.356
66	642	"	2.005	1	8.360
67	656	"	2.010	1	8.365
68	671	"	2.015	1	8.370
69	685	"	2.019	1	8.374
70	699	"	2.024	1	8.379
71	713	"	2.029	1	8.384
72	727	"	2.034	1	8.389
73	742	"	2.039	1	8.394
74	756	"	2.045	1	8.400
75	770	"	2.050	1	8.405
76	784	"	2.055	1	8.410
77	799	"	2.061	1	8.416
78	813	"	2.066	1	8.421
79	827	"	2.072	1	8.427
80	841	"	2.078	1	8.433
81	856	"	2.084	1	8.439
82	870	"	2.089	1	8.444
83	884	"	2.095	1	8.450
84	898	"	2.101	1	8.456
85	913	"	2.108	1	8.463
86	927	"	2.114	1	8.469
87	941	"	2.120	1	8.475
		TOTAL			557.991

S-2 D2 D16 L= 305.314

NO	h	l_1	l_2	LAP	NOS	T.l
1-31	0	2.914	9.900	480	31	412.114
32	148	"	9.901	"	1	12.795
33	298	"	9.904	"	1	12.798
34	448	"	9.910	"	1	12.804
35	598	"	9.918	"	1	12.812
36	748	"	9.928	"	1	12.822
37	899	"	9.936	"	1	12.830
38	950	"	9.945	"	1	12.839
		TOTAL				505.314

S-2 D3 D16 L= 185.920

l	LAP	NOS	T.l
12.500	480	14	185.920

S-2 D4 D29 L= 762.381

NO	h	l_1	l_2	l_3	LAP	NOS	T.l
1	1.990	5.500	2.814	870	870	1	9.959
2	1.990	"	2.800	"	"	1	9.940
3	1.970	"	2.796	"	"	1	9.926
4	1.955	"	2.765	"	"	1	9.905
5	1.940	"	2.794	"	"	1	9.884
6	1.925	"	2.727	"	-	1	8.992
7	1.910	"	2.701	"	-	1	8.971
8	1.895	"	2.680	"	-	1	8.750
9	1.850	"	2.659	"	-	1	8.929
10	1.865	"	2.635	"	-	1	8.906
11	1.850	"	2.616	"	-	1	8.886
12	1.835	"	2.595	"	-	1	8.865
13	1.820	"	2.574	"	-	1	8.844
14	1.805	"	2.553	"	-	1	8.823
15	1.790	"	2.531	"	-	1	8.801
16	1.775	"	2.510	"	-	1	8.780
17	1.760	"	2.489	"	-	1	8.759
18	1.745	"	2.468	"	-	1	8.738
19	1.730	"	2.447	"	-	1	8.717
20	1.715	"	2.425	"	-	1	8.695
21-87	1.700	"	2.404	"	-	67	581.158
		TOTAL					763.625
		-(0.006 x 2 x 87) =					762.381

Approved by KIPIN KDC-05/85 BY: [illegible]
DATE 8/19/85
cont. by Jan. '85

H.G. MAJESTY'S GOVERNMENT OF NEPAL
KANKAI DEVELOPMENT BOARD
KANKAI DIVERSION STRUCTURE
GENERAL WORK

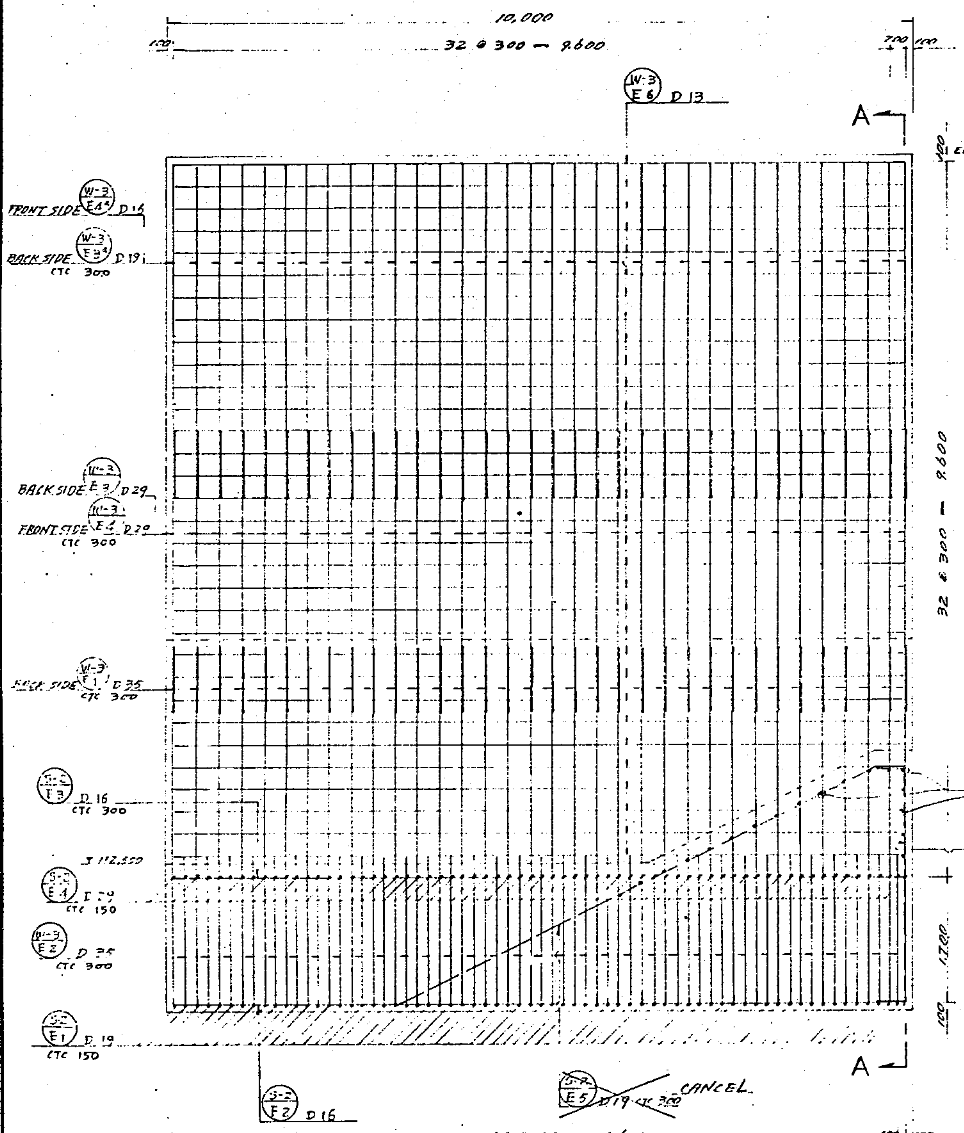
SHOP DWG

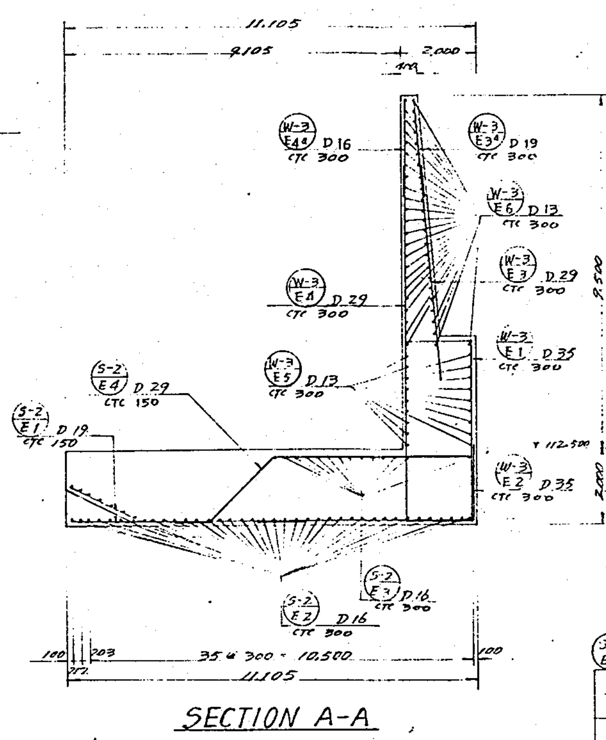
REINFORCEMENT BAR FOR LEFT BANK

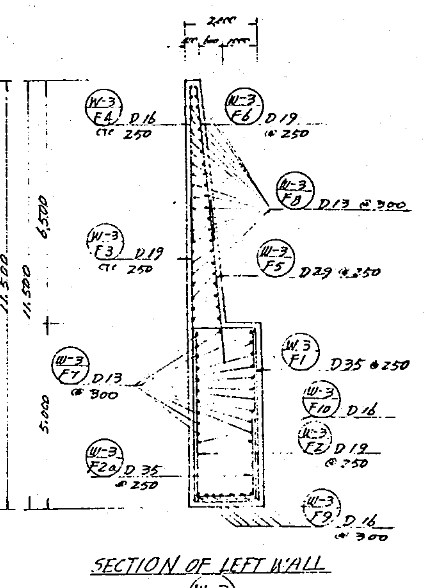
SECTION "D"-"D"

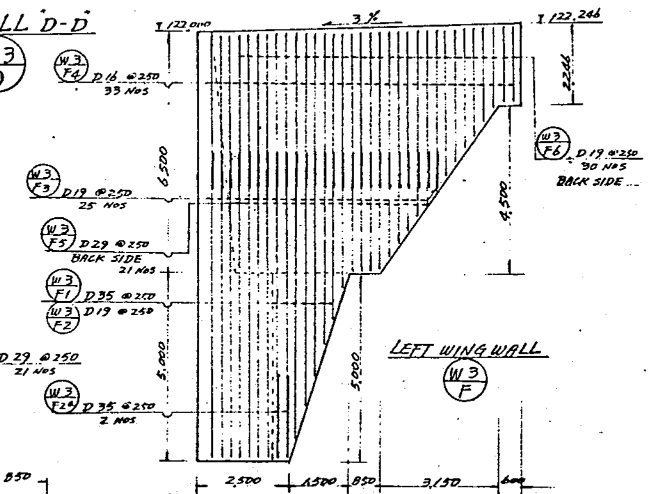
DESIGNED BY:	CHECKED BY:
	APPROVED BY:
DATE 8/19/85	DWG NO SD 012

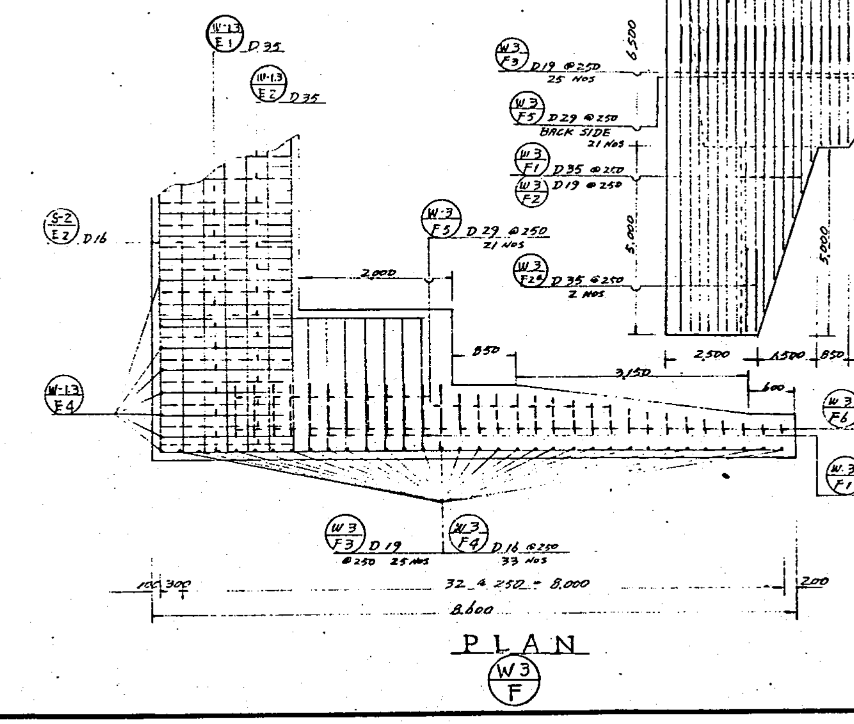
KOREA DEVELOPMENT CORP.











(W-3/E1) D35 L= 452.200

l_1	l_2	h	LAP	NOS	T.L
1.800	5.775	4.800	1.225	34	462.400

−(0.150 × 2 × 34) = 452.200

(W-3/E2) D35 L= 248.325

L	h	NOS	T.L
5.775	1.900	33	253.275

−(0.150 × 33) = 248.325

(W-3/E3) D29 L= 124.707

L	NOS	T.L
3.779	33	124.707

(W-3/E3a) D19 L= 148.137

L	NOS	T.L
4.489	33	148.137

(W-3/E4) D29 L= 261.800

L	NOS	T.L
7.700	34	261.800

(W-3/E4a) D16 L= 151.980

L	NOS	T.L
4.470	34	151.980

(W-3/E5) D13 L= 176.400

L	NOS	T.L
9.800	18	176.400

(W-3/E6) D13 L= 460.600

L	NOS	T.L
9.800	47	460.600

(S-2/E1) D19 L= 437.966

No	h	l_1	l_2	NOS	T.L
1~50	−	4.355	2.121	50	323.[illegible]
51	903	〃	2.104	1	6.552
52	831	〃	2.074	1	6.521
53	760	〃	2.056	1	6.501
54	652	〃	2.021	1	6.476
55	618	〃	1.993	1	6.453
56	546	〃	1.977	1	6.432
57	475	〃	1.958	1	6.413
58	404	〃	1.942	1	6.397
59	332	〃	1.929	1	6.384
60	261	〃	1.918	1	6.373
61	190	〃	1.909	1	6.364
62	119	〃	1.904	1	6.359
63	48	〃	1.901	1	6.356
64		6.355	−	1	6.355
65		〃	−	1	6.355
66		〃	−	1	6.355
67		〃	−	1	6.355
TOTAL					437.966

(S-2/E2) D16 L= 391.326

No	h	l_1	l_2	l_3	LAP	NOS	T.L
1-31	0	7.800	−	−	480	31	218.590
32	148	7.400	2005	400	〃	1	10.245
33	298	〃	2022	〃	〃	1	10.302
34	448	〃	2050	〃	〃	1	10.330
35	598	〃	2087	〃	〃	1	10.367
36	746	〃	2135	〃	〃	1	10.415
37	847	〃	2173	〃	〃	1	10.453
38	950	〃	2214	〃	〃	1	10.494
TOTAL							391.326

(S-2/E3) D16 L= 143.920

L	LAP	NOS	T.L
9.800	480	14	143.920

(S-2/E4) D29 L= 580.354

l_1	l_2	l_3	NOS	T.L
5.400	2.404	870	67	581.159

−(0.006 × 2 × 67) = 580.354

(W-3/F1) D35 L= 46.320

L	h	NOS	T.L
1.80 × 2	4.800	2	16.800
〃	4.300	1	7.900
〃	3.510	1	7.110
〃	2720	1	6.320
〃	1.940	1	5.540
〃	1.150	1	4.750
TOTAL			48.400

−(0.150 × 2 × 7) = 46.320

(W-3/F2) D19 L= 59.602

h	b	LAP	NOS	T.L
4.800 × 2	1.800	570	2	23.940
4.300 × 2	〃	570	1	10.970
3510 × 2	〃	−	1	8.820
2720 × 2	〃	−	1	7.240
1.940 × 2	〃	−	1	5.680
1.150 × 2	〃	−	1	4.100
				60.750

−(0.082 × 2 × 7) = 59.602

(W-3/F2a) D35 L= 8.100

No	h	b	NOS	T.L
1-2	2.400	1.800	2	8.400

−(0.150 × 2) = 8.100

(W-3/F3) D19 L= 120.150

No	h	NOS	T.L
1~9	7.700	9	69.300
10~15	7.200−3.200	6	31.200
16-19	2.700	4	10.800
20-25	2,350−0,600	6	8.850
TOTAL			120.150

(W-3/F4) D16 L= 129.352

No	h	NOS	T.L
1-25	417 ~ 4.35	25	106,500
26-31	376 ~ 2.30	6	18.780
32-33	2,032 − 2040	2	4.072
TOTAL			129.352

(W-3/F5) D29 L= 64.636

No.	h	NOS	T.L
1~11	3.779	11	41.569
12	3.311	1	3.311
13-16	2.809	4	11.236
17-21	2407 − 1001	5	8.520
TOTAL			64.636

(W-3/F6) D19 L= 124.102

No	h	NOS	T.L
1-21	4489−4441	21	93.075
22-28	4498−2284	7	25.787
29	2141	1	2.141
30	2.149	1	2.149
TOTAL			124.102

(W-3/F7) D13 L= 65.300

L	NOS	T.L
3.800	3	11.400
3700 ~ 2300	15	55.000
TOTAL		66.400

(W-3/F8) D13 L= 305.100

No	L	NOS	T.L
a	7.800 − 4.700	15 × 2	187.500
b	8.400	7 × 2	117.600
TOTAL			305.100

(W-3/F9) D16 L= 9.100

L	NOS	T.L
1.300	7	9.100

(W-3/F10) D16 L= 5.600

L	NOS	T.L
2.800	2	5.600

Approved by KIP/NKSC-05/85 on 4 Jan. '85

H.M. MAJESTY'S GOVERNMENT OF NEPAL
KANKAI DEVELOPMENT BOARD
KANKAI DIVERSION STRUCTURE
REMEDIAL WORKS PROJECT

SHOP DWG

REINFORCEMENT BAR FOR

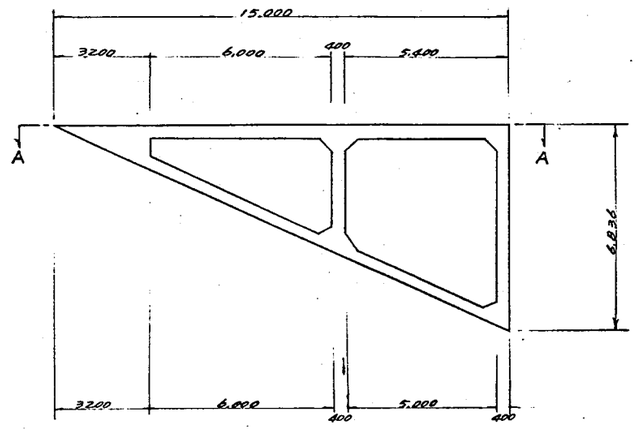
LEFT BANK

SECTION "E"-"E"
SECTION "F"-"F"

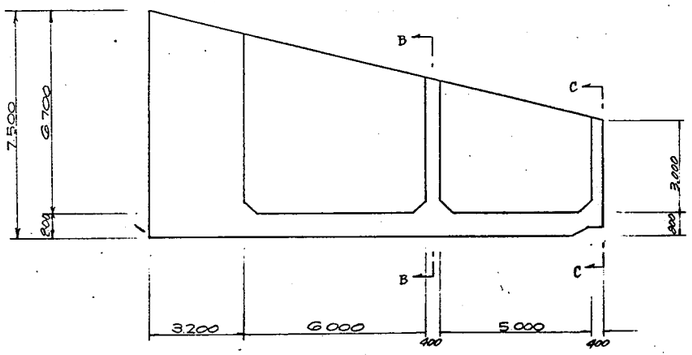
DESIGNED BY:	CHECKED BY:
DRAWN BY:	APPROVED BY:
DATE: 8/7/'84	DWG NO: SD-013

KOREA DEVELOPMENT CORP.

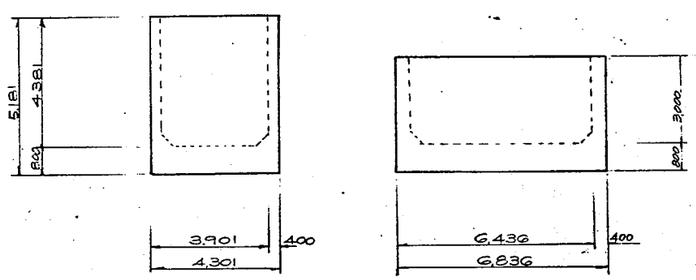
16



PLAN



PROFILE A-A



B – B

C – C

SECTION

CHUTE BLOCK

(CB 1) D.19 L= 477.456

l_1	l_2	l_3	NOS	T.l
300	2.200	100	4×49	109.600

-(0.082×2×4×49) = 477.456

(CB 2) D.19 L= 1,226.568

NO	l_1	l_2	h	NOS	T.l
1	1.300	100	2.000	49	269.500
2	"	"	1.800	49	249.900
3	"	"	1.600	49	230.300
4	"	"	1.400	49	210.700
5	"	"	1.200	49	191.100
6	"	"	1.000	49	171.500
TOTAL					1323.000

-(0.082×4×49×6) = 1,226.568

(CB 3) D.19 L= 865.340

NO	l_1	l_2	LAP	NOS	T.l
1	1.300	1.200	-	23	85.100
2	"	2.200		23	121.900
2A	"	1.700	-	24	70.200
3	"	2.800		23	158.700
3A	"	1.478	-	26	110.656
4	"	3.600		23	195.500
4A	"	2.257	-	26	151.164
TOTAL				170	893.220

-(0.082×2×170 = 865.340

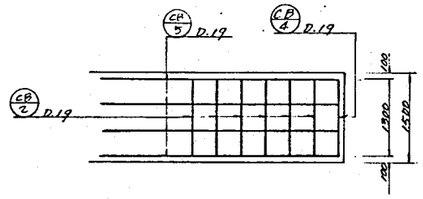
(CB 4) D.19 L= 63.700

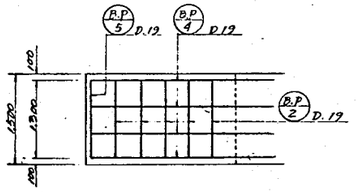
l	NOS	T.l
1.300	49	63.700

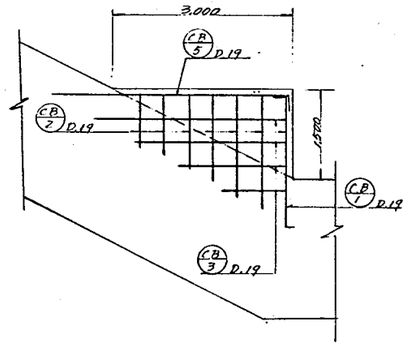
(CB 5) D.19 L= 763.168

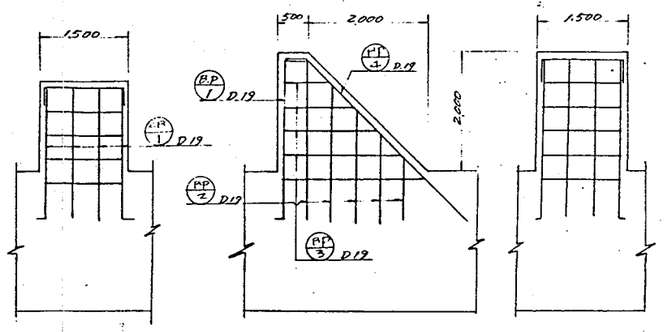
l_1	l_2	NOS	T.l
4.400	300	4×23	432.400
3.035	300	4×26	346.840
TOTAL		196	779.240

-(0.082×196) = 763.168

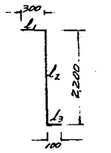


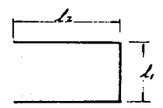


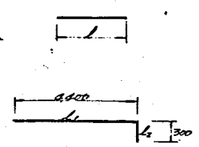




CHUTE BLOOK







BAFFLE PIER

(BP 1) D.19 L= 544.448

l_1	l_2	l_3	NOS	T.l
2600	360	100	4×47	575.230

-(0.082×2×4×47) = 544.448

(BP 2) D.19 L= 1,121.420

NO	l_1	l_2	h	NOS	T.l
1	1300	100	2600	47	314.900
2	"	"	2200	47	277.300
3	"	"	1800	47	239.700
4	"	"	1400	47	202.100
5	"	"	1000	47	164.500
TOTAL					1198.500

-(0.082×4×47×5) = 1,121.420

(BP 3) D.19 L= 1,401.070

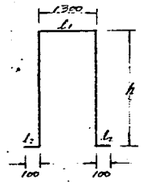
NO	l_1	l_2	LAP	NOS	T.l
1	760	1.300	570	47	220.430
2	1.160	"	"	47	258.030
3	1.560	"	"	47	295.630
4	1.960	"	"	47	333.230
5	2360	"	"	47	370.830
TOTAL					1478.150

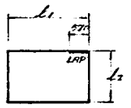
-(0.082×4×47×5) = 1.401.070

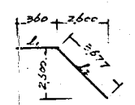
(BP 4) D.19 L= 758.016

l_1	l_2	NOS	T.l
360	3.677	47×4	758.956

-(0.005×47×4) = 758.016



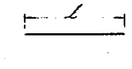




BAFFLE PIER

(BP 5) D.19 L= 61.100

l	NOS	T.l
1.300	47	61.100



HIS MAJESTY'S GOVERNMENT OF NEPAL
KANKAI DEVELOPMENT BOARD
KANKAI DIVERSION STRUCTURE
REMEDIAL WORKS PROJECT

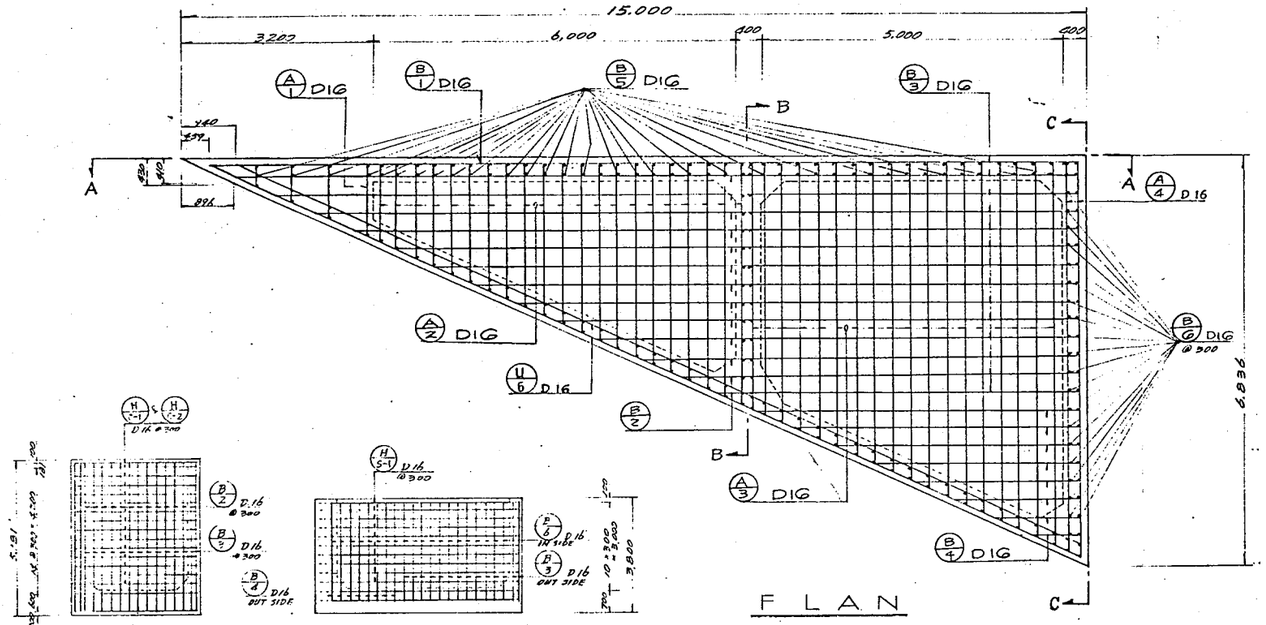
SHOP DWG

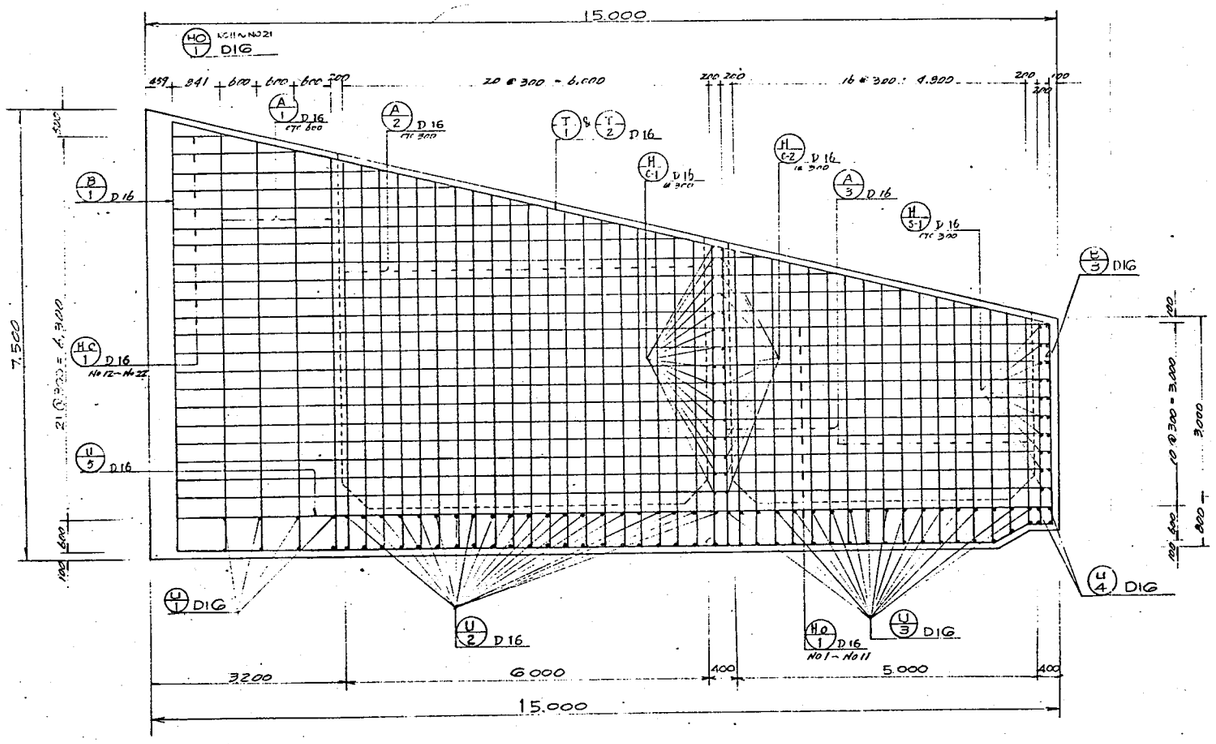
REINFORCEMENT BAR FOR
1) CHUTE BLOCK
2) BAFFLE PIER
3) TRIANGLE WALL

DESIGNED BY:	CHECK BY:
DRAWN BY:	APPROVED BY:
DATE: 31-1-85	DWG NO. SD 014

KOREA DEVELOPMENT CORP.

Approved by KIP/NKDB-05/85
on 4 Jan. 85





A1 D16 L = 59.162

No	h	b	LAP	Nos	T.L
1	6.979	385	480	1	14.823
2	6.831	659	"	1	14.801
3	6.683	934	"	1	14.780
4	6.535	1209	"	1	14.758
TOTAL					59.162

A2 D16 L = 307.535

No	h	b	LAP	Nos	T.L
1	6.486	1300	480	1	14.752
2	6.412	1437	"	1	14.742
3	6.338	1574	"	1	14.730
4	6.264	1712	"	1	14.720
5	6.190	1849	"	1	14.709
6	6.116	1986	"	1	14.698
7	6.042	2123	"	1	14.687
8	5.968	2261	"	1	14.677
9	5.894	2398	"	1	14.666
10	5.820	2535	"	1	14.655
11	5.746	2672	"	1	14.644
12	5.672	2810	"	1	14.634
13	5.598	2947	"	1	14.623
14	5.524	3084	"	1	14.612
15	5.450	3222	"	1	14.602
16	5.376	3359	"	1	14.591
17	5.302	3496	"	1	14.580
18	5.228	3633	"	1	14.569
19	5.154	3771	"	1	14.559
20	5.080	3908	"	1	14.548
21	5.006	4.045	"	1	14.537
TOTAL					307.535

A5 D16 L = 259.071

No	h	b	LAP	Nos	T.L
1	4.927	4.137	480	1	14.531
2	4.907	4.228	"	1	14.522
3	4.833	4.365	"	1	14.511
4	4.759	4.503	"	1	14.501
5	4.685	4.640	"	1	14.490
6	4.611	4.777	"	1	14.479
7	4.537	4.914	"	1	14.468
8	4.463	5.052	"	1	14.458
9	4.389	5.189	"	1	14.447
10	4.315	5.326	"	1	14.436
11	4.241	5.463	"	1	14.425
12	4.167	5.601	"	1	14.415
13	4.093	5.738	"	1	14.404
14	4.019	5.875	"	1	14.393
15	3.945	6.012	"	1	14.382
16	3.871	6.150	"	1	14.372
17	3.660	6.287	"	1	14.087
18	3.423	6.424	"	1	13.750
TOTAL					259.071

A4 D16 L = 23.880

No	h	b	LAP	Nos	T.L
1	3374 x 2	6.516	480	1	13.744
2	3325 x 2	6.607	480	1	10.412
TOTAL					24.156

-(0.069 x 2 x 2) = 23.880

B1 D16 L = 22.007

No	h1	h2	b	LAP	Nos	T.L
1	7.187	4.957	9.041	2 x 480	1	22.185

:-(0.069 x 2 x 1) = 22.007:

B2 D16 L = 127.614

No	h	b	LAP	Nos	T.L
1	4.957	8.604	480	1	14.041
2	"	7.948	"	1	13.358

No	h	b	LAP	Nos	T.L
3	4.957	7.293	480	1	12.730
4	"	6.637	480	1	12.074
5	"	5.981	480	1	11.419
6	"	5.326	480	1	10.763
7	"	4.670	480	1	10.107
8	"	4.014	—	1	8.971
9	"	3.359	—	1	8.316
10	"	2.703	—	1	7.660
11	"	2.047	—	1	7.004
12	"	1.392	—	1	6.349
13	"	736	—	1	5.693
TOTAL					128.611
-(0.069 x 13) =					127.614

H3 D 16 L = 200.956

No	h1	h2	b1	b2	S	LAP	Nos	T.L
1-14	5.006	3.325	4.672	429	583	480	14	202.916
-(0.130 x 14) =								200.956

H4 D 16 L = 52.169

No	h	h1	b2	S	Nos	T.L
1	3325	4.552	428	583	1	8.868
2	"	3.896	"	"	1	6.732
3	"	3.240	"	"	1	7.576
4	"	2.595	"	"	1	6.421
5	"	1.929	"	"	1	6.265
6	"	1.273	"	"	1	5.609
7	"	617	"	"	1	4.953
8	"	—	"	537	1	4.292
TOTAL						52.736
-(0.071 x 7 + 0.070 x 1) =						52.169

B5 D16 L = 444.305

No	h	Nos	T.L
1	6.979	1	6.779
2	6.831	2	13.662
3	6.683	2	13.366
4	6.535	2	13.070
5	6.386	2	12.772
6	6.238	2	12.476
7	6.090	2	12.180
8	6.761	2	12.522
9	6.190	2	12.380
10	6.116	2	12.232
11	6.042	2	12.084
12	5.968	2	11.936
13	5.894	2	11.788
14	5.820	2	11.640
15	5.746	2	11.492
16	5.672	2	11.344
17	5.598	2	11.196
18	5.524	2	11.048
19	5.450	2	10.900
20	5.376	2	10.752
21	5.302	2	10.604
22	5.228	2	10.456
23	5.154	2	10.308
24	5.080	2	10.160
25	5.006	1	5.006
26	4.957	1	4.957
27	4.905	2	9.816
28	4.834	2	9.668
29	4.760	2	9.520
30	4.686	2	9.372
31	4.612	2	9.224
32	4.538	2	9.076
33	4.464	2	8.928
34	4.390	2	8.780

No	h	Nos	T.L
35	4.316	2	8.632
36	4.242	2	8.484
37	4.168	2	8.336
38	4.094	2	8.188
39	4.020	2	8.040
40	3.946	2	7.892
41	3.872	2	7.744
42	3.662	2	7.324
43	3.424	2	6.848
44	3.374	2	6.748
45	3.325	1	3.325
TOTAL			444.305

P6 D16 L = 67.480

No	h	Nos	T.L
1-20	3.374	20	67.480

HO1 D16 L = 607.199

No	l1	l2	l3	LAP	Nos	T.L
1-11	14.441	15.891	6.607	2 x 480	11	472.612
12	13.351	14.655	—	2 x 480	1	29.421
13	12.110	13.318	—	2 x 480	1	26.388
14	10.896	11.990	—	2 x 480	1	23.934
15	9.677	10.643	—	2 x 480	1	21.280
16	8.461	9.305	—	480	1	15.245
17	7.245	7.968	—	480	1	15.673
18	6.029	6.630	—	480	1	13.139
19	4.813	5.293	—	480	1	11.586
20	3.596	3.955	—	—	1	7.551
21	2.352	2.618	—	—	1	4.998
22	1.164	1.280	—	—	1	2.444
TOTAL						607.199

HO2 D16 L = 236.127

No	l1	LAP	Nos	T.L
1-11	14.006	480	11	159.324
12	12.888	"	1	13.343
13	11.672	"	1	12.152
14	10.456	"	1	10.936
15	9.240	"	1	9.720
16	8.024	—	1	8.024
17	6.908	—	1	6.908
18	5.591	—	1	5.591
19	4.375	—	1	4.375
20	3.159	—	1	3.159
21	1.943	—	1	1.943
22	727	—	1	727
TOTAL				236.127

HIS MAJESTY'S GOVERNMENT OF NEPAL
KANKAI DEVELOPMENT BOARD
KANKAI DIVERSION STRUCTURE
REMEDIAL WORKS PROJECT.

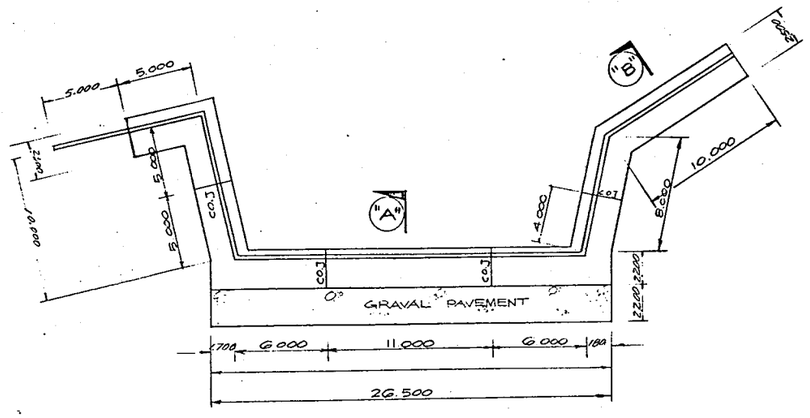
SHOP DWG

REINFORCEMENT BAR FOR

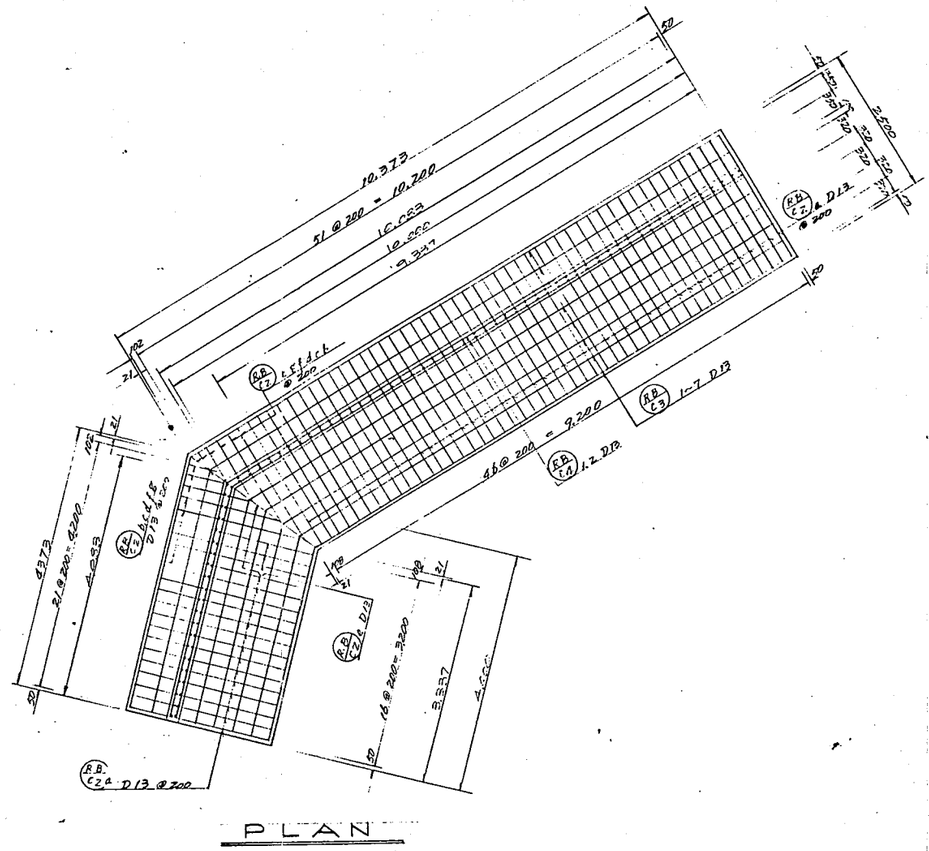
TRIANGLE WALL

DESIGNED BY:	CHECKED BY:
DRAWN BY: [illegible]	APPROVED BY:
DATE: 6/7/84	DWG NO. SD 015

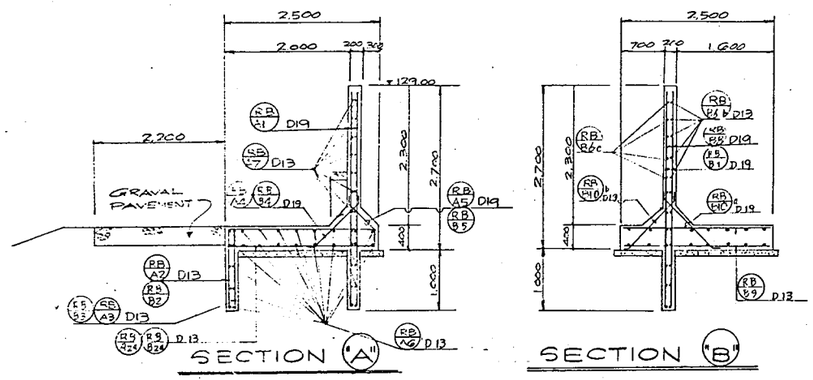
Approved by KIP/NKDC-05/85 DEVELOPMENT CORP. on 4 Jan. '85 falls

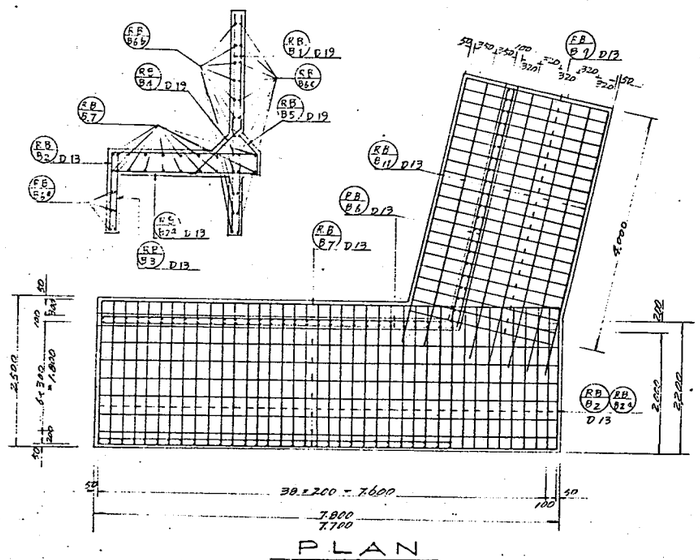


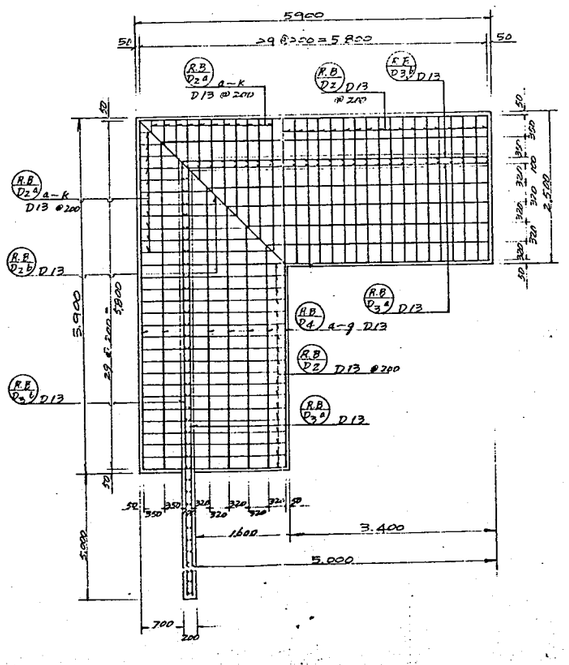
PLAN OF RETAINING WALL



PLAN







A1 D19 L= 403.200

l	Nos	T.l
3.600	56 x 2	403.200

A2 D13 L= 204.064

l_1	l_2	Nos	T.l
2.400	1.300	56	207.200

-(0.056 x 56) = 204.064

A24 D13 L= 134.400

l	Nos	T.l
2.400	56	134.400

A3 D13 L= 72.800

l	Nos	T.l
1.300	56	72.800

A4 D19 L= 71.680

l_1	l_2	l_3	Nos	T.l
150	490	150	56	72.240

-(0.005 x 2 x 56) = 71.680

A5 D19 L= 60.144

l_1	l_2	l_3	l_4	Nos	T.l
150	586	300	150	56	65.296

-(0.092 x 56) = 60.144

A6 D13 L= 261.600

l	Nos	T.l
10.900	24	261.600

A7 D13 L= 261.600

l	Nos	T.l
10.900	24	261.600

Approved by KIP/NEDC-05/85 on 4 Jan. '85

HIS MAJESTY'S GOVERNMENT OF NEPAL
KANKAI DEVELOPMENT BOARD
KANKAI DIVERSION STRUCTURE
REVEDIAL WORKS PROJECT

SHOP D.WG

REINFORCEMENT BAR FOR RETAINING WALL

DESIGNED BY:	CHECKED BY:
DRAWN BY: PARK	APPROVED BY:
DATE: 9/1/85	D.WG. NO. SD 016

KOREA DEVELOPMENT CORP.

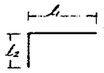
RB/B1 D.19 L=432.000

h	Nos	T.l
3.600	30×2×2	432.000

RB/B2 D.13 L=218.640

l_1	l_2	Nos	T.l
2.400	1.300	30×2	222.000

-(0.056×30×2) = 218.640



FB/B24 D.13 L=235.200

NO	l	Nos	T.l
A	2.400	30×2	144.000
B	2.400	(10-9)×2	91.200
TOTAL			235.200

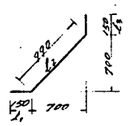
RB/B3 D.13 L=78.000

h	Nos	T.l
1.300	30×2	78.000

RB/B4 D.19 L=77.400

l_1	l_2	l_3	Nos	T.l
150	990	150	30×2	77.400

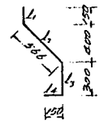
-(0.005×2×30×2) = 76.800



RB/B5 D.19 L=66.000

l_1	l_2	l_3	l_4	Nos	T.l
150	566	300	150	30×2	69.960

-{(0.005×2+0.056)×60} = 66.000



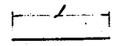
RB/B6 D.13 L=569.184

NO	l_1	l_2	Nos	T.l
a	5.900	—	6×2	70.800
b	5.907	4.070	12	119.748
b_1	5.907	5.070	12	131.748
c	5.929	3.990	12	117.828
c_1	5.829	4.990	12	129.828
TOTAL				569.952

-(0.016×12×4) = 569.184

RB/B7 D.13 l=275.400

l	Nos	T.l
7.700	9×2	138.600
7.600	9×2	136.800
TOTAL		275.400

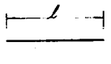


RB/B8 D.19 L=338.400

h	Nos	T.l
3.600	(21+24)×2	338.400

RB/B9 D.13 L=225.600

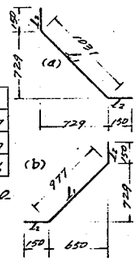
l	Nos	T.l
2.400	(21+26)×2	225.600



RB/B10 D.19 L=121.730

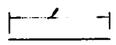
NO	l_1	l_2	Nos	T.l
a	1.031	150	21+26	62.557
b	977	150	21+26	60.019
TOTAL				122.576

-{(0.005×2+0.008)×47} = 121.730



RB/B11 D.13 L=136.640

NO	l	Nos	T.l
a	4.380	7×2	61.320
b	5.380	7×2	75.320
TOTAL			136.640

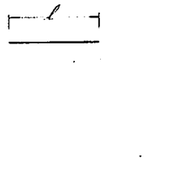


RB/C1 D.19 L=511.200

h	Nos	T.l
3.600	71×2	511.200

RB/C2 D.13 L=338.936

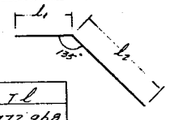
NO	l	Nos	T.l
a	2.400	64×2	307.200
b	2.492	2×2	9.968
c	2.085	2×2	8.340
d	1.602	2×2	6.408
e	1.119	2×2	4.476
f	0.636	2×2	2.544
TOTAL			338.936



RB/C4 D.13 L=344.880

NO	l_1	l_2	LAP	Nos	T.l
1	4.012	10.012	390	12	172.968
2	3.971	9.971	390	12	171.984
TOTAL					344.952

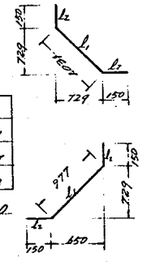
-(0.003×12×2) = 344.880



RB/C5 D.19 L=183.890

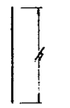
NO	l_1	l_2	Nos	T.l
a	1.031	150	71	94.501
b	977	150	71	90.667
TOTAL				185.168

-{(0.010+0.008)×71} = 183.890



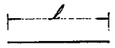
RB/D1 D.19 L=561.600

l	Nos	T.l
3.600	156	561.600



RB/D2 D.13 L=172.800

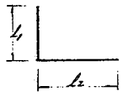
l	Nos	T.l
2.400	36×2	172.800



RB/D24 D.13 L=51.568

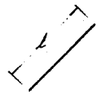
NO	l_1	l_2	Nos	T.l
a	2.200	2.200	2	8.800
b	2.000	2.000	2	8.000
c	1.800	1.800	2	7.200
d	1.600	1.600	2	6.400
e	1.400	1.400	2	5.600
f	1.200	1.200	2	4.800
g	1.000	1.000	2	4.000
h	0.800	0.800	2	3.200
i	0.600	0.600	2	2.400
j	0.400	0.400	2	1.600
k	0.200	0.200	2	0.800
TOTAL				52.800

-(0.056×2×11) = 51.568



RH/D12b D.13 L=6.788

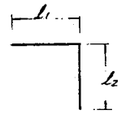
l	Nos	T.l
3.394	2	6.788



RB/D3 D.13 L=358.656

NO	l_1	l_2	Nos	T.l
a	5.000	5.000	12	120.000
b	5.100	5.100	12	122.400
c	4.900	—	24	117.600
TOTAL				360.000

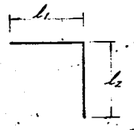
-(0.056×12×2) = 358.656



RB/D4 D.13 L=125.016

NO	l_1	l_2	Nos	T.l
a	5.800	5.800	2	23.200
b	5.450	5.450	2	21.800
c	4.680	4.680	2	18.720
d	4.360	4.360	2	17.440
e	4.040	4.040	2	16.160
f	3.720	3.720	2	14.880
g	3.400	3.400	2	13.600
TOTAL				125.800

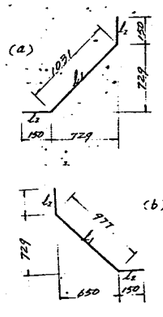
-(0.056×2×7) = 125.016



RB/D5 D.19 L=134.732

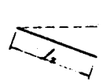
NO	l_1	l_2	Nos	T.l
a	1.031	150	53	70.543
b	977	150	51	65.127
TOTAL				135.670

-(0.010×53+0.008×51) = 134.732



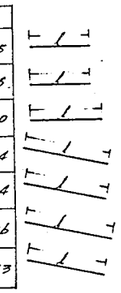
HD/2-1 D.16 L=258.353

NO	l_2	LAP	Nos	T.l
1-11	13.352	480	11	174.669
12	14.126	"	1	14.606
13	12.788	"	1	13.268
14	11.450	"	1	11.930
15	10.113	"	1	10.593
16	8.775	—	1	8.775
17	7.437	—	1	7.437
18	6.100	—	1	6.100
19	4.762	—	1	4.762
20	3.424	—	1	3.424
21	2.087	—	1	2.087
22	749	—	1	749
TOTAL				258.353



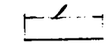
D.16

	NO	l	LAP	Nos	T.l
H/C-1	1-15	4.035	—	15	60.675
H/C-2	1-15	4.137	—	15	62.055
H/S-1	1-10	6.516	—	10	65.160
T/1	-1	14.874	480	1	15.354
	-2	14.424	480	1	14.904
T/2	-1	16.276	480	1	16.756
	-2	15.733	480	1	16.213



U/4 D.16 L=6.516

NO	l
1	6.516



U/5 D.16 L=135.744

NO	l	LAP	Nos	T.l
1	13.349	480	1	13.829
2	12.693	"	1	13.173
3	12.037	"	1	12.517
4	11.381	"	1	11.861
5	10.726	"	1	11.206
6	10.070	"	1	10.550
7	9.414	"	1	9.894
8	8.759	—	1	8.759
9	8.103	—	1	8.103
10	7.447	—	1	7.447
11	6.791	—	1	6.791
12	6.136	—	1	6.136
13	5.480	—	1	5.480
14	4.824	—	1	4.824
15	4.169	—	1	4.169
16	3.513	—	1	3.513
17	2.857	—	1	2.857
18	2.201	—	1	2.201
19	1.546	—	1	1.546
20	890	—	1	890
TOTAL				135.744

U/1 D.16 L=3.196

NO	l
1	3.05
2	65.9
3	93.1
4	1.205
TOTAL	3.196

U/3 D.16 L=95.650

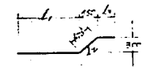
NO	l
1	4.136
2	4.728
3	4.365
4	4.503
5	4.640
6	4.777
7	4.914
8	5.052
9	5.189
10	5.326
11	5.463
12	5.601
13	5.738
14	5.875
15	6.012
16	6.150
17	6.287
18	6.424
TOTAL	98.680

U/2 D.16 L=56.125

NO	l
1	1.300
2	1.437
3	1.575
4	1.712
5	1.849
6	1.986
7	2.124
8	2.261
9	2.398
10	2.535
11	2.673
12	2.810
13	2.947
14	3.084
15	3.222
16	3.359
17	3.496
18	3.633
19	3.771
20	3.908
21	4.045
TOTAL	56.125

U/6 D.16 L=37.345

NO	l_1	l_2	l_3	LAP	Nos	T.l
1	14.860	626	471	480	1	16.427
2	14.331	626	471	480	1	15.918
TOTAL						32.345



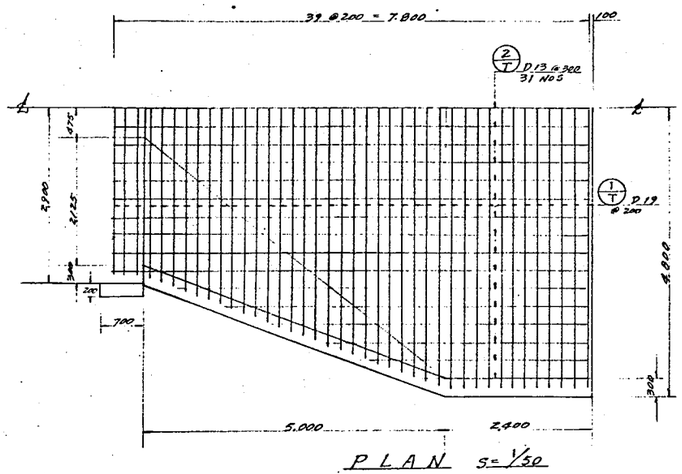
HIS MAJESTYS GOVERNMENT OF NEPAL
KANKAI DEVELOPMENT BOARD
KANKAI DIVERSION STRUCTURE
REMEDIAL WORKS PROJECT

SHOP DWG.

REINFORCEMENT BAR FOR RETAINING WALL AND TRIANGLE WALL

DESIGNED BY:	CHECKED BY:
DRAWN BY:	APPROVED BY:
DATE: 10/10/84	DWG NO. SD 017
KOREA DEVELOPMENT CORP.	

Approved by KIPIN on 4 Jan. '85

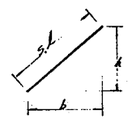


PLAN S= 1/50

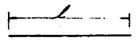
(1/T) D19 L= 494.440						
NO	b	h	LAP	NOS	T.L	
1-3	5300	2000 x 2	570	3	30.210	
4	5576	1988 x 2	"	1	10.122	
5	5728	1984 x 2	"	1	10.226	
6	5880	1940 x 2	"	1	10.330	
7	6032	1916 x 2	"	1	10.434	
8	6184	1928 x 2	"	1	10.610	
9	6336	1939 x 2	"	1	10.784	
10	6488	1951 x 2	"	1	10.960	
11	6640	1963 x 2	"	1	11.136	
12	6792	1975 x 2	"	1	11.312	
13	6944	1986 x 2	"	1	11.486	
14	7096	1998 x 2	"	1	11.662	
15	7248	2010 x 2	"	1	11.832	
16	7400	2021 x 2	"	1	12.012	
17	7552	2033 x 2	"	1	12.188	
18	7704	2045 x 2	"	1	12.364	
19	7856	2057 x 2	"	1	12.540	
20	8008	2068 x 2	"	1	12.714	
21	8160	2080 x 2	"	1	12.890	
22	8312	2092 x 2	"	1	13.066	
23	8464	2103 x 2	"	1	13.240	
24	8616	2115 x 2	"	1	13.416	
25	8768	2127 x 2	"	1	13.592	
26	8920	2139 x 2	"	1	13.768	
27	9072	2150 x 2	"	1	13.942	
28	9224	2162 x 2	"	1	14.118	
29-40	9300	2150 x 2	"	12	170.040	
		TOTAL			col. 000	

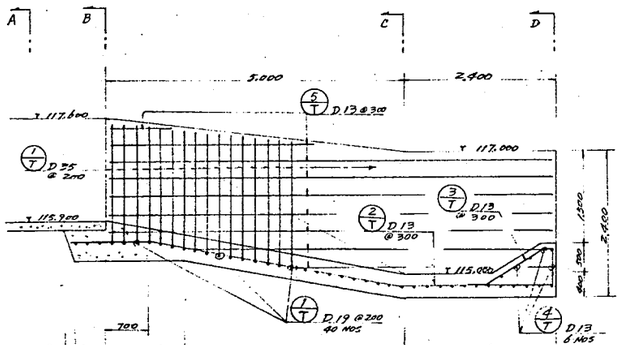
-(0.082 x 2 x 40) = 494.440

(6/T) D13 L= 39.936					
NO	h	b	s.l	NOS	T.L
1	1566	1933	2.488	2	4.976
2	1462	1806	2.324	2	4.648
3	1362	1678	2.161	2	4.322
4	1260	1550	1.998	2	3.996
5	1158	1423	1.835	2	3.670
6	1056	1295	1.671	2	3.342
7	954	1169	1.508	2	3.016
8	852	1040	1.344	2	2.688
9	750	913	1.182	2	2.364
10	648	785	1.018	2	2.036
11	546	658	855	2	1.710
12	444	530	691	2	1.382
13	342	402	528	2	1.056
14	240	275	365	2	730
TOTAL					39.936

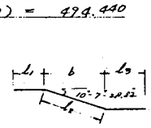


(7/T) D13 L= 55.352			
NO	l	NOS	T.L
1	1.296	2	2.592
2	2.167	2	4.334
3	3.039	2	6.078
4	3.914	2	7.828
5	3.777	2	7.554
6	3.314	2	6.628
7	2.852	2	5.704
8	2.389	2	4.778
9	1.926	2	3.852
10	1.463	2	2.926
11	1.001	2	2.002
12	538	2	1.076
TOTAL			55.352

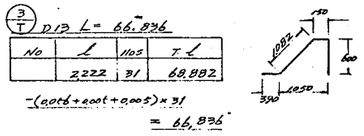


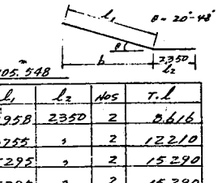


ELEVATION S= 1/50

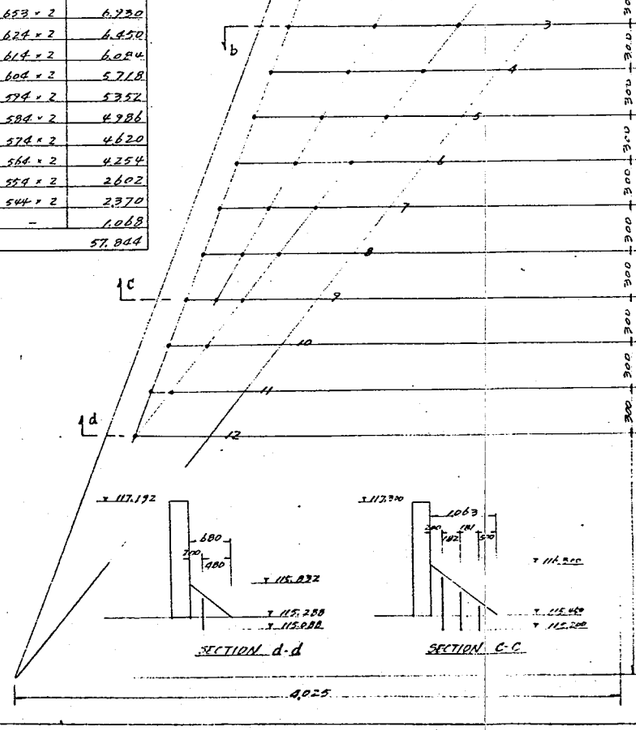


(2/T) D13 L= 209.658						
NO	b	l2	l1	l3	NOS	T.L
1	4200	4246	1250	2450	19	151.354
2	4200	4246	182	2450	2	13.716
3	3553	3609	-	2450	2	12.118
4	2763	2806	-	2450	2	10.512
5	1974	2025	-	2450	2	8.950
6	1184	1203	-	2450	2	7.306
7	395	401	-	2450	2	5.702
			TOTAL			209.658



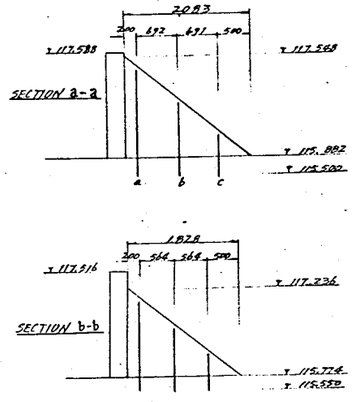


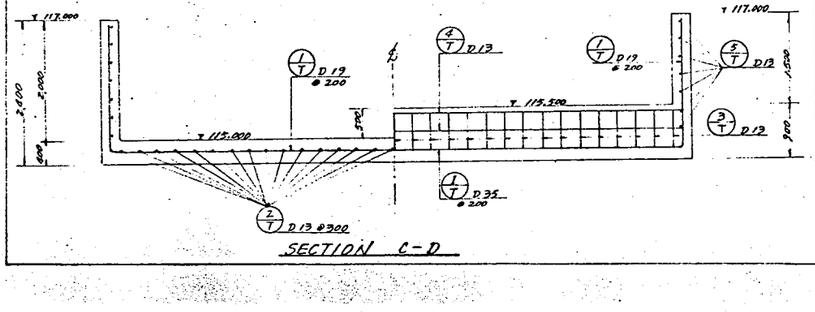
(8/T) D13 L= 57.844				
LINE NO	a	b	c	T.L
1	1788 x 2	1235 x 2	682 x 2	7.410
2	1657 x 2	1155 x 2	653 x 2	6.930
3	1526 x 2	1075 x 2	624 x 2	6.450
4	1414 x 2	1014 x 2	614 x 2	6.084
5	1302 x 2	953 x 2	604 x 2	5.718
6	1190 x 2	892 x 2	594 x 2	5.352
7	1078 x 2	831 x 2	584 x 2	4.986
8	966 x 2	770 x 2	574 x 2	4.620
9	854 x 2	709 x 2	564 x 2	4.254
10	747 x 2	-	554 x 2	2.602
11	641 x 2	-	544 x 2	2.370
12	534 x 2	-	-	1.068
TOTAL				57.844



SECTION d-d

SECTION C-C





SECTION A-B S= 1/50

SECTION C-D

HIS MAJESTY'S GOVERNMENT OF NEPAL
KANKAI DEVELOPMENT BOARD
KANKAI DIVERSION STRUCTURE REMEDIAL WORKS PROJECT

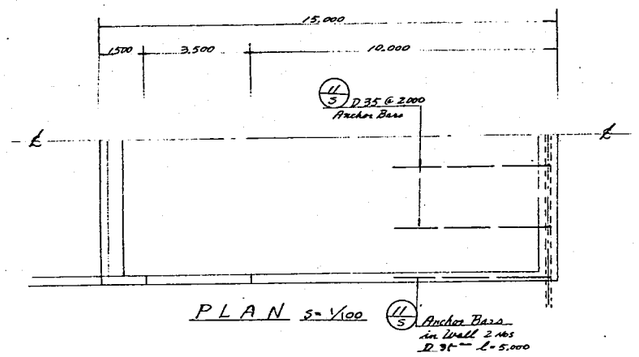
SHOP DWG

REINFORCEMENT BAR FOR OUTLET STRUCTURE (1/2)

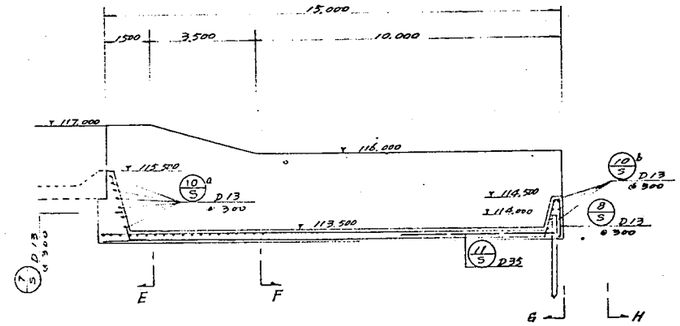
SCALE 1/50

DESIGNED BY :	CHECKED BY
DRAWN BY :	APPROVED BY
DATE :	DWG NO : SD 018

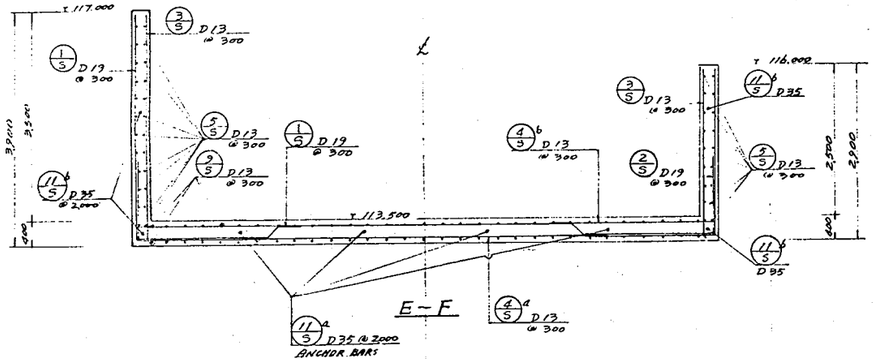
KOREA DEVELOPMENT CORPORATION

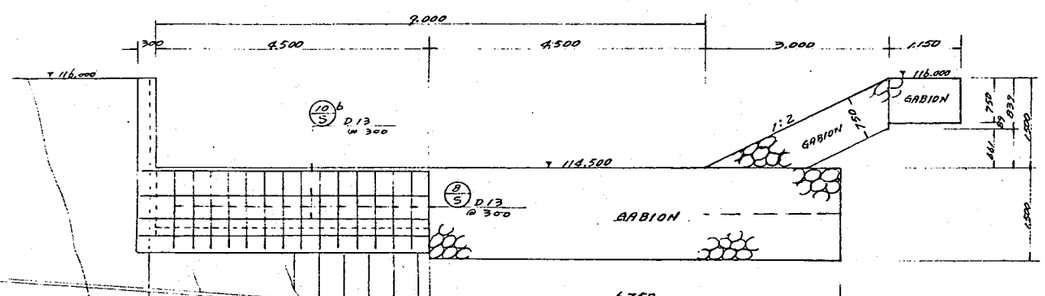


PLAN S=1/100 (11/5) Anchor Bars in Wall 2 nos D 35 L=5.000



ELEVATION S=1/100

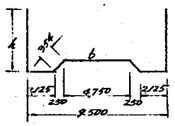




(1/5) D 19 L= 820.754

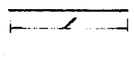
No	b	h	LAP	Nos	T. ℓ
1	0.708	1.500 x 2	570	1	13.278
2-6	"	3.800 x 2	"	5	89.320
7	"	3.772 x 2	"	1	17.822
8	"	3.689 x 2	"	1	17.656
9	"	3.606 x 2	"	1	17.490
10	"	3.522 x 2	"	1	17.322
11	"	3.439 x 2	"	1	17.156
12	"	3.356 x 2	"	1	16.990
13	"	3.273 x 2	"	1	16.824
14	"	3.190 x 2	"	1	16.658
15	"	3.107 x 2	"	1	16.492
16	"	3.023 x 2	"	1	16.324
17	"	2.940 x 2	"	1	16.158
18	"	2.857 x 2	"	1	15.992
19-51	"	2.800 x 2	"	33	523.974
TOTAL					829.526

-(0.082 x 2 + 0.004 x 2) x 51 = 820.754



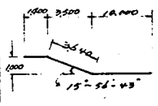
(4/5) D13 L= 626.280

NO	ℓ	Nos	T. ℓ
a	6.390	51	325.890
b	2.945	51x2	300.390
TOTAL			626.280



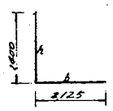
(5/5) D13 L= 585.840

NO	ℓ	Lap	Nos	T. ℓ
1	15.000	390	4x2x2	246.240
2	14.700	390	5x2x2	301.800
3	4.200	—	1x2x2	16.800
4	3.150	—	1x2x2	12.600
5	2.100	—	1x2x2	8.400
TOTAL				585.840



(2/5) D 19 L= 344.300

NO	b	h	Nos	T. ℓ
1-50	2.125	1.400	50x2	352.500
-(0.082 x 100) =				344.300

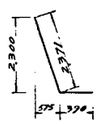


(6/5) D13 L= 61.72

NO	ℓ	Lap	Nos	T. ℓ
1	15.040	390	2x2	61.720

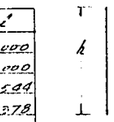
(7/5) D13 L= 79.170

NO	h	S	b	Nos	T. ℓ
1-29	2300	2371	390	29	80.069
-(0.031 x 29) =					79.170



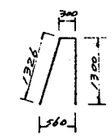
(3/5) D13 L= 305.348

NO	h	Nos	T. ℓ
1	1.500	2	3.000
2-6	3.800	5x2	38.000
7	3.772	2	7.544
8	3.689	2	7.378
9	3.606	2	7.212
10	3.522	2	7.044
11	3.439	2	6.878
12	3.356	2	6.712
13	3.273	2	6.546
14	3.190	2	6.380
15	3.107	2	6.214
16	3.023	2	6.046
17	2.940	2	5.880
18	2.857	2	5.714
19-51	2.800	33x2	184.800
TOTAL			305.348



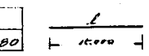
(8/5) D13 L= 81.606

NO.	ℓ	Nos	T. ℓ
1-29	2.926	29	84.854
-(0.056 x 2 x 29) =			81.606



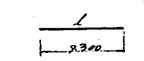
(9/5) D13 L= 954.180

NO	ℓ	Lap	Nos	T. ℓ
1-31	15.000	390	31x2	954.180



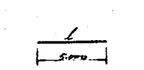
(10/5) D13 L= 120.900

NO	ℓ	Nos	T. ℓ
a	9.300	7	65.100
b	9.300	6	55.800
TOTAL			120.900



(11/5) D 35 L= 40.000

NO	ℓ	Nos	T. ℓ
a	5.000	4	20.000
b	5.000	4	20.000
TOTAL		8	40.000



HIS MAJESTY GOVERNMENT OF NEPAL
KANKAI DEVELOPMENT BOARD
KANKAI DIVERSION STRUCTURE REMEDIAL WORKS PROJECT

SHOP DWG
REINFORCEMENT BAR FOR
OUTLET STRUCTURE (3/3)
SCALE. 1/50, 1/100

DESIGNED BY:	CHECKED BY:
DRAWN BY	APPROVED BY:
DATE:	DWG NO: SD 019

KOREA DEVELOPMENT CORPORATION

ANNEX - 4

LIST OF CORRESPONDENCES

April 1983 to January 1984

Letter from NK to Project Manager

NKP-16	Apr. 10	Site Inspection by Mr. T. Terai
NKK-14	Apr. 15	Diversion Weir, Kankai Irrigation Project
KBO-53	May 31	ADB Mission for Kankai Project
NKK-24	Jul. 28	Damage of Launching Apron by Flood
" -35	Sept. 11	Departure Report - Mr. Y. Murai
CEH-01	Sept. 16	Performance of Engineering Services by Mr. Y. Murai for Kankai Diversion Structure Remedial Works Project
" -02	"	Submission of Contract Document (Civil) for Kankai Diversion Structure Remedial Works Project
NKK-37	Sept. 18	Specification of Steel Sheet Pile
" -38	Sept. 30	Submission of Report on "Evaluation on Qualification of Tenderers for KDSRW"
" -39	"	Submission of Report on "Evaluation on Bids for Supply of Steel Sheet Piles for KDSRW"
" -40	"	Recommendation on Change of Type of Steel Sheet Pile for KDSRW
" -41	Oct. 2	Hydraulic Model Test, Diversion Weir
" -42	Oct. 3	Bid for Supply of Sheet Pile
" -43	Oct. 4	Classification on Change of Sheet Pile Type
" -44	Oct. 6	Taxation Clause to Civil Tender Document for KDSRW
" -46	"	Arrival Information, Mr. Y. Murai
" -47	"	Submission of Original Copy of Civil Tender Document for KDSRW
" -48	"	Change of Conditions for Civil Tender Document for KDSRW to be Informed to ADB
" -49	Oct. 9	Recommendation for Amendment on Civil Work Tender Document for KDSRW
" -50	"	Submission of Tender Document on KDSRW
KBO-98	"	Departure Information - Mr. Y. Murai
CEH-03	Oct. 19	Increase of Sheet Piles Procurement
NKK-51	Oct. 25	Draft Contract for Engineering Services for KDSRW
CEH-06	Nov. 19	Hydraulic Model Test Report
NKK-53	Dec. 5	Submission of Report on "Tender Evaluation for Construction of KDSRW"
" -54	"	Arrival Report - Mr. T. Kawakatsu
CEH-05	Dec. 12	Submission of Report on "Hydraulic Model Test for Stilling Basin for Kankai Diversion Weir
NKK-59	Dec. 14	Departure Notice of Mr. T. Kawakatsu
CEH-08	Jan. 31	Submission of Additional Technical Note on Detailed Design of Stilling Basin of Kankai Diversion Structure

Letter from NK to ADB

CEH-04	Nov. 4	KDSRW, Text of Amendment for SFRC
" -05	Nov. 18	Explanatory Note on Hydraulic Model Test for KDSRW

Letter from Project Manager (DIHM) to NK

KIP-C/O-039/40	Mar. 21	Assignment of an Experienced Hydraulic Engineer
KIP-039/40 Cha. No. 617	May. 12	Regarding Visit of ADB Specialist Consultant
IRR/PA(F)39/040 Cha. No. 1739	Sept. 7	Proposal for Consulting Services for Diversion Structure Remedial Measure Works of KIP
KPO/KDB/040-041 Cha. No. 32	Sept. 19	Assignment of One Consultant for Evaluation of Bid Document and Prequalification Document
KPO/IRR/AD/040-41 Cha. No. 54	Oct. 12	Consulting Services for KDSRW
KDB/IRR/040-41 Cha. No. 92	Nov. 14	Model Test Results and Detailed Design Reports
KDB/IRR/040-41 Cha. No. 93	"	Guidelines for the Design of KDSRW
KDB/AD/040-41 Cha. No. 96	Oct. 15	Assigning Experienced Personal for the Evaluation of Tender Documents for Civil Works of KDSRW

Letter from ADB to DIHM/NK

ARI 2/SAN-115/L	Aug. 1	Kankai Irrigation Project - Diversion Weir
- NA -	Dec. 6	Nepal, KDSRW, Draft Agreement for Consulting Services
IRRI 2/SAN-012/L	Jan. 26	KDSRW, Review of Hydraulic Model Test & Final Report

February and March 1984

Letter from NK to Project Manager

NKP/RE-13/84	Feb. 14	Arrival Information, Mr. Y. Murai
" -14/84	Feb. 15	Revised design of stilling basin
" -21/84	Feb. 26	Estimation of HMGN Expenditure schedule for Kankai Diversion Structure Remedial Works Project
" -22/84	"	First Assignment of Chief Engineer for Kankai Diversion Structure Remedial Works Project
" -23/84	"	Nippon Koei's Brief Note on Mr. S.F. Hillis report for Kankai Diversion Structure Remedial Works
" -24/84	Feb. 28	Original Drawings Returned
" -26/84	Mar. 2	Trial Mix of Concrete for Diversion Structure Remedial Works
" -28/84	Mar. 4	Arrival Information- Mr. Y. Gotanda
" -31/84	Mar. 18	Submission of Final Drawings and Calculation Reports for Kankai Diversion Structure Remedial Works Project
" -32/84	Mar. 19	Advance Payment for Mobilization
" -33/84	Mar. 20	Samples of Steel Fiber
" -34/84	Mar. 21	Quarry Site of Concrete Aggregates
" -35/84	"	Report on Construction Plan
" -36/84	Mar. 22	Construction Plants Imported by Korea Development Corporation for Kankai Diversion Structure Remedial Works Project
" -38/84	Mar. 25	Departure Information, Mr. Y. Gotanda
" -39/84	"	Monthly Progress Report No.1 for the Kankai Diversion Structure Remedial Works Project

Letters from Engineer to KDC

KIP/NKDC-01/84	Mar. 5	Address of the Contractor
" -02/84	"	Contractor's Office, Quarters & other Facilities
" -03/84	"	Contractor's Superintendence Staffs
" -04/84	Mar. 6	Construction Schedule
" -05/84	"	Measurement of Existing Concrete Blocks quantity to be removed
KIP/NKDC-06/84	Mar. 6	Insurance
" -07/84	Mar. 7	Correspondence to the Engineer
" -08/84	"	Daily Report & other report
" -09/84	"	Visa Extension of KDC Staffs
" -10/84	Mar. 8	Sample of Steel Fiber
" -11/84	Mar. 18	Contractor's Superintendence Staffs
" -12/84	"	Sample of PVC Pipes and Vinyl hembrane
" -13/84	Mar. 20	Daily Report
" -14/84	"	Issuance of Engineer's Drawings
" -15/84	"	Samples of Steel Fiber for SFRC

Letter from KDC to Engineer

KIP-ST-GEN/84	Mar. 1	Hiring Crane for KIP
" -84-2	Feb. 29	Sample-steel fibre 30 mm length
KDC-KIP-84-1	"	Appointment- Project Manager
" -ST/84-1	Mar. 7	Visa Extension-KDC Expatriat Staff
" -ST/84-2	"	"
" -ST/84-3	"	"
KIP-ST/84-2	"	Sample & Catalogue-steel fibre
" /84-3	Mar. 9	Import of Equipment from Bangladesh to Nepal Via India
" /84-4	Mar. 10	Address of the Contractor
" /84-5	"	Contractor's Office, quarters & other facilities
" /84-6	"	Contractor's superintendence staffs
" /84-7	"	Construction Schedule
" /84-8	"	Measurement of Existing Concrete Blocks-quantity to be removed
" /84-9	"	Correspondence to Engineer
" /84-10	"	Daily Report & Other Reports
" /84-11	"	Sample of Steel Fibre
" /84-12	"	Samples-PVC Pipes
" /84-13	Mar. 12	Receiving report-Imported Materials
" /84-14	"	"
" /84-15	Mar. 13	Notice board
" /84-16	Mar. 16	Procurement of Timber

February and March 1984

KIP-ST/84-17	Mar. 16	Return of labour etc. (supplement GC-35)
" /84-18	Mar. 18	Advance Payment for Mobilization
" /84-19	Mar. 19	Security- Assault on KDC Guard
" /84-20	Mar. 22	Works sample PVC pipes
" /84-21	Mar. 23	Daily Report
" /84-22	Mar. 25	Shop drawing-temporary general site plan
" /84-23	"	Receiving report
" /84-24	"	Air Fare for Foreigneer's
" /84-25	"	Equipment receiving report
" /84-26	Mar. 27	Weep hole steel frame

Letter from Project Manager to Nippon Koei

C/O-KIP-040/41 Cha. No.386	Mar. 6	Use of Toyota Diesel Jeep No.B.A.703
KDB/AC/040-41 Cha. No.219	Mar. 1	Contract Aggrement for Kankai Diversion Structure Remedial Works
KDB/AC/040-41 Cha. No.222	"	Kankai Diversion Structure Remedial Measure Works order of Commencement
KDB/AC/040-41 Cha. No.223	Feb. 28	Submission of Contract Aggrements
C/O-KIP-040-41 Cha. No.	Mar. 9	To whom it may concern
KIP-040-41 Cha. No.321	Mar. 18	"
C/O-KIP-040/41 Cha. No.460(15)	Mar. 26	Office Order

April 1984

Letter from NK to Project Manager

NKP/RE-41/84	Apr. 8	Monthly Progress Report No.2 for the Kankai Diversion Structure Remedial Works Project
" -46/84	Apr. 17	Advance Payment for Mobilization in connection with delivery of construction plants

Letter from Engineer to KDC

KIP/NKDC-16/84	Apr. 3	Steel frame of weephole
" -17/84	"	Aproval of PVC pipes
" -18/84	Apr. 12	Notice Board
" -19/84	Apr. 15	Forms of Daily Report, Request for Inspection & Material & Equipment Imported
" -20/84	Apr. 18	Payment Schedule of Lump Sum Items
" -21/84	Apr. 19	Drawing for Work Schedule for Sheet Piling & Plan
" -22/84	Apr. 22	Tentative Mix Proportion of Concrete
" -23/84	Apr. 29	Construction Schedule

Letter from KDC to Engineer

KIP-ST/84-27	Apr. 1	Contractor's superintendence staffs
" /84-28	"	Procurement of Timber
" /84-29	Apr. 12	Equipment receiving report
" /84-30	Apr. 15	Advance payment for mobilization
" /84-31	"	Equipment receiving report
" /84-32	Apr. 16	Shop drawing-Work Schedule for steel piling
" /84-35	Apr. 20	Sample & catalogue- steel fibre
" /84-36	Apr. 22	Operation of Main gates at weir site
" /84-37	"	Equipment receiving report
" /84-38	Apr. 23	Allocation of Mechi Anchal Vehicle number
" /84-39	Apr. 24	Actual length of cross sheet piles
" /84-40	Apr. 25	Schedule 'A'-General Items
" /84-41	Apr. 26	Equipment receiving report
" /84-42	Apr. 27	Receiving report-construction materials
KIP-ST/84-43	Apr. 29	Construction Schedule
KDC/G-84-026	Apr. 12	Import of 6 sets of Walkie-Talkie
" -84-029	Apr. 16	Advance payment for mobilization
" -84-031	Apr. 18	Kankai Diversion Structure Remedial Works
" -84/030	Apr. 19	Visa Extension -KDC Expatriat Staff
" -84-032	"	Advance payment for Mobilization
" -84/055	Apr. 23	Request for Visa Extension
" -84-037	Apr. 24	Custom Exemption papers

Letter from Project Manager to Nippon Koei

KDB/AC/040/41 Cha. No.249	Apr. 5	Kankai Diversion Structure Remedial Works Project Extreme delay in mobilization of construction plant

Letter from Kathmandu(NK) to Project Manager

NKK-85	Apr. 16	Import Procedure of consultant project personnel Kankai Diversion Structure Remedial Works Project

May 1984

Letter from NK to Project Manager

NKP/RE-48/84	May 2	Monthly Progress Report No.3 for the Kanhai Diversion Structure Remedial Works Project
" -51/84	May 14	Completion of Sheet Piles Installation
" -52/84	May 18	Design modification of side walls of stilling basin
" -54/84	May 21	Plan of Operation for supervision of Kankai Diversion Structure Remedial Works
" -58/84	May 25	Rainfall Data in the Kankai River Basin
" -59/84	"	Supervision Work during Rainy Season

Letter from Engineer to KDC

KIP/NKDC-24/84	May 1	Screening Plant
" -25/84	May 6	Approval of Work Schedule for Sheet Piling and Plan
" -26/84	May 7	Payment Schedule for BOQ Item A-4 "Contractor's Site Facilities"
" -27/84	"	Left Bank Side Wall wrongly constructed
" -28/84	May 8	Improvement of Screening Plant
" -29/84	May 9	Electricity supply to Engineer's Office & Quarter (EOQ)
" -30/84	May 11	Sample of Steel Fiber
" -31/84	May 13	Completion of Sheet Piles Installation
" -32/84	May 14	Orders for Variation
" -33/84	"	Issuance of revised drawings for sidewalls & Guidewalls
" -34/84	"	Payment Schedule for BOQ Item No.B-1 River Diversion & care of water
" -35/84	May 21	Provision of ASS ware house for cement storage
" -36/84	"	Steel sheet piles for screening plant
" -37/84	"	Protection of Installed Sheet Piles
" -38/84	May 25	Notification of Engineer's Representatives
" -39/84	"	Aggregates Crading

Letter from KDC to Engineer

KIP-ST/84-45	May 2	Receiving Report Construction Materials
" /84-46	May 6	Security-KDC Camp site at Nunmati
" /84-47	May 10	Opening of a Bank Account with Nepal Bank Limited
" /84-48	May 13	Completion Report Installation of Sheet Piles
" /84-49	May 14	Statement of Monthly Payment No.1
" /84-50	"	Completion of Sheet Piles Installation
" /84-51	"	Advance Payment for Mobilization
" /84-52	"	Schedule 'B' Construction Items
" /84-53	"	Security-KDC Camp Site at Nunmati
" /84-54	May 15	Partial Advance Payment for Imported Construction Materials
" /84-55	May 16	Returns of Tyre Crane to Owner
" /84-56	May 18	Cement receiving report - & Storage Facilities
" /84-57	"	Use of Steel Sheet Piles for Screening Plant
" /84-58	May 23	Cutting of Sheet Piles & Protection
" /84-59	May 24	Screening Report - Construction Materials
KDC/KIP-84-04	May 10	Import license for Walkie-Talkie

Letter from Project Manager to Nippon Koei

KIP-040/41 Cha. No.413	May 8	To Contract TCN for Procurement of Timber

June to October 1984

Letter from NK to Project Manager

NKP/RE-81/84	Oct. 30	Commencement of Engineering Services of Mr. Y. Murai, Construction Engineer, Kankai Diversion Structure Remedial Works Project
KBO-180	Jun. 15	2nd & 3rd Calender quarter payment Kankai Diversion Structure Remedial Works
CEH-01	Jun. 10	Monthly Progress Report No.4 for the Kankai Diversion Structure Remedial Works Project
NKK-104	Aug. 20	Contract for Engineering Services for Kankai Diversion Structure Remedial Works (Itemized Invoice)
NKK-106	Sep. 4	"
NKK-107	Sep. 11	"
NKK-109	Oct. 10	Assignment of Mr. Y. Murai, Construction Engineer for Kankai Diversion Structure Remedial Works Project
NKK-110	Oct. 14	Contract for Engineering Services for Kankai Diversion Structure Remedial Works (Itemized Invoice)

Letter from Engineer to KDC

KIP/NKDC-42/84	Oct. 30	Daily Reports
" -43/84	"	Construction Equipment & Materials
" -44/84	Oct. 31	Trial of River Diversion
" -45/84	"	Aggregate Production
" -46/84	"	Construction Schedule
" -47/84	"	Plan of River Diversion
" -48/84	"	Trial Mix of Steel Fiber Reinforced Concrete

Letter from KDC to Engineer

KIP-ST/84-63	Jun. 1	Holiday- Jun. 2, 1984
" /84-64	Jun. 3	Installation of a Gate & Notice Board at Weir Site
" /84-65	"	Supply of Electricity to EOQ
" /84-66	Jun. 6	Receiving report- constructional plant
" /84-67	Jun. 11	Sluice Gates Operation
KIP-ST/84-68	Jun. 11	Request for inspection- concreting works
" /84-69	"	Water for concreting works
" /84-70	Jun. 27	Maintenance canal service road
" /84-71	Jun. 28	Works Schedule
" /84-72	Jun. 29	Holiday- June 30, 1984
" /84-73	"	Home leave- Mr. J.M. Yoo, Project Manager, KDC
" /84-74	Jul. 4	Allocation of Mechin Anchal vehicle No.
" /84-75	Jul. 6	Steel fibres for concrete reinforcement
" /84-76	Jul. 8	Advance Payment for mobilization
" /84-77	"	Shop Drawing
" /84-78	Jul. 9	Compressive strength test of cement mortar
" /84-79	Jul. 13	Sieve aggregate analysis report
" /84-80	"	Allocation of Mechi Anchal Number
" /84-81	Jul. 16	Bending & Compressive Test of Cement Mortar
" /84-82	Jul. 23	Contractor's all risk insurance
" /84-83	"	Allocation of Mechi Zone number for our vehicle
" /84-84	"	Installation of batcher plant
" /84-85	Jul. 26	Allocation of Mechi Anchal number for our vehicle
" /84-86	Aug. 1	Allocation of Mechi Zone number for our vehicle
" /84-87	"	Contractor's all risk insurance
" /84-88	Aug. 7	Supply of Electricity
" /84-89	Aug. 9	Allocation of Mechi Anchal number
" /84-90	Aug. 12	Payment of taxes for River materials
" /84-91	"	Contractor's all risks insurance
" /84-92	Aug. 19	Bending & compressive strength test of cement mortar
" /84-93	Aug. 23	Daily Reports
" /84-94	Aug. 30	Production of aggregates & pre-cast concrete blocks
" /84-95	"	Construction Schedule
" /84-96	Sep. 2	Daily Reports
" /84-97	Sep. 4	Step bars in retaining wall
" /84-98	Sep. 23	Disruption of Work

June to October 1984

KIP-ST/84-99	Sep. 25	Concrete strength
" /84-100	Oct. 31	Procurement of Empty Jute Bags from India
KDC/KIP/84-042	Jun. 5	Extension of Visa
" /84-044	Jul. 12	"
" /84-045	"	"
" /84-046	Jul. 22	Request for import license & other facilities for pat filter M-type
" /84-048	Jul. 24	Import license & other facilities for batching plant spareparts
" /84-049	Aug. 7	Import license & other facilities for general motor
" /84-050	Aug. 14	Import license & other facilities for steel fibre
" /84-051	Sep. 6	Import license & other facilities for CAT Payloader spareparts
" /84-052	Sep. 30	Import license & other facilities for equipment & plants

Letter from Project Manager to Nippon Koei

KIP/040/41 Cha. No.455	Jun. 3	About the gradation of coarse aggregates for concrete work in H/W Diversion Structure Remedial Works
KIP/040/41 Cha. No.472	Jun. 10	Water for concreting in Kankai Diversion Structure Remedial Works
KIP/040/41 Cha. No.499	Jun. 22	Detailed construction work programme and inspection slip
KIP/040/41 Cha. No.504	Jun. 24	Sluce Gate Operation
KIP/040/41 Cha. No.505	Jun. 25	About cement use and stacking in go-down
KIP/040/41 Cha. No.506	"	Lab. Test about gradation of aggregates & Trial Mix Test
KIP/040/41 Cha. No.507	"	About maintenance of approach road
KIP/040/41 Cha. No.512	Jun. 26	Kankai Diversion Structure Remedial Works about contraction joint in retaining wall & pre-cast concrete blocks
C/O-KIP/040/41 Cha. No. 625	Jul. 2	Kankai Diversion Structure Works Step Bars in the retaining wall
C/O-KIP/041/42 Cha. No. 4	Jul. 17	Compressive Strength Test of Cement Mortar
" Cha. No. 18	Jul. 20	Construction Schedule- Kankai Diversion Structure Remedial Works
" Cha. No. 20	"	Supply of Electricity
" Cha. No. 21	"	Repair of approach road of ASS
KDB/A/C/041/42 Cha. No. 8	Jul. 29	Home work man month for review of Contractor's Construction Schedule & Shop drawings of Kankai Diversion Structure Remedial Works Project
KDB/M/Sevete/041/42 Cha. No. 47	Sep. 10	Regarding Concrete Strength
C/O-KIP/041/42 Cha. No. 140	Sep. 27	Assignment of Site Engineer Mr. R.C. Chaudhary
KIP-041/42 Cha. No. 89	Oct. 22	Confirmation of Discussion
KDB/AC/041/42 Cha. No. 90	Oct. 30	Permission to Use Komatsu Dozer on rental basis

November 1984

Letter from NK to Project Manager

NKP/RE-82/84	Nov. 9	Safety Measures at construction site
" -83/84	"	Time Schedule for Electricity Supply
" -84/84	Nov. 11	KDC's Stock Balance of concrete Aggregate
" -85/84	Nov. 13	Measurement and quantity calculation of concrete works
" -86/84	Nov. 15	Temporary recovery of outlet channel and of settling basin
" -87/84	Nov. 16	Monthly Progress Report No.5 for the Kankai Diversion Structure Remedial Works Project
" -88/84	Nov. 18	Delay of Progress of Kankai Diversion Structure Remedial Works
NKK-113	Nov. 28	Interim Certificate - 1st Statement
NKK-114	"	Progress Statement of Kankai Diversion Structure Remedial Works, No.2

Letter from Engineer to KDC

KIP/NKDC-49/84	Nov. 6	Start of River Diversion Works
" -50/84	Nov. 9	Contractor's Superintendence Staffs
" -51/84	Nov. 14	Production of Concrete Aggregates
" -52/84	Nov. 15	Approval to use of sheet piles for Scouring Sluice
" -53/84	"	Trial Mix Proportion for SFRC
" -54/84	"	Acceptance of construction schedule
" -55/84	Nov. 20	Acceptance of shop drawings
" -56/84	"	Return of shop drawings for correction
" -57/84	"	Criteria for bending portion and unit weight of reinforcement bars
" -58/84	"	Order of additional works, recovery of outlet channel end of settling basin for aid of river diversion
" -59/84	Nov. 22	Coffering for river diversion
" -60/84	Nov. 25	Cross Section of River bed before Excavation

Letter from KDC to Engineer

KIP-ST/84-101	Nov. 7	Aggregate Production
KIP-ST/84-102	Nov. 7	Disturbance at work site
" /84-103	"	Construction Equipment and Materials
" /84-104	Nov. 11	Contractor's superintendence Staff
" /84-105	Nov. 13	Equipment receiving report
" /84-106	Nov. 14	Construction Schedule
" /84-107	"	Start of river diversion works
" /84-108	"	Shop drawings
" /84-109	Nov. 15	Use of Sheet piles at water stop
" /84-110	Nov. 16	Production of concrete aggregate
" /84-111	Nov. 23	Daily Reports
" /84-112	"	Cement transfer to Kathmandu
" /84-113	Nov. 25	Statement of Monthly Payment No.2
" /84-114	Nov. 26	Daily Reports
" /84-115	Nov. 29	Vehicle- India Entry Permit
KDC-ST-GEN/84	Nov. 14	Procurement of empty jute bags from Siliguri, India

Letter from Project Manager to Nippon Koei

KIP-041/42		
Cha. No. 97	Nov. 11	Time Schedule for Electricity Supply
"		
Cha. No. 198	Nov. 19	Temporary recovery of outlet channel end of settling basin
"		
Cha. No. 207	Nov. 25	Disturbance at Head Works site
"		
Cha. No. 226	Nov. 28	Assesment of damages in the Civil Works done by Contractor M/S B. S. Dhatt & Co.
KDB/AD/041/42		
Cha. No. 123	Nov. 30	Kankai Diversion Structure Remedial Works Project, Delay in Progress

December 1984

Letter from NK to Project Manager

NKP/RE-89/84	Dec. 5	Use of partially set cement in Kankai Diversion Structure Remedial Works Project
" -90/84	Dec. 11	Certification delivery of cement & Bulldozer
" -91/84	Dec. 12	Acceleration of gabion works at escape channel outlet
" -92/84	"	Establishment of construction site office for Kankai Diversion Structure Remedial Works Project
" -93/84	Dec. 13	Core Drill Equipment
" -94/84	"	Safety Measures for Project supervisory staffs
" -95/84	Dec. 17	Assignment of Chief Engineer
" -96/84	"	Arrival information of Mr. N. Nagano, Construction Engineer
" -97/84	"	Arrival information of Mr. E. Yamauchi, Chief Engineer
" -98/84	Dec. 18	Work Schedule of Mr. E. Yamauchi, Chief Engineer
" -99/84	Dec. 24	Monthly Progress Report No.6 for Kankai Diversion Structure Remedial Works Project
" -100/84	Dec. 27	Submission of Report on revised construction plan & schedule for the Kankai Diversion Structure Remedial Works Project
" -101/84	Dec. 31	Assignment of Mr. Y. Kawano, Assistant Engineer
" -102/84	"	Departure information of Mr. E. Yamauchi, Chief Engineer
" -103/84	"	One Day leave on New Year's Day
" -104/84	"	Reimbursement for Foreign Staff quarter's Facilities & Petrol

Letter from Engineer to KDC

KIP/NKDC-61/84	Dec. 5	Mixer Truck Delivered
" -62/84	Dec. 12	Plan & Schedule of drainage sump
" -63/84	"	Installation of Barrier
" - 64/84	"	Approval of revised construction schedule and use of concrete admixture for earlier strengthening
" -65/84	"	Fabrication of concrete buckets
" -66/84	"	Installation method of concrete shuttering
" -67/84	"	Further delivery schedule of cement
" -68/84	"	Rejection of concrete using partially set cement
KIP/NKDC-69/84	Dec. 16	Order of additional works-concrete coating on the Gabion at escape channel outlet
" -70/84	"	Recruit of Bulldozer and Wheel Loader
" -71/84	Dec. 21	Notification on Engineer's Representative
" -72/84	"	Confirmation of discussion on 20 Dec. '84
" -73/84	"	Confirmation of discussion on 19 Dec. '84
" -74/84	Dec. 31	Improper use of concrete vibrators
" -75/84	"	Prohibition of concrete transit by direct truck loading
" -76/84	"	Log Book's of Project's Bulldozer's
" -77/84	"	Notification of Engineer's Representative
" -78/84	"	Weekly Construction Schedule

Letter from KDC Engineer

KIP/ST/84-116	Dec. 3	Daily Reports
" /84-117	Dec. 5	Receiving
" /84-118	Dec. 6	Mixer Truck delivered
" /84-119	Dec. 7	Cement storage - ASS Chandradangi warehouse
" /84-120	"	Equipment recieving report
" /84-122	Dec. 9	Use of sheet piles
" /84-123	Dec. 10	Daily Reports
" /84-124	Dec. 11	Equipment receiving report
" /84-125	"	Hiring of equipment
" /84-126	Dec. 13	Installation of a barrier
" /84-127	Dec. 17	Daily Report
" /84-128	Dec. 21	Receiving report
" /84-129	Dec. 30	Equipment hire - Dumpers
" /84-130	"	Receiving report construction material
" /84-131	"	Receiving report construction equipment
" /84-132	Dec. 31	Holiday- January 1, 1985- New Year's day
KDC-ST-GEN/84-23	Dec. 2	Blasting operations of existing concrete blocks
KDC-ST-GEN-24	Dec. 14	Disturbance at the working site at Nunmati

December 1984

Letter from Project Manager to Nippon Koei

KIP-041/42		
Cha. No. 236	Dec. 2	About use of partial set cement in Kankai Diversion Structure Remedial Works
"		
Cha. No. 239	Dec. 4	About payment of Local Taxes for River Bed Materials
"		
Cha. No. 262	Dec. 16	About Gabion works at escape channel outlet
KDB/AC/041-42		
Cha. No. 128	Dec. 7	Kankai Diversion Structure Remedial Works Project (loan No. 659 NEP(SF) Remedial Actions for Delay in progress
C/O-KIP/041/42		
Cha. No.263	Dec. 20	Assignment of Chief Engineer Mr. E. Yamauchi
"		
Cha. No. 280	"	Use of partial set cement in Kankai Diversion Structure Remedial Works
KIP-041/42		
Cha. No. 285	Dec. 21	Posting of HMG supervising staff
"		
Cha. No. 294	Dec. 24	About declaration of prohibited area for picnic parties
"		
Cha. No. 295	"	Kankai Diversion Structure Remedial Works Cement storage-ASS warehouse
"		
Cha. No. 307	Dec. 26	About damage of outlet escape channel
"		
Cha. No. 317	Dec. 27	About diversion of river water in canal

January 1985

Letter from NK to Project Manager

NKP/RE-01/85	Jan. 3	Explanatory Note on Finalization of Design
" -02/85	Jan. 4	Weekly Meeting
" -03/85	Jan. 6	Current Progress of Kankai Diversion Structure Remedial Works Project
" -04/85	Jan. 8	Submission of Approved drawings
" -05/85	"	Calculation of Hire charge of Soil Compactor and the Bulldozers
" -06/85	Jan. 9	Weekly Meeting
" -07/85	"	Design and Cost Estimate of Outlet Structure of Escape Channel
" -08/85	Jan. 13	Site visit of Mr. S. Yano, Director of Nippon Koei Co., Ltd.
" -09/85	Jan. 15	Monthly Progress Report No.7 for the Kankai Diversion Structure Remedial Works Project
" -10/85	"	Manual of Supervisory Work
" -11/85	Jan. 17	Weekly Meeting
" -12/85	Jan. 24	Weekly Meeting
" -13/85	Jan. 30	Accident at Batching Plant
" -14/85	Jan. 31	Weekly Meeting
NKK-117	Jan. 11	Monthly Invoice in Nepali Rupee portion for October-December 1984

Letter from Engineer to KDC

KIP/NKDC-01/85	Jan. 2	Mix Proportion of SFRC
" -02/85	"	Use of concrete type C for slope portion
" -03/85	Jan. 3	Anchor Bars at Endsill
" -04/85	"	Policy of Insurance
" -05/85	Jan. 4	Acceptance of Shop Drawings
" -06/85	Jan. 8	Excavation of left-half area of the River Bed
" -07/85	Jan. 9	Order for Variation
" -08/85	"	Treatment of Driven Sheet Piles
" -09/85	"	Cover of Re-Bar of Basin Slab
" -10/85	Jan. 13	Prohibition of Picnic at the job site
" -11/85	"	Deliver of Vibrations Roller
" -12/85	"	Plan & Section of Diversion Channel
KIP/NKDC-13/85	Jan. 14	Order of Additional Work for construction of outlet structure of Escape Channel
" -14/85	Jan. 15	Foundation Excavation up to 31 December 1984
" -15/85	Jan. 17	SFRC on the Scouring Sluice slab
" -16/85	"	Revise Re-Bar Arrangement of Chute Block
" -17/85	"	Correction of Shop Drawing
" -18/85	Jan. 18	Provision of Lock for Cement Scale of Batching Plant
" -19/85	Jan. 20	Chart for construction schedule and progress
" -20/85	Jan. 21	Accidents of Payloader and Insurance against accidents to workmen
" -21/85	"	Wear of Helmets
" -22/85	Jan. 31	Report on Accident
" -23/85	"	Accident at Aggregate stock yard of Batching Plant

Letter from KDC to Engineer

KIP-ST/85-133	Jan. 2	Use of Concrete Type 'C' at FS8
" /85-134	"	Trial Mix Proportion Results of SFRC
" /85-135	"	Contractor's all risks insurance
" /85-136	Jan. 3	Daily Reports
" /85-137	Jan. 4	Weekly Construction Schedule
" /85-138	Jan. 6	Hiring of equipment- Type Back Hoe
" /85-139	Jan. 7	Daily Reports
" /85-140	Jan. 8	Shop Drawings-acceptance of
" /85-141	"	Daily Works Performance Report
" /85-142	Jan. 9	Compressive strength test
" /85-143	Jan. 11	Weekly Construction Schedule
" /85-144	Jan. 13	Transfer of No. Screen plant to Mahakali
" /85-145	Jan. 14	Magh Sanskranti- Observance of Holiday
" /85-146	Jan. 15	Assignment of skilled manpower
" /85-147	"	Procurement of Laboratory Equipments
" /85-148	Jan. 16	Daily Reports
" /85-149	Jan. 17	E-1 slab concrete type 'B'
" /85-150	"	Accident-Payloader control No.03-4
" /85-151	"	Foundation excavation upto 31 December 1984

January 1985

KIP-ST/85-152	Jan. 17	Wheel Type Pocklain Excavator
" /85-153	Jan. 18	Weekly Construction Schedule
" /85-154	Jan. 20	Provision of lock for cement scale Batching Plant
" /85-155	Jan. 21	Batching Plant-Calibration of heighing scale & dial gauge
" /85-156	Jan. 23	Water Diversion from Temporary Channel left bank
" /85-157	Jan. 24	Rejection of concrete using partially set cement
" /85-158	Jan. 25	Weekly Construction Schedule
" /85-159	Jan. 27	Daily Reports
" /85-160	Jan. 28	Coffering for river diversion
" /85-161	Jan. 30	HMG equipment on hire basis
" /85-162	"	Accident at Batching Plant-Aggregate storage compartment wall
" /85-163	Jan. 31	Equipment-receiving report
" /85-164	"	Accident of Payloader & Insurance against accident to workmen

Letter from Project to Nippon Koei

KIP-041/42 Cha. No. 327	Jan. 4	To get one Wheel type Pocklain Excavator
C/O-KIP-041/42 Cha. No. 339	Jan. 7	Opinion on the arbitration for the settlement of dispute on contract for Main Civil Work of Kankai Irrigation Project (Extension area)
" Cha. No. 342	Jan. 8	Calculation of Hire charge of one unit of soil compactor
KIP-041/42 Cha. No. 369	Jan. 16	Procurement of Laboratory Equipments
" Cha. No. 374	"	Use of partial set cement in Kankai Diversion Structure Remedial Works
" Cha. No. 383	Jan. 17	Removal of Trash-racks from MIC
" Cha. No. 409	Jan. 22	About KDC Batching Plant scale calibration test on 21st Jan. '85
" Cha. No. 422	Jan. 24	About KDC Batching Plant scale calibration

February 1985

Letter from NK to Project Manager

NKP/RE-16/85	Feb. 7	Weekly Meeting
" -17/85	"	Data and catalogue of apron rubber
" -18/85	Feb. 10	Interim Certificate-3rd statement
" -19/85	"	Progress Statement of Kankai Diversion Structure Remedial Works (No. 3)
" -20/85	"	Payment of Remaining advance payment for mobilization
" -21/85	"	Supension of Concrete Work
" -22/85	Feb. 13	Monthly Progress Report No. 8 for Kankai Diversion Structure Remedial Works Project
" -23/85	Feb. 14	Weekly Meeting
" -24/85	Feb. 21	"
NKK-118	Feb. 24	Contract for Engineering Services for Kankai Diversion Structure Remedial Works (Itemized Invoice)

Letter from Engineer to KDC

KIP/NKDC-24/85	Feb. 1	Honey-combs on the guidewall surface
" -25/85	Feb. 3	Type of steel wire being used
" -26/85	Feb. 4	Lifting wire rope of concrete bucket
" -27/85	"	Neglect against the Engineer's instruction
" -28/85	"	Record of delivery of 2,200 tons cements
" -29/85	Feb. 5	Daily Report concerning delivery of 2,200 tons cements
" -30/85	Feb. 7	Treatment of sheet piles at slab blocks B-5, B-6 and C-5
" -31/85	Feb. 8	Laboratory Equipment
" -32/85	Feb. 10	Treatment of concrete surface on basin slab
" -33/85	"	Increase of flow capacity of Temporary Diversion channel
" -34/85	Feb. 11	Delay in progress of concrete works
" -35/85	Feb. 22	Design revision of right wing sall
" -36/85	"	Foundation concrete for precast concrete block installation
" -37/85	Feb. 26	Issuance of Engineer's drawing for launching apron

Letter from KDC to Engineer

KIP-ST/85-165	Feb. 1	Weekly Construction Schedule
" /85-166	"	February 2, 1985 - Observance of Holiday
" /85-167	Feb. 4	Advance payment for mobilization
" /85-168	Feb. 5	Record of delivery of 2,200 tons cement
" /85-169	"	Lifting wire rope on concrete bucket
" /85-170	Feb. 6	Cement 2,200 tons-daily Report concerning delivery
" /85-171	"	Neglect against engineer's instructions
" /85-172	Feb. 7	Daily reports
" /85-173	Feb. 8	Statement of monthly payment No. 3
" /85-174	Feb. 7	Weekly Construction Schedule
" /85-175	Feb. 8	Foundation excavation upto December 3, 1984
" /85-176	Feb. 13	Daily reports
" /85-177	Feb. 14	Equipment receiving report
" /85-178	Feb. 15	Weekly Construction Schedule
" /85-179	Feb. 19	Compressive strength test
" /85-180	Feb. 22	Installation of precast concrete blocks
" /85-181	"	Weekly Construction Schedule
" /85-182	Feb. 24	Daily reports
" /85-183	Feb. 25	Transfer of No. 1 screen plant to Mahakali

Letter from Project to Nippon Koei

KIP-041/42 Cha. No. 477	Feb. 28	Posting of HMG supervision staff

March 1985

Letter from NK to Project Manager

NKP/RE-25/85	Mar. 14	Interim Certificate- 4th statement
NKP/RE-26/85	"	Progress statement of Kankai Diversion Structure Remedial Works (No.4)
NKP/RE-27/85	Mar. 17	Monthly Progress Report No.9 for the Kankai Diversion Structure Remedial Works Project

Letter from Engineer to KDC

KIP/NKDC-38/85	Mar. 4	Engineer's Estimate for quantities of major works from 21 Jan. to 28 Feb. '85
" -39/85	Mar. 5	SFRC coating on the Basin Slab downstream of scouring sluice
" -40/85	Mar. 13	Opening the Scouring Sluice Gates
" -41/85	Mar. 18	SFRC coating on the Basin Slab of slope portion
" -42/85	"	Foundation excavation of remaining river bed
" -43/85	Mar. 22	Acceleration of progress for remaining works
" -44/85	Mar. 28	Coffering for second enclosure
" -45/85	Mar. 31	Blanket concrete
" -46/85	"	Submission of daily report for cement

Letter from KDC to Engineer

KIP-ST/85-184	Mar. 3	Work schedule
" /85-185	Mar. 6	Daily Reports
" /85-186	"	Hiring of equipment- HMG Road Roller
" /85-188	Mar. 8	Receiving report-construction schedule
" /85-189	"	Statement of monthly payment No.4
" /85-190	Mar. 14	Daily Reports
" /85-191	Mar. 17	Accident to workmen
" /85-192	Mar. 18	Assignment- Chief Engineer
" /85-193	Mar. 24	Accident to workmen
" /85-194	Mar. 25	Daily Reports

Letter from Project to Nippon Koei

KIP/IRR/AC/041-42 Cha. No. 168	Mar. 1	Permission for transferring one unit of screen plant
KIP-041/42 Cha. No. 502	Mar. 18	About procurement certificate of wooden materials
" Cha. No. 511	Mar. 21	About accident to KDC workmen

April 1985

Letter from NK to Project Manager

NKP/RE-28/85	Apr. 1	Meeting for Kankai Diversion Structure Remedial works project
" -29/85	"	Arrival Information of Mr. E. Yamauchi, Chief Engineer
" -30/85	Apr. 4	Re-commendation Report on Construction of new settling basin
" -31/85	Apr. 10	Calculation Note for raising height of scouring sluice gates
" -32/85	Apr. 15	Departure information of Mr. E. Yamauchi, Chief Engineer
" -33/85	Apr. 16	Monthly Progress Report No. 10 for the Kankai Diversion Structure Remedial works project
" -34/85	Apr. 25	Revised design drawing of outlet structures of escape channel
" -35/85	"	Design drawings of New Settling Basin
" -36/85	Apr. 26	Reimbursement for Foreign Staff Quarter's Facilities & Petrol
" -37/85	"	Insurances
" -38/85	Apr. 30	Payment schedule for Lump Sum Items
" -39/85	"	Interim Certificate-5th Statement
" -40/85	"	Progress Statement of Kankai Diversion Structure Remedial Works (No. 5)
NKK-122	Apr. 8	Provisional Implementation Programme on the Greater Kankai Irrigation Project
" -244	"	Monthly Invoice in Nepali Rupee portion for January 1985-March 1985

Letter from Engineer to KDC

KIP/NKDC-47/85	Apr. 9	Engineer's Estimate for Quantities of major works from 1 Mar. to 31 Mar. 1985
" -100/85	Apr. 5	Mobilizing stand by crane
" -48/85	Apr. 11	Modification of weep hole in existing weir apron
" -49/85	"	Removal of top portion of existing Baffle wall
" -50/85	Apr. 15	Removal of form & curing of concrete
" -51/85	"	Construction schedule for the remaining works
KIP/NKDC-52/85	Apr. 15	Mobilization of stand by crane
" -53/85	"	Strengthening Coffer embankment
" -54/85	Apr. 16	Mobilization of stand by crane
" -55/85	Apr. 18	Order of additional work construction of new settling basin
" -56/85	Apr. 16	Meeting
" -57/85	Apr. 19	Shop drawing for raising scouring sluice gates
" -58/85	"	SFRC coating on the basin slab of slope portion
" -59/85	Apr. 22	Issuance of Drawing
" -60/85	Apr. 25	Schedule for the remaining works

Letter from KDC to Engineer

KIP-ST/85-195	Apr. 4	Road Roller to local contractor
" /85-196	"	Daily reports
" /85-197	Apr. 11	Return of equipment to its owner
" /85-198	Apr. 15	Mobilization of a stand by crane
" /85-199	Apr. 16	Daily reports
" /85-200	Apr. 17	Shop drawing-extension of sluice gates
" /85-201	Apr. 21	Hiring of trailor
" /85-202	Apr. 26	Statement of monthly payment No. 5
" /85-203	"	Daily reports
" /85-204	Apr. 29	Lump Sump Items, Clause 60(5) - Payment schedule
" /85-205	"	Order of additional work-construction of New Settling Basin
" /85-206	Apr. 30	Fluctuation in Prices of specified materials petrol & diesel - payment schedule

May 1985

Letter from NK to Project Manager

NKP/RE-41/85	May 1	Careful supervision of SFRC coating
" -42/85	May 10	Completion of stilling basin slab and downstream river bed protection
" -44/85	May 16	Monthly Progress Report No. 11 for the Kankai Diversion Remedial Works Project
" -45/85	May 23	Cement consumption for Kankai Diversion Structure Remedial Project
" -46/85	May 28	Use of remaining Precast concrete blocks for downstream right bank protection

Letter from Engineer to KDC

KIP/NKDC-61/85	May 1	SFRC coating on the basin slab of remaining portion
" -62/85	"	High water content in SFRC for coating
" -63/85	May 3	Damages by storm
" -64/85	May 7	Revised drawing for outlet structure of escape channel
" -65/85	May 10	Construction Schedule for the remaining works
" -66/85	May 15	Schedule for removing downstream sheet piles
" -67/85	May 27	Transfer of Equipment
" -68/85	May 28	Issuance of Engineer's drawing for outlet structures

Letter from KDC to Engineer

KIP-ST/85-207	May 3	Thunderstorm-drainage to contractor's property
" /85-208	"	Kaily Reports
" /85-209	May 5	Damage by storm
" /85-210	"	Equipment hire
" /85-211	"	Compressive strength test reports
" /85-212	May 6	Return of Equipment-Mixer Truck Nigata
" /85-213	May 7	Refund of custom duty & Sales Tax for 500 M/Tons of Portland cement
" /85-214	May 8	Report on date of completion-stage 1 & 2
KIP-ST/85-215	May 12	Flood water
" /85-216	May 14	Daily Reports
" /85-217	"	Construction schedule for remaining works
" /85-218	May 23	Daily reports
" /85-219	May 24	Transfer of equipment
" /85-220	"	Accident to XDC workmen-medical expenses
" /85-221	May 30	Order of Variation

Letter from Project to NK

KIP-041/42		
Cha. No. 590	May 2	Supervision of Kankai Diversion Structure Remedial Works by FMG staff
"		
Cha. No. 614	May 8	Time of site supervision
"		
Cha. No. 633	May 17	About claim for medical treatment of KDC carpenter helper
"		
Cha. No. 638	May 19	About under drains gate operating handles

June 1985

Letter from NK to Project Manager

NKP/RE-47/85	Jun. 11	Extension of Assignment period of Mr. Y. Murai, Construction Engineer
" -50/85	Jun. 13	Payment for Insurance against accidents etc. to workmen
" -51/85	"	Contructor's Claim for Clearing existing weir apron's surface
" -52/85	"	Procedure to issue the maintenance certificate
" -53/85	"	Monthly Progress Report No.12 for Kankai Diversion Structure Remedial works Project
" -54/85	Jun. 16	Tentative Closing of NK's Kankai Project Office
" -56/85	"	Evaluation of unit prices quoted by KDC
" -57/85	"	Rental Charges Payable by KDC
" -58/85	Jun. 17	Consultant's View on unsatisfied concrete works
" -59/85	"	Additional concrete wall & sheet pile wall downstream from guidewall
" -60/85	"	Quantity of sheet piles incorporated into permanent works
" -61/85	Jun. 20	Kankai Diversion Structure Remedial Works Project Certificate of Partial Completion of the works & recommendation
" -62/85	"	Interim Certificate - 6th Statement
" -63/85	"	Progress Statement of Kankai Diversion Structure Remedial Works (No.6)

Letter from Engineer to KDC

KIP/NKDC-69/85	Jun. 16	Installation of Precast Concrete Blocks at the right bank
" -70/85	"	Engineer's Rate for Additional Works
" -71/85	"	Price escalation for cement and Re- bar
" -72/85	"	Sheet Piling, Omission in Billing
" -73/85	"	Rental Charge
" -74/85	Jun. 18	Rental Charge

Letter from KDC to Engineer

KIP-ST/85-222	Jun. 3	Plooding of Kankai River
KIP-ST/85-223	Jun. 4	Daily Reports
" /85-224	"	Order of rasiation
" /85-225	Jun. 13	Re-imbursement of custom duties & sales tax to contractor
" /85-226	"	Cleaning existing weir apron's surface
" /85-227	"	Fluctuation of Prices of Specified Materials
" /85-228	Jun. 14	Daily Reports
" /85-229	Jun. 16	Electricity Supply to Engineers
" /85-230	"	Sheet piling, Omission in Billing
" /85-231	Jun. 17	Removal of our office Building East Side of HMG's KIP Camp Area
" /85-232	Jun. 16	Sheet Piling
" /85-233	Jun. 17	Extension of Time
" /85-234	Jun. 16	Raising Scouring Sluice Gates
" /85-235	Jun. 17	Fluctuation in Prices of Specified Materials Petrol & Diesel
" /85-236	"	Bosaking of Baffle Wall
" /85-238	"	Rental Charge
" /85-239	Jun. 20	Fluctuation in Prices of Specified Materials Petrol & Diesel Additional Claim
" /85-240	Jun. 26	Compressive Strength Tests Reports
" /85-241	"	Daily Reports
" /85-243	Jun. 30	KDSR Works Bonus for Barly Completion
" /85-250	Jun. 23	Statement of Monthly Payment No.6

Letter from HMG to Nippon Koei

KIP-041/42 Cha. No. 763	Jun. 24	About Maintenance of Canal Service Road