APPENDIX-6

Effective Use of the Accumulated Sediment as Aggregate

The sandpockets of the S. Cikunir and S. Ciloseh basins are almost full due to the inflow of debris in the 1982 eruption of Mt. Galunggung. There are still possible sediments in the upper regions and it is assumed that sediment inflow into the sandpockets will continue in the future.

The annual sediment inflow in the S. Cikunir area was particularly remarkable. Emergency excavation has become necessary to manage the 4,741,000 m^3 of inflow sediment that has accumulated over a ten year period and 1,400,000 m^3 spare capacity sediment.

Five alternatives have been established as the sediment management method. Upon consideration of the results of the economic evaluation, 128,000 m^3 of sediment will be producted as aggregate at an aggregate plant from within the 614,000 m^3 of the design management sediment. For the remaining sediment, the alternative D which lets sediment accumulate within the sandpocket has the lowest economic cost. Accordingly, the alternative D has been selected as the economic alternative for disaster prevention project.

According to an aggregate industry company, the accumulated sediment from within the sandpocket is presently being transported as aggregate from Pirusa station, near to the sandpocket, to Jakarta after being cleansed and excavated. In recent years the amount of shipped aggregate has been increasing. The cumulative shipped volume of aggregate over one year period from July 1987 to June 1988 amounted to 428,000 m^3. The greatest shipped volume for one month was April 1987 at 42,900 m^3.

According to the railroad operation diagram, there are five Jakarta bound trains scheduled per day. The average number of trains per days as estimated from actual service in each day is 4 - 5.

The aggregate market condition in Jakarta where the final consumption place of aggregate from the Mt. Galunggung area and the social circumstance surrounding this were summarized as follows:

a) In Tangerang area which has been served as the main supply base of aggregate to Jakarta and surrounding area, lowering of ground water level by over excavation, environmental destruction, traffic conjection and road damage have all become problems, causing the Indonesian government to curtail quarrying.

b) The demand for aggregate in Jakarta and surround area will be higher in the future because of a number of capital district highway project and urban development project are scheduled for this area as part of the Jakarta master plan for the year 2005.

On the other hand, the actual condition of the sandpocket area in the Mt. Galunggung area is summarized as follows:

a) The sandpocket in the S. Cikunir area and S. Ciloseh area are almost full from the inflow of sediment. It is undesirable to raise the dike because of no freeboard for the flow and debris flow from a point of technical view. It is necessary to excavate 6,535,000 m^3 of accumulated sediment urgently from the sandpocket.

b) It is impossible to acquire the land for the sediment management from a point of social view. The Indonesian government is worried about how to deal with this.

It is a good idea to both produce the aggregate at an aggregate plant and to transport it to Jakarta by PJKA to be saled. The greater in aggregate volume, the better the aggregate sales, when taking into account the aggregate demand in Jakarta.

Taking into account the background above mentioned, the financial evaluation was made for the effective use of the sediment.

The actual conditions for the effective use of the acumulated sediment in the sandpocket area are surveyed by JICA study team. Survey items are shown as follows;

1) Excavation Volume and operation condition
2) Demand for aggregate
3) Market price
4) Rail car composition
5) Operation diagram
6) Transportation volume by PIJA

1. Actual Condition for Effective Use of the Accumulated Sediment

1.1 Excavation Conditions and Operations for the Sandpockets in the S. Ciloseh and S. Cikunir Basins

In order to excavate a sandpocket region an aggregate industry company is required to have an excavation license. The excavation license can be obtained from the Department Mine General Mine Bureau and from the State of West Java Government Steel and Energy Division (Pinas Pertambongan dan Energi Jawa Brat). The excavation region within the sandpocket is determined by the Galunggung Project Office. At present (July 1987), eleven companies maintained excavation licenses but only three companies were actually conducting excavation operations.

The possible region of sandpocket excavation and the aggregate industries are indicated as shown in Fig. - 1.1. The results of the interviews with those involved in actual operations for the production of aggregate are shown in Table - 1.1.

Table - 1.1 Interview Items and Answers for Excavation Company in Sand Pocket

Item \ Company name	PT. BUMINDO	PT. SARANA KARYA		PT. PASIR GRAMA MAS
Excavation Area	Cimampang	Ciponyo I (L)	Cimampang	Ciponyo II
Excavation Area on the Permission (Ha/year)	25 Ha 5 years	25 Ha 10 years	25 Ha 10 years	25 Ha 10 years
Max. Excavation Volume at Present Facility per day	1,000 m^3	1,000 m^3	1,000 m^3	600 m^3
Actual Product Volume per-day (m^3/day)	850	500	500	500
Means of Transportation to Jakarta	By PJKA from Pirusa	By PJKA from Pirusa	By PJKA from Pirusa	By PJKA from Tasikmalaya

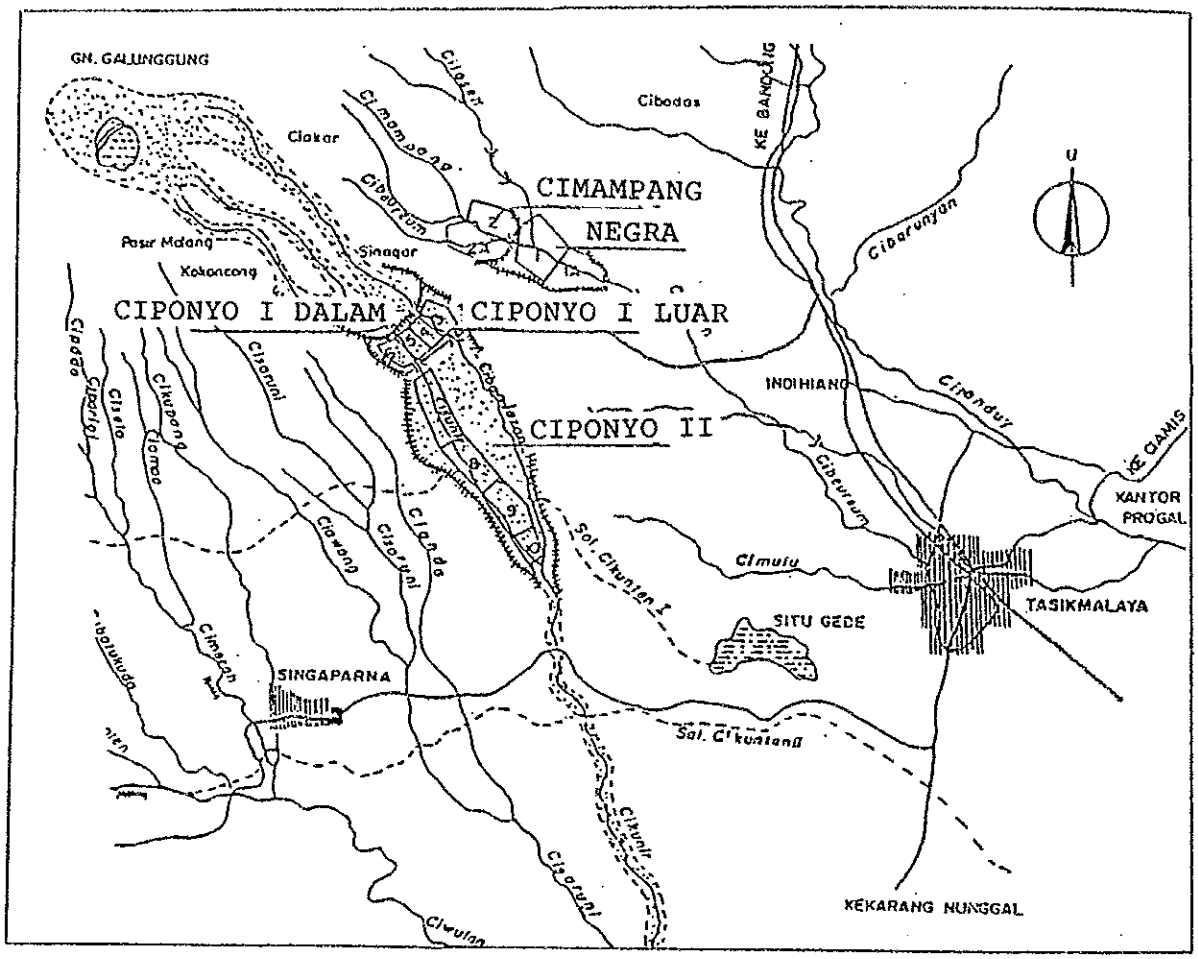


Fig. - 1.1 Location to be permitted the Excavation in Sandpockets

Table - 1.2 Company to be permitted the Excavation of Materials in Sand Pockets

No.	Name of Location	Name of Sand Pockets (Excavation Area)	Name of Company	Remarks
1	NO. 1	Negla	PT. BINTANG P. MANGGALA	
2	NO. 1A	Negla	PT.GRAHA LUHUR SEMPURNA	
3	NO. 2	Cimampang	PT. BUMINDO	* Operating
4	NO. 2A	Cimampang	PT. SARANA KARYA	* Operating
5	NO. 3	Ciponyo I. Luar	PT. SARANA KARYA	* Operating
6	NO. 4	Ciponyo I. Luar	PT. TORA AGUNG	
7	NO. 5	Ciponyo I. Luar	PT. HAPOLTAKAN MELATI JAYA	
8	NO. 6	Ciponyo I. Luar	PT. HUMPUSS	
9	NO. 7	Ciponyo II	PT. INDASATI MAKMUR	Cikunir Gede
10	NO. 8	Ciponyo II	PT. PASIR GRAHA MAS	* Cikunir side Operating
11	NO. 9	Ciponyo II	PT; LESTARI	Cikunir side
12	NO. 10	Ciponyo II	PT. TUNAS UTAMA	Cikunir side

1.2 Demand for Aggregate and Market Price

(1) The Demand for Aggregate

The demand for aggregate in Jakarta and Bandung was not investigated. Rather, the following describes the results of interviews concerning aggregate demand with those in the aggregate industry. Other information was gained from newspaper articles.

1) In October 1987, the aggregate demand for Jakarta was predicted to be from 9,000 m^3 to 10,000 m^3 per day. In the greater Jabotabek region, the aggregate demand was estimated at 10,000 m^3 per day.

2) In the future, a number of major projects are planned that would engender large-scale demand for aggregate in the Jakarta regions. These are the city development project based on the year 2005 master plan, the capital district highway project, the international airport project, etc.

3) In Tengerang, which had served as the main supply base of aggregate to Jakarta and the surrounding area, and increase in the number of trucks has caused traffic congestion, road damage, the lowering of ground water levels due to excavation, and general environmental damage.

In consideration of the above points, without being able to estimate the aggregate demand amounts for Jakarta and the surrounding area- it can be judged that the demand for aggregate will increase in the future. In addition, as a result of the problem of decreased aggregate supply will soon become urgently needed.

(2) The Market Price for Aggregate

a) Jakarta

The market price for aggregate in Jakarta is shown in Table - 7.3.

The price of the aggregate varies according to the type. The following indicates the recent prices of aggregate based on type.

Sand	13,000 Rp/m^3
Gravel	15,500 Rp/m^3
Rock	15,600 Rp/m^3

Table - 1.3 Market Price of Construction Materials
Price on September 1987, in Jakarta.

(Rp)

No.	Kind of Materials	Unit	Market / Selling Price (Jakarta) (Rp)			
			Low Price	Low Price (Contract)	High Price	High Price (Contract)
1	STONE					
	River Stone (Pebble)	m^3	18,000	13,000	18,000	13,500
	Crushed Stone	m^3	18,500	13,000	19,000	13,500
2	GRAVEL					
	For Concrete	m^3	19,000	12,500	20,000	13,000
	Regular	m^3	18,500	12,000	19,000	12,500
	Split	m^3	25,000	15,000	25,000	16,000
3	SAND					
	Urung	m^3	14,000	10,000	14,500	11,000
	Pasang	m^3	15,000	11,500	14,500	11,000
	For Concrete	m^3	16,000	12,500	17,000	13,000

Data : Pusat Informasi Teknik Pembangunam PU. Cipta Karya

1.3 Amount Transported Volume by PJKA

Rail transportation by PJKA starts at Pirusa station near the Negla sandpocket, goes through Bandung and Cikampek, and on to Jakarta's Cipinang station. The distance between the two stations is 274 km and transportation, according to schedules, takes 7-8 hours. (Refer to Fig. - 1.2)

(1) Freight Cars

At present, there are two types of freight cars which haul aggregate from the Galunggung region. The standard size of these freight cars is indicated in Fig. - 1.3 as well as Table - 1.4.

Table - 1.4 Description of Wagon for Aggregate Transportation

Item	YYW	YW
Loading weight	30 ton	15 ton
Empty weight	31.1 ton	7.15 ton
Measure of Wagon	27 m^3	12 m^3
Loading volume	20 m^3	9 m^3

(2) Rail Car Composition

The composition of rail cars which haul aggregate presently running to Jakarta is indicated in Table - 1.5. Fig. - 1.4 shows the diagram from Pirusa station to Cipinang station in Jakarta. According to this train-schedule, the required transport time is 7-8 hours.

Fig. - 1.5 shows the possible number of the train services and its actual record from Tasikmalaya to Jakarta via Bandung. According to Fig. - 1.5, the actual record of the train service is 22 (24 in Hari Raya) between Tasikmalaya and Bandung, 35 (38 in Hari Raya) between Bandung and Jakarta. The possible number of the train services for actual train services is from 24 to 49 between Tasikmalaya and Bandung, from 34 to 78 between Bandung and Jakarta in the case of no improvement of the train operation system. There is a fall operation section such as between Ciawi and Cipeunduy at present. It would be estimated to increase 40% due to the improvement of the train diagram compared with the no improvement.

(3) Actual Shipped Volumes

Calculated from the number of freight cars that actually operated during the one year period from July 1987 to June 1988, the real volume of aggregate shipped to Jakarta is shown in Table - 1.6 and Fig. - 1.6.

1) The cumulative shipped volume of aggregate over the one year period from July 1987 to June 1988 amounted to 428,000 m^3.

2) The greatest shipped volume for one month from within this one year period was April 1988 at 42,900 m^3.

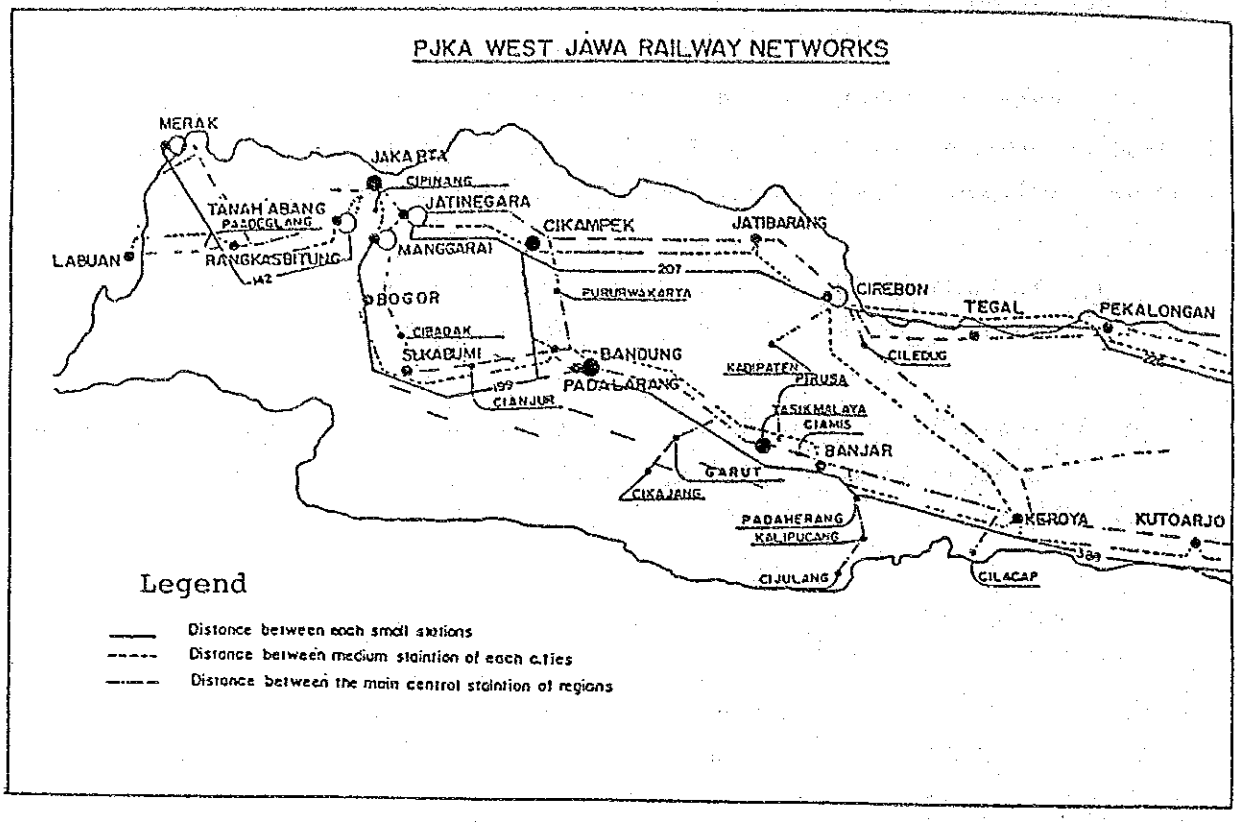
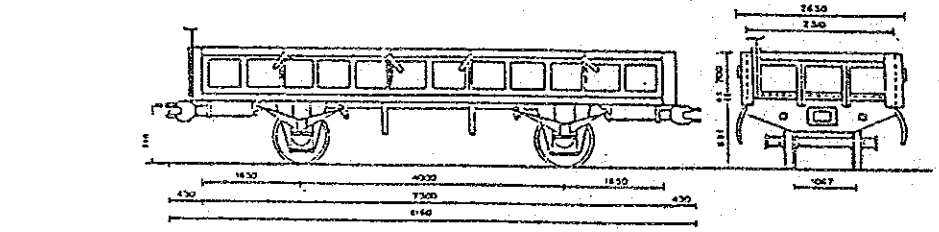


Fig. - 1.2 Railway Network of PJKA in West Java

YW TYPE(EX.YR TYPE)



YYW1-70

Type 4 Akled (ride comrol bogie)

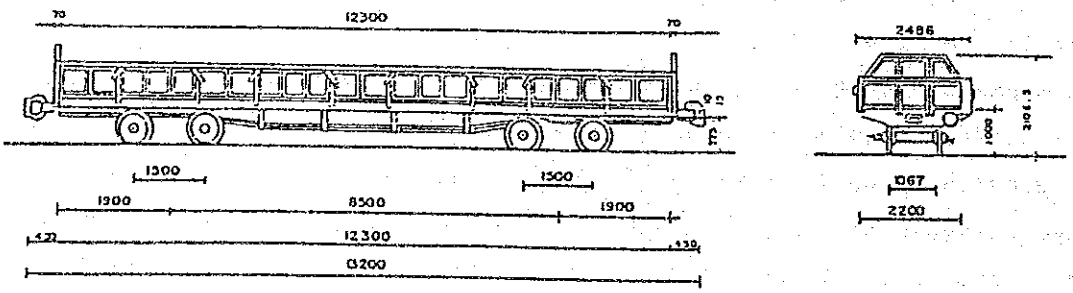


Fig. - 1.3 Profile of Wagon for Aggregate Transportation

Table - 1.5 Volume of Transportation and Railway Wagon Circumstance

(Pirusa Station October, 1987)

Car No. and Type of Locomotive	Name of Company	Loading Volume/ Time	Type of Wagon/Car and Capacity
BC 4001 (CC 201/GE)	PT. BUMINDO	280 m^3/time	Capacity 20 m^3/Wagon, YYW Type(*) 14 Wagons carried by 2 units Locomotive
BC 4003 (CC 201/GE)	PT. SARANA KARYA	252 m^3/time	Capacity 9 m^3/Wagon, YW Type(*) 28 Wagons carried by 1 unit Locomotive
BC 4005	PT. BUMINDO	280 m^3/time	Capacity 20 m^3/Wagon, YYW Type 14 Wagons carried by 2 units Locomotive
BC 4007	PT. BUMINDO	280 m^3/time	Capacity 20 m^3/Wagon, YYW Type 14 Wagons carried by 2 units Locomotive
ELK/234	PT. SARANA KARYA	140 m^3/time	Capacity 20 m^3/Wagon, YYW Type 7 Wagons carried by 1 unit Locomotive

Source: Pirusa Station October, 1987

Note) (*):

a) Transportation cost from Pirusa Station up to Cipinang Station Jakarta.

1) Carried by YYW Type Wagon, Capacity 20 m^3 = Rp.117,500/Wagon

2) Carried by YW Type Wagon, Capacity 9 m^3 = Rp. 52,900/Wagon

b) Actual Condition of railway facilities between the Cipinang Station and the Pirusa Station.

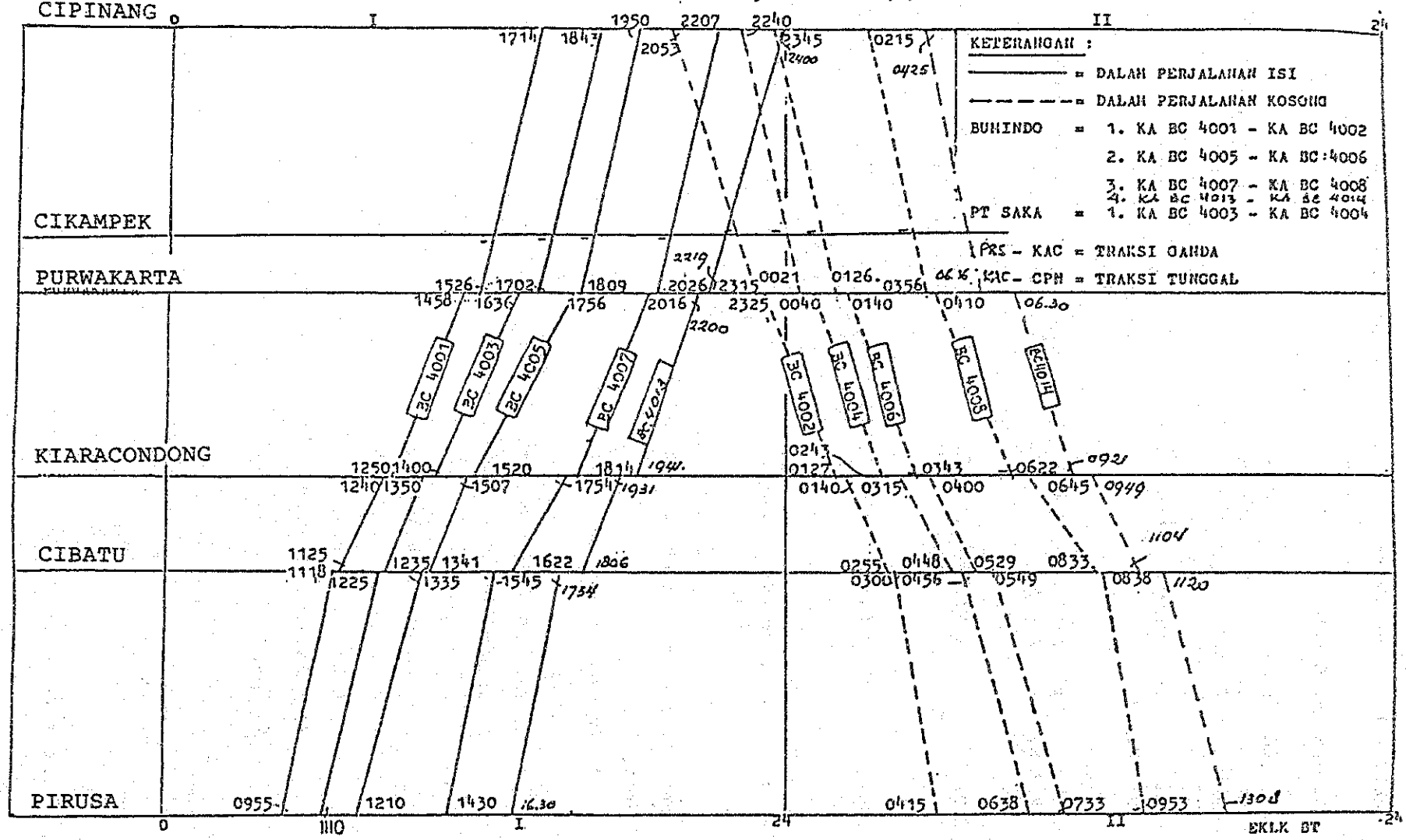
1) Cipinang Station - Cikampek Station : Double Track

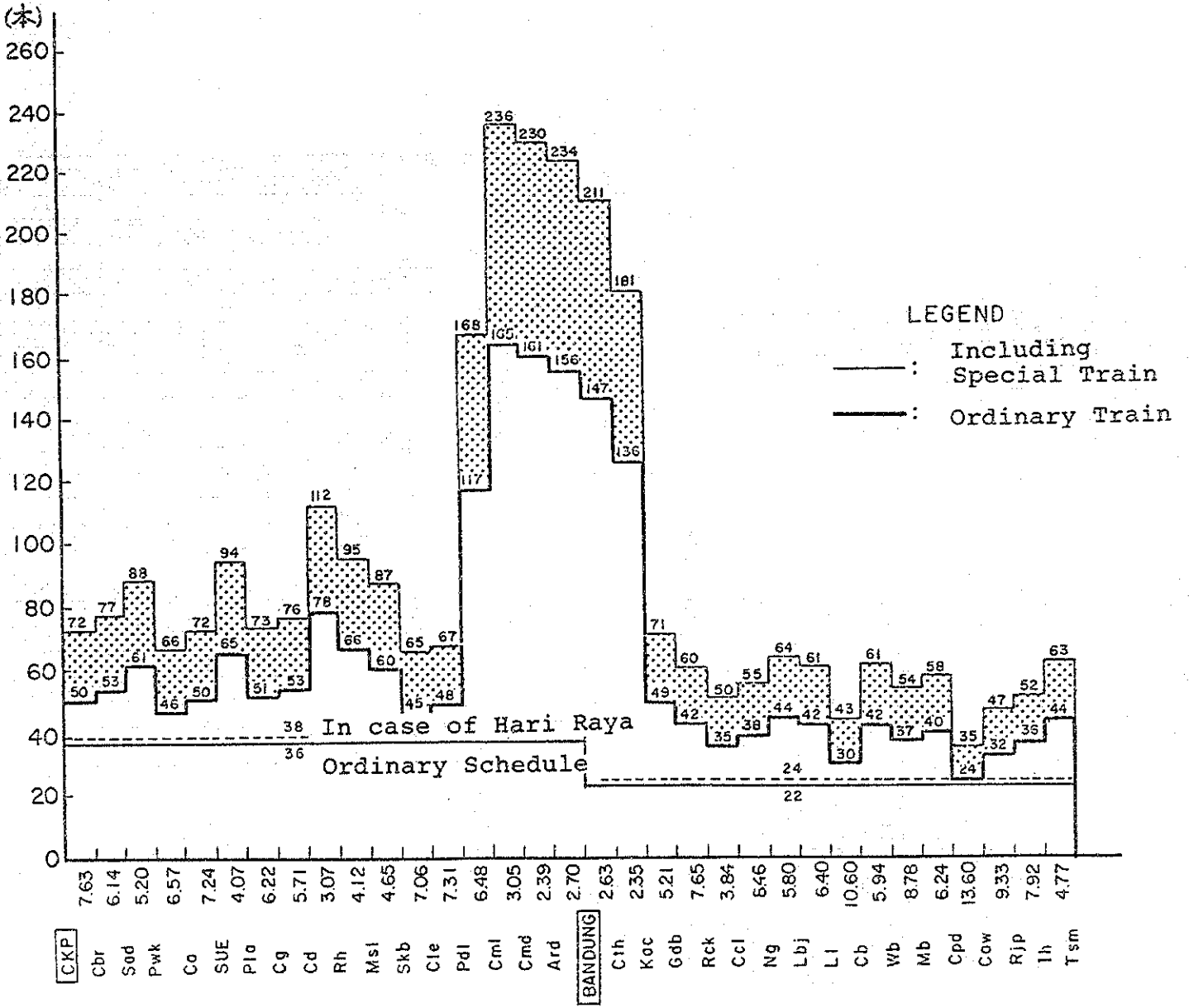
2) Cikampek Station - Padalaran Station : Single Track

3) Padalarang Station - Kiaracondong Station : Double Track

4) Kiaracondong Station - Pirusa Station : Single Track

BERLAKU MULAI TANGGAL 5 SEPTEMBER 1987




(本)
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Ordinary Schedule
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36
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Cbr
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Cg
Cd
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Msl
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2.63
2.35
5.21
7.65
3.84
5.46
5.80
6.40
10.60
5.94
8.78
6.24
13.60
9.33
7.92
4.77

Table - 1.6 List of Sand Loading Volume by PJKA at Pirusa Station

Month/Year		Kind of Wagon			Number of Wagon in a Month (Wagon)	Total of Sand Loading Volume in a Month (m^3)
		Y	YY	BB		
July	1987	1,151	822	-	1,973	25,484.30
August	1987	698	1,049	-	1,747	26,779.67
September	1987	930	1,190	-	2,120	31,578.13
October	1987	837	1,522	-	2,359	38,997.06
November	1987	415	1,558	-	1,973	39,223.40
December	1987	-	1,862	-	1,862	37,390.00
January	1988	-	1,952	-	1,952	39,040.00
February	1988	-	2,004	-	2,004	39,980.00
March	1988	-	2,121	-	2,121	36,120.00
April	1988	-	2,125	-	2,125	42,920.00
May	1988	-	1,731	-	1,731	34,620.00
June	1988	-	1,806	-	1,806	36,120.00
Total	-	4,031	19,742	-	23,773	428,251,56

Source: Pirusa Station, July 1988

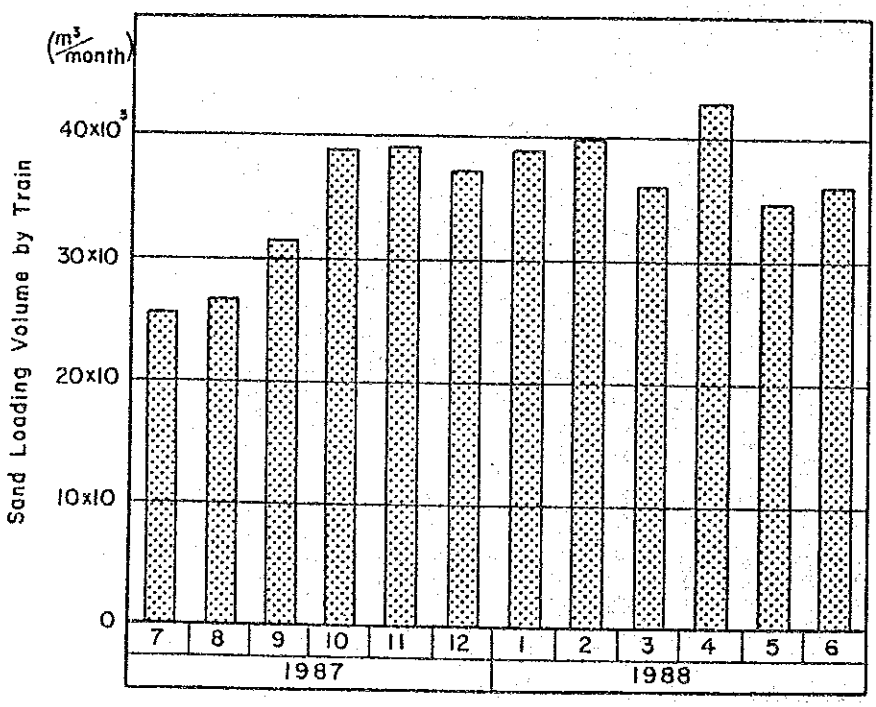

Fig. - 1.6 Sand Loading Volume by PJKA

2. Financial Evaluation

The process of sales as aggregate in Jakarta after the accumulated sediment has been excavated and hauled from the sandpocket, is as shown in Fig. - 2.1. The work process from excavation up to the production of aggregate is a sediment management works on the disaster prevention project, part of the public works projects. The work process from aggregate transport to aggregate sales is the aggregate sales industry, part of the third sector.

The scope of public work projects on the project was made by economic evaluation, the scope of aggregate sales industry on the project was made by financial evaluation respectively.

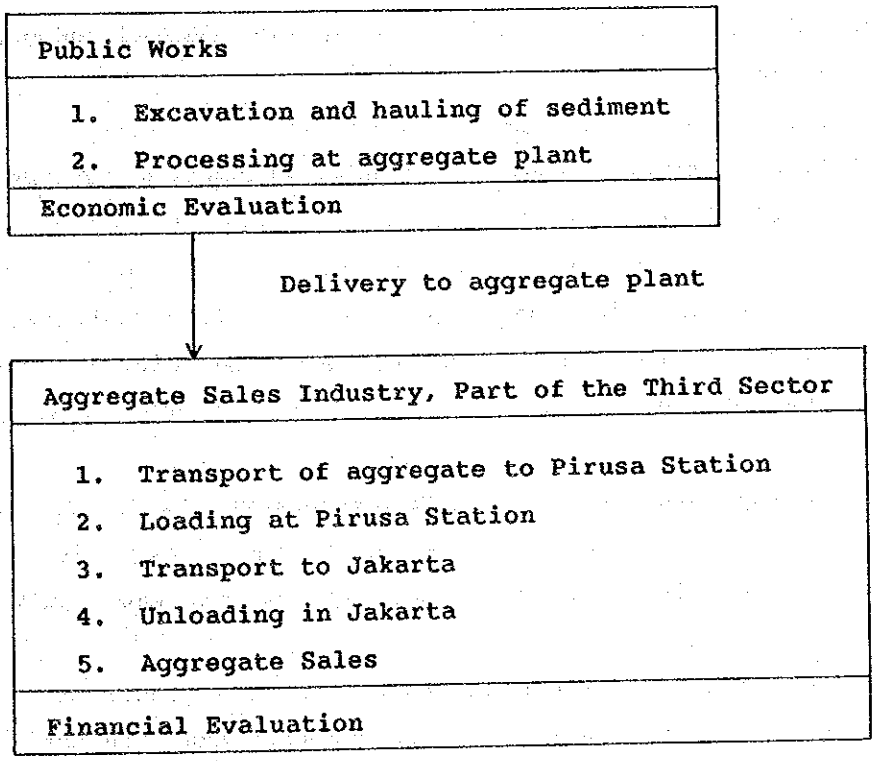

Fig. - 2.1 Classifications of Industry Categories and the Sphere between Economic Evaluation and Financial Evaluation for Sediment Management Work Process

On the basis of the economic evaluation, Alternative D was chosen for the method to manage sediment in the sandpockets since it showed the least cost. According to Alternative D, 128,000 m^3 of the total design annual sediment management volume of 614,000 m^3 is to be hauled and processed into aggregate at the aggregate plant. The remaining sediment volume is accumulated in the sandpocket for the storing.

However, while Alternative D is economical, as the inflowing sediment is accumulated, the riverbed inside the sandpocket rises and the dikes must be increased in height due to storing. Alternative D is not the most desirable plan from the point of view of river planning and disaster prevention if there is a aggradation of the riverbed. Also, the capacity of aggregate transport to Jakarta by rail is now at 428,000 m^3 and the need for aggregate in Jakarta is high. Therefore, it is determined from both the technological and sociological standpoints, that removal of the accumulated sediment from the sandpockets is best.

Furthermore, since the aggregate sales volume for Alternative D is small, low profitability is predicted.

With these points in mind, a general comparison of the alternatives including a study of profitability of the aggregate sales industry for each alternatives was executed.

(1) Basic Conditions of Financial Evaluation

The basic conditions of the financial analysis are as shown below.

1) The capacity of aggregate transport is supposed at over 600,000 m^3 per year and it is supposed that the entire volume of aggregate shipped to Jakarta can be sold.

2) The process of the aggregate shipping from the plant to Jakarta is in the form of consignment shipping. The direct cost for 1 m^3 of aggregate for each process is as shown below.

II - 1.	Aggregate transport	1,800 Rp/m^3
II - 2.	Loading	1,022 Rp/m^3
II - 3.	Rail transport charges	5,875 Rp/m^3
II - 4.	Unloading	1,022 Rp/m^3

3) Aggregate Sales Price

The sales price of aggregate will be the construction price in Jakarta. It will be used as a concrete mix and for gravel. The comparative ratios of sand and aggregate, which has been set at 14,600 Rp/m^3, are as shown below.

	Price	Ratio
Sand :	13,250 Rp/m^3	2
Gravel:	15,500 Rp/m^3	3

4) In the organization of the main constituent parts, consignment shipping and aggregate sales are the main operations, with about 20 employees. The fixed rates of labor, rent and other various expenses are attached to these for each of Alternatives A, B and C. In the case of Alternative D, it is 50%.

5) The tax on the profits has been calculated at 10%.

6) The cost of the aggregate plant equipment, spare parts and aggregate plant engineering foundation work is shown as follows for each alternative.

Table - 2.1

Alternatives	Plant Equipment Costs (x 10^6Rp)	Spare Parts (x 10^6Rp)	Foundation Works (x10^6Rp)
Alternative A	3,056.2	611.3	2,139.0
Alternative B	2,412.4	482.5	1,711.1
Alternative C	1,975.7	395.0	1,254.0
Alternative D	1,475.0	295.0	941.4

7) Aggregate plant operating cost, including labor costs, electricity cost, etc. are 224 Rp/m^3.

8) Aggregate plant lifespan is as shown below.

Machinery and equipment:	8 years
Engineering:	50 years

(2) Financial Evaluation

The sphere of financial evaluation is shown as in Fig. - 2.1 to be the transport of aggregate from the plant, the loading, the railroad transportation, unloading and aggregate sales. In this sphere, because profit is the difference between the cost of aggregate sales and the amount of sales, the FIRR value will be high for whatever alternative is used.

Therefore, in order to decide on the profitability for each alternative, the financial evaluation has been conducted with the assumption that the cost for purchase of aggregate plant equipment will be paid by the third sector. The FIRR values for each alternative are as shown in Table - 2.2.

Table - 2.2 Results of Financial Evaluation for Aggregate Use

Alternatives	FIRR (%)
Alternative A (Aggregate production 610,000 m^3	29.6
Alternative B (420,000 m^3)	26.9
Alternative C (300,000 m^3)	22.2
Alternative D (120,000 m^3)	5.6

The following items became clear from the results.

1) The FIRR Value for Alternative A, B, and C is above 20%. In Indonesia, it is a market rate of 17% which is considered a profitable undertaking. However, the 6% FIRR of Alternative D is not a profitable operation.

2) There is the trend of the profit ratio increasing with the amount of aggregate that is shipped. The most desirable is Alternative A with a very high FIRR (29.6%).

(3) Evaluation of Alternative for the Effective Use of the Accumulated Sediment in the Sandpocket Area

The four alternatives for the effective use of the accumulated sediment in the sandpocket area were set up by making the combination with the aggregate production at the aggregate plant and the storing by dike raising as shown in Table - 2.2.

As a result of comparison from the various aspect, the alternative D which shows the least cost was selected from a point of economical view. (Refer to Chapter 5)

The alternative A which shows the highest FIRR value was selected from a point of financial view.

Evaluating for the alternative D from the point of technical view, this alternative has a high potential for disaster as compared with another alternatives because of the height of the dike due to levelling works of the sediment would be 5.3 m.

The alternative A that transport 610,000 m^3 to Jakarta as aggregate to be saled is the best alternative. However, because 428,000 m^3 is the highest possible volume of aggregate of which the PJKA transportation capacity can guarantee at present.

For these reason, alternative B, with actual transportation volume and the smallest dike raising, is selected for the effective use of the accumulated sediment in the sandpocket area.

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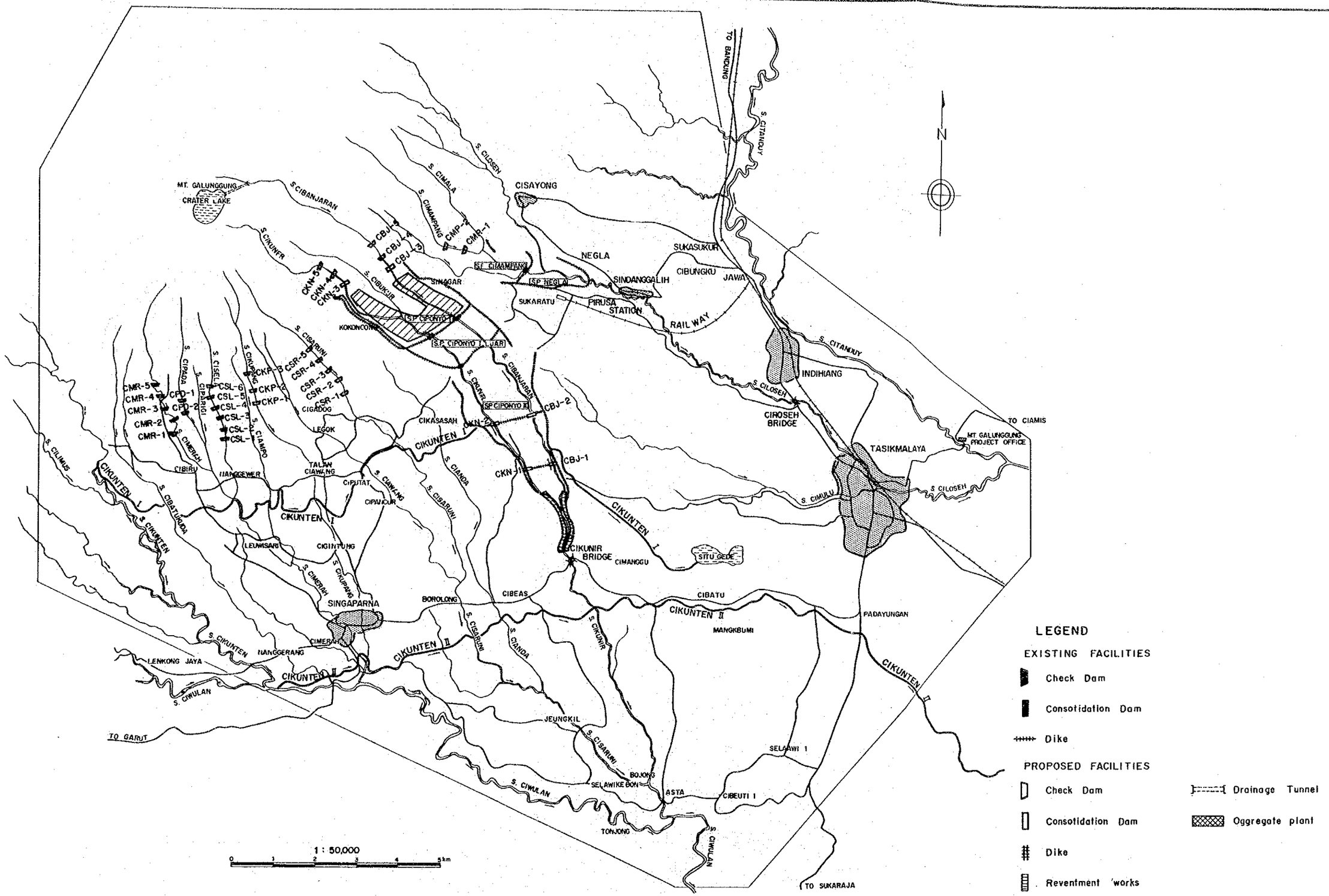
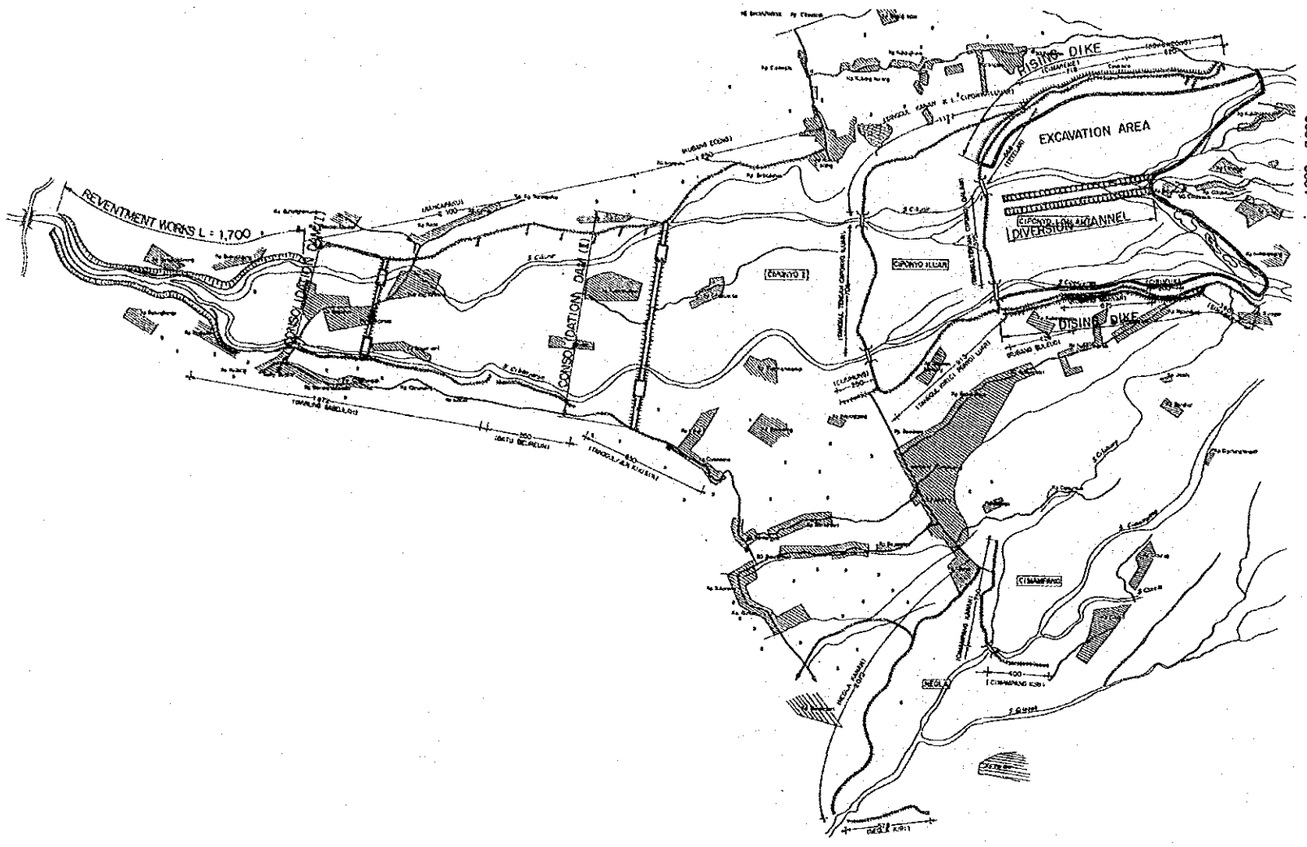


Drawing 1 Location Map of Proposed Facilities of the Disaster revention Project (1/50,000)

PLAN



Typical Section of Cross Dike

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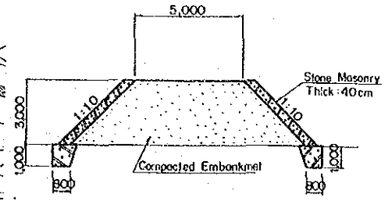

Typical Section of Improvement Dike

(Ciponyo I Luar, Ciponyo II, Cimampang, Negla)

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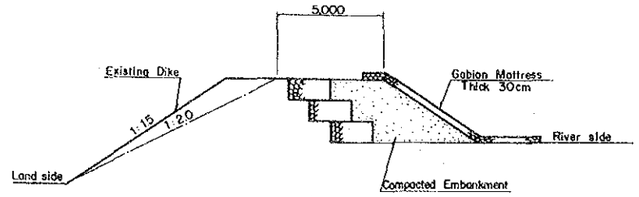

Typical Section of Rising Dike and Reinforced Dike

(Ciponyo I Dalam Area)

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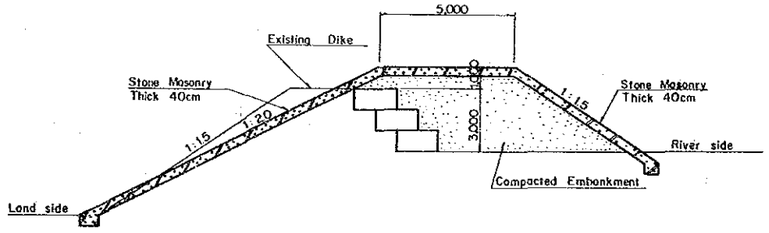

Typical Section of Diversion Channel

(Cibukur)

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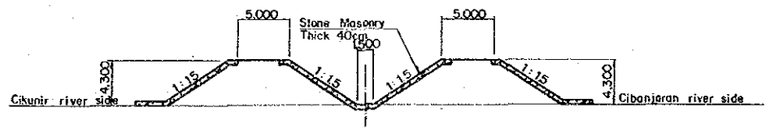

Typical Section of Cikunir River (9km+600)

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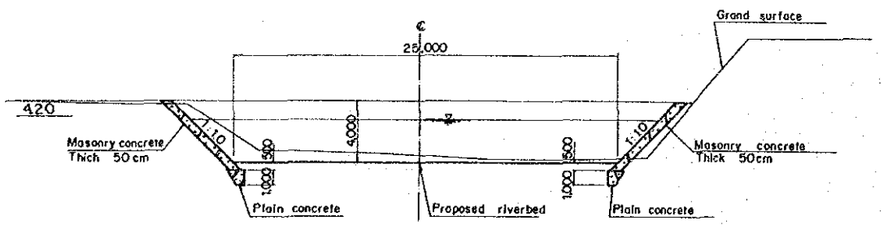
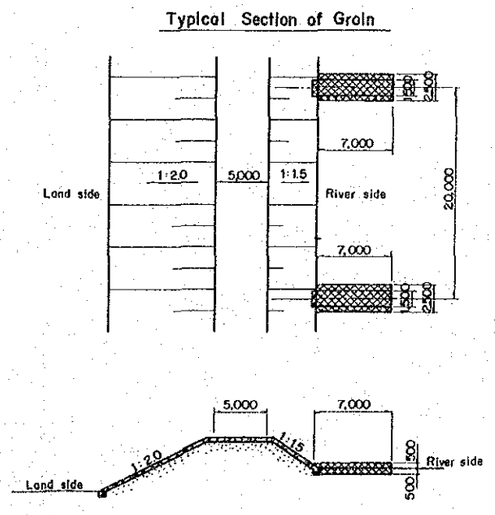
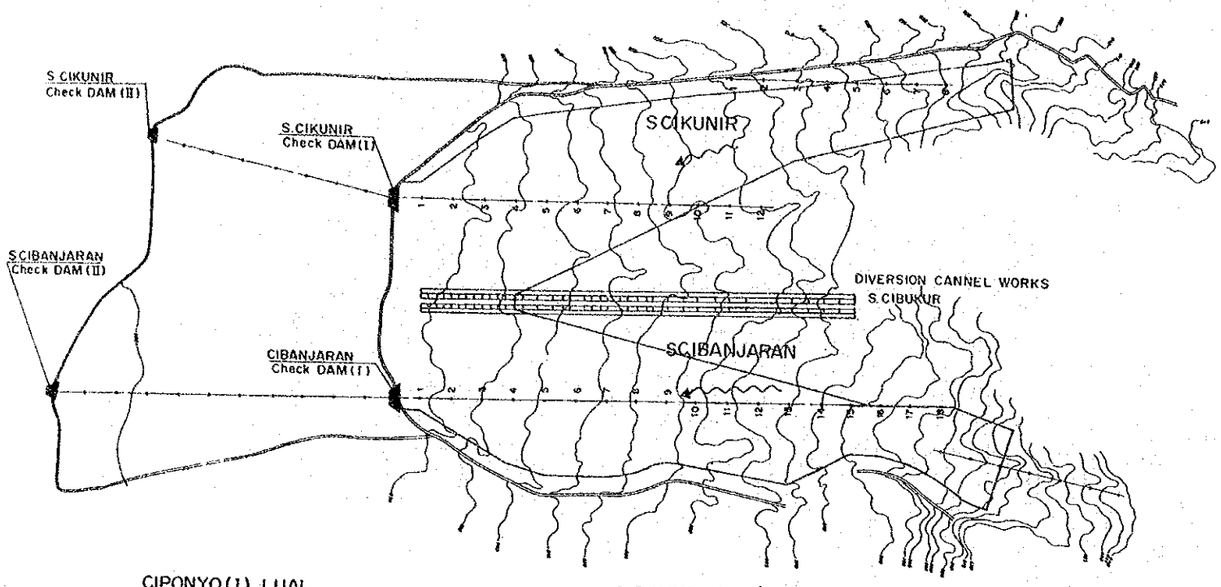


Typical Section of Groin

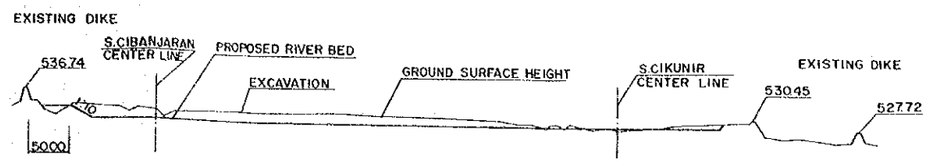


Drawing 2 General Plan of Proposed Facilities of the Sediment Management Works for Sandpocket(S. Cikunir, S. Ciloseh)

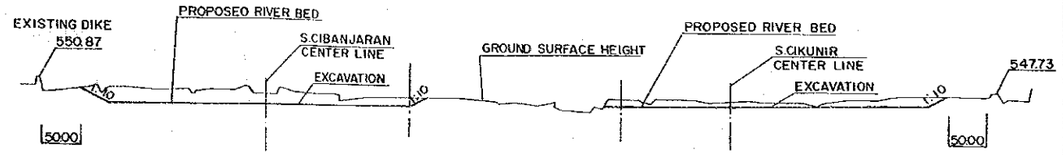
PLAN (SCALE 1:10,000)



TYPICAL SECTION (NO.4)
(SCALE 1:4,000 1:800)

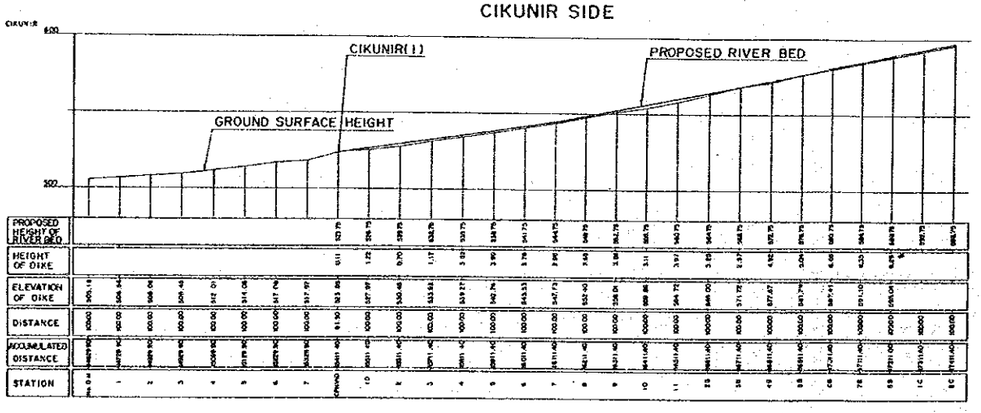


TYPICAL SECTION(NO.12)
(SCALE 1:4,000 1:800)

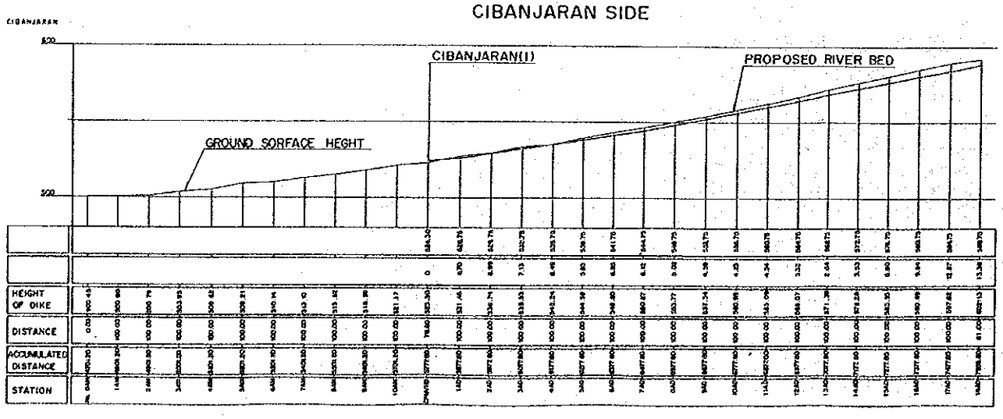


PROFILE (SCALE V=1:2,000 H=1:10,000)

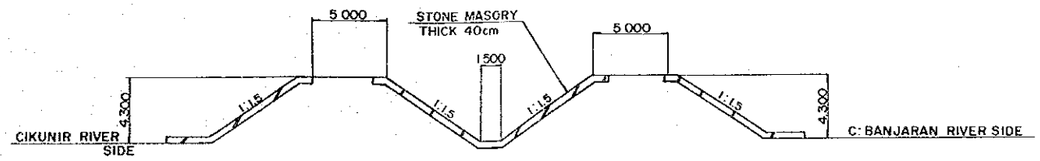
CIKUNIR SIDE



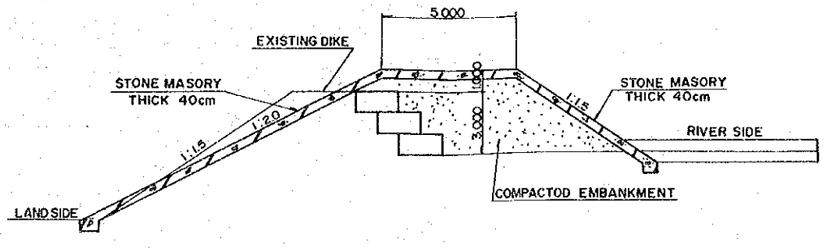
CIBANJARAN SIDE



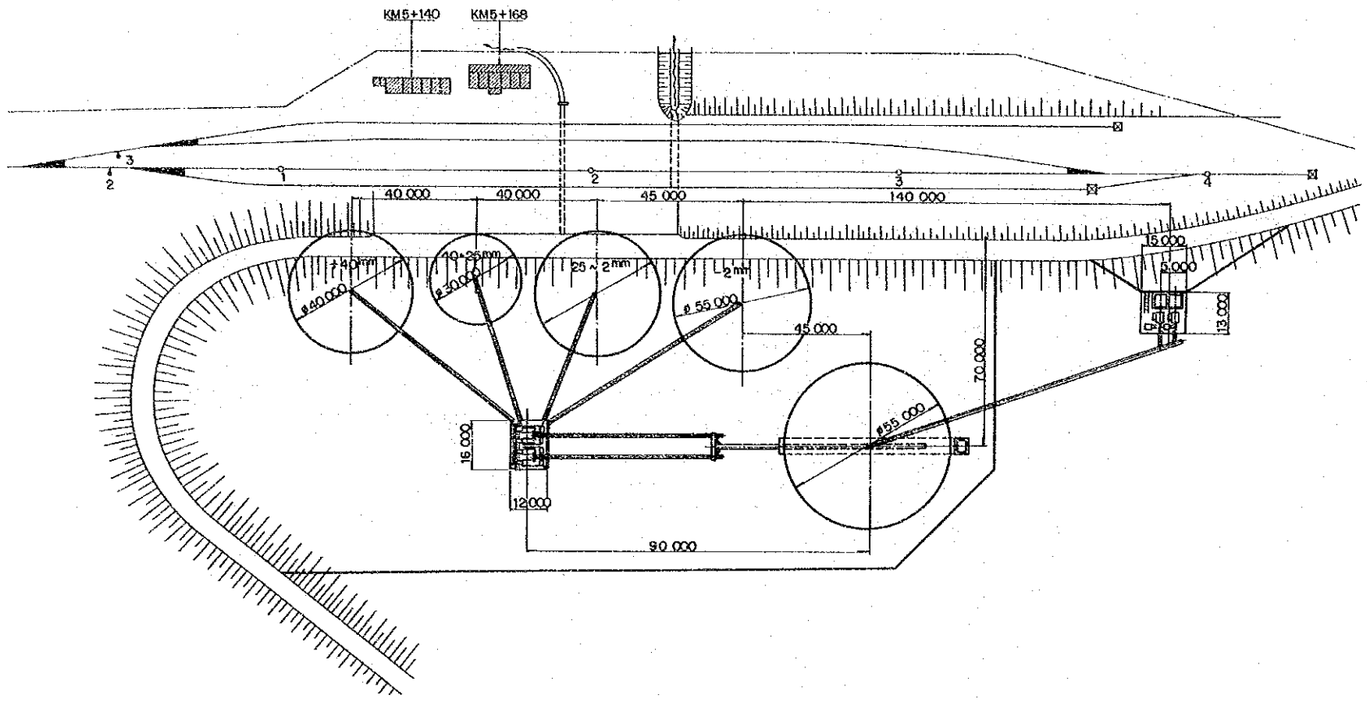
TYPICAL SECTION OF DIUERION CHANNEL
(C: BEKUR) (SCALE 1:200)

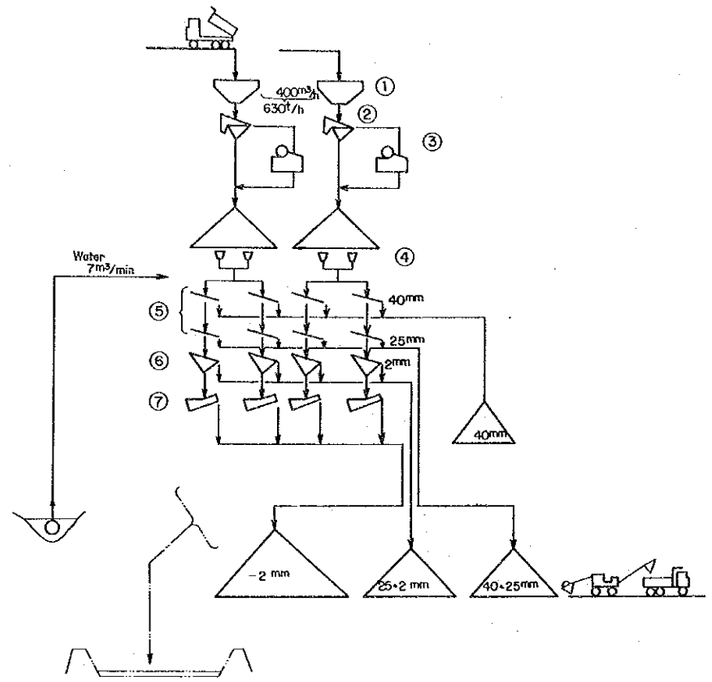


TYPICAL SECTION OF RISING DIKE AND PAINTORCED DIKE
(C: PONYO I DALAM AREA (SCALE 1:100)



Drawing 3 General Plan of Sediment Treatment Works in Ciponyo I Dalam



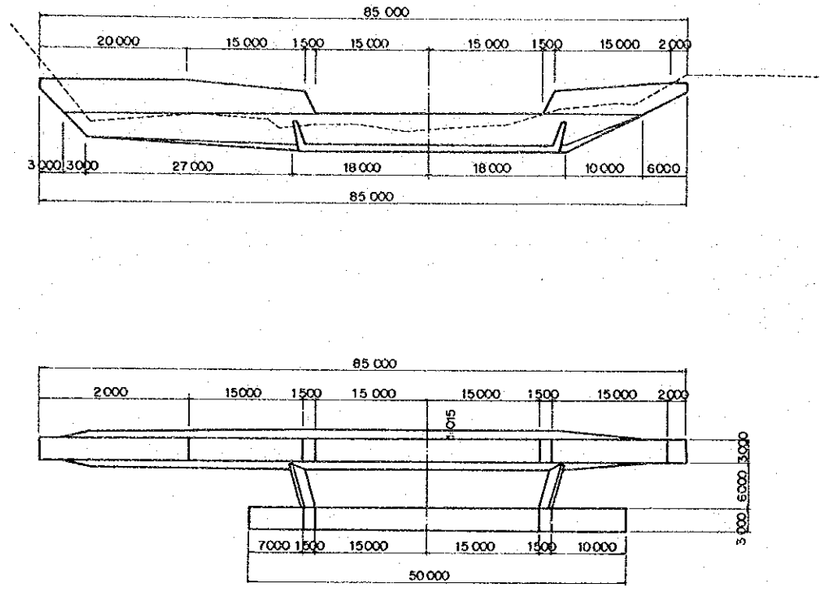


(Case 1) List of Crushing and Screening Plant Equipment

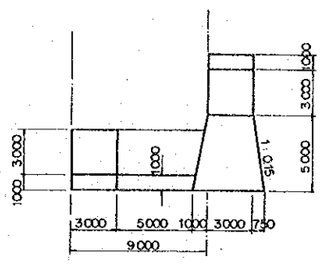
	Equipment	Quantity.	Specification	Total Description power.	Total Weight
1.	Feed hopper	2	50 m³× 2	---	
2.	Vibrating grizzly feeder	2	160(cm) x 500(cm)	22kw	22(t)
3.	Jaw Crusher	2	500(mm) x 750(mm)	90kw	40(t)
4.	Cut gate	4	400t/h	6kw	1.0(t)
5.	Vibrating screen (I)	4	1 500(mm) x 3 000(mm)	30kw	15.6(t)
6.	Vibrating screen (I)	4	2 400(mm) x 6 600(mm)	120kw	40(t)
7.	Crassifier (Spiral type)	2	φ 1,050(mm) x 7,500(mm)	22kw	28(t)
8.	Pump	2	φ 250mm	110kw	3.2(t)
9.	Belt conbeyer	m	B=750m and 900mm	(100kw)	90(t)
				400kw (545kw)	

Drawing 4 General Plan of Aggregate Plant (1/500)

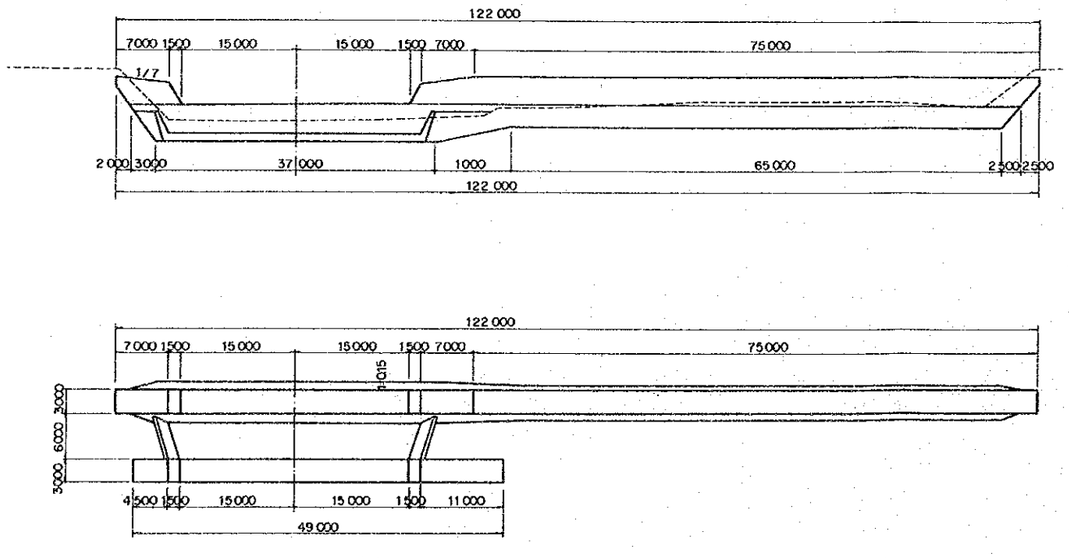
CKN－3 S=1/400



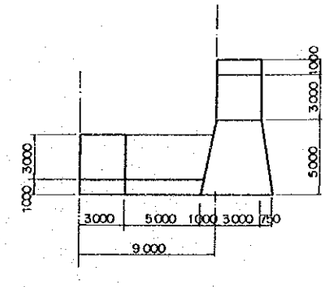
S=1/200



CKN－4 S=1/400

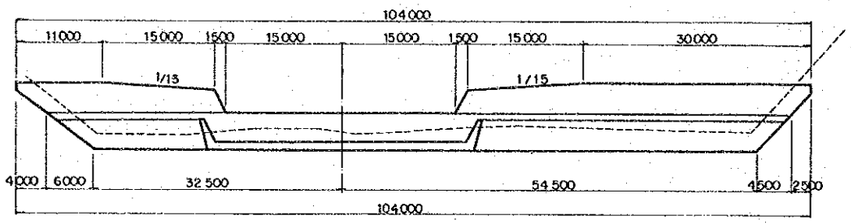


S=1/200

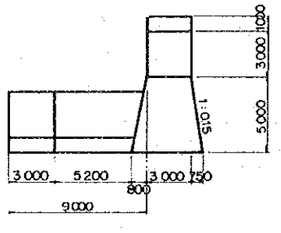


Drawing 5 General Plan of Check Dam in S. Cikunir

CKN-5 S=1/400

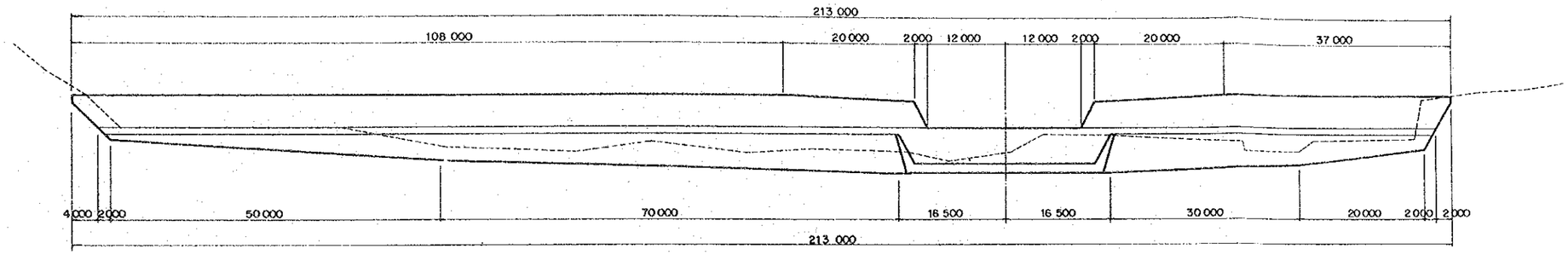


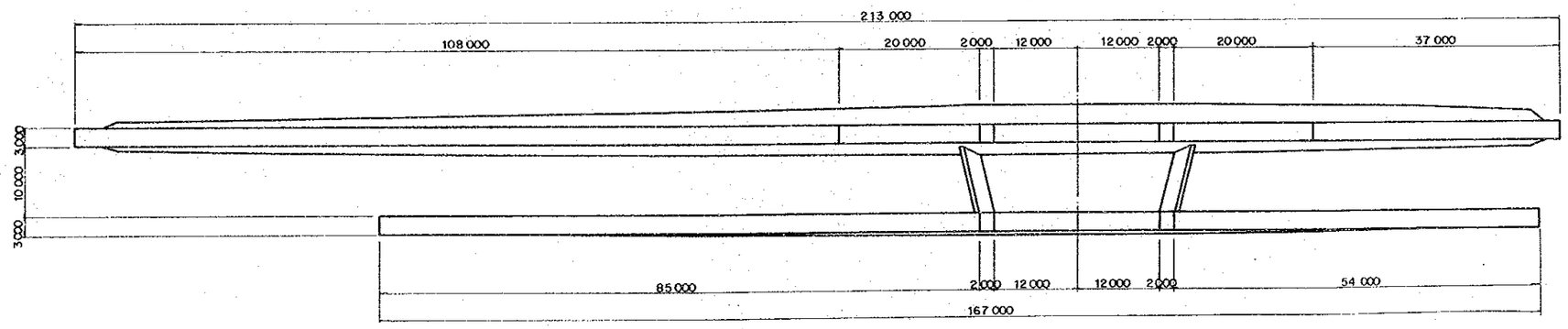
S=1/200

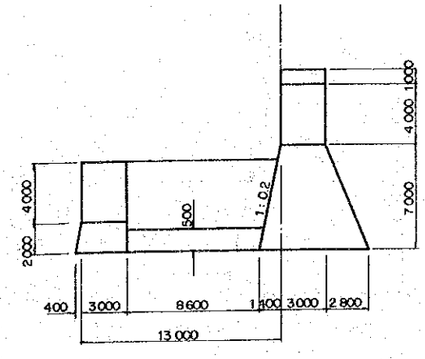


Drawing 6 General Plan of Check Dam of S. Cikunir

CBJ — 3 S=1/400

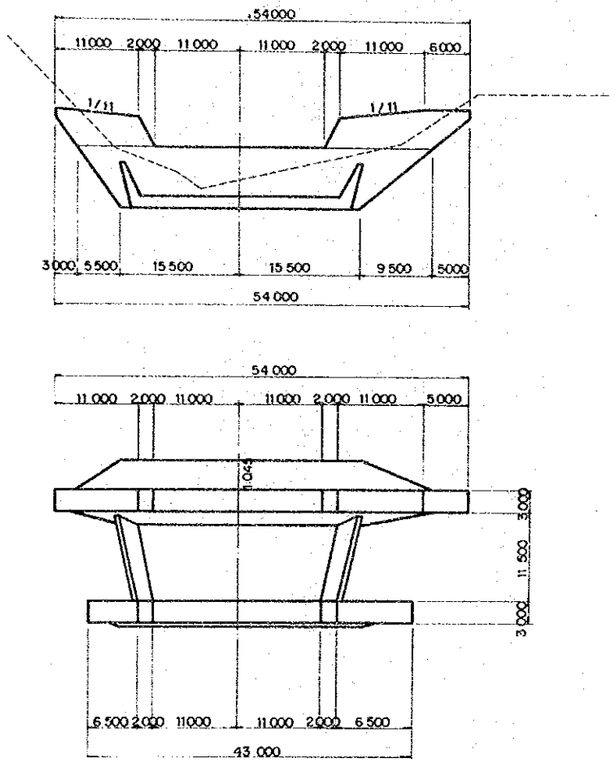




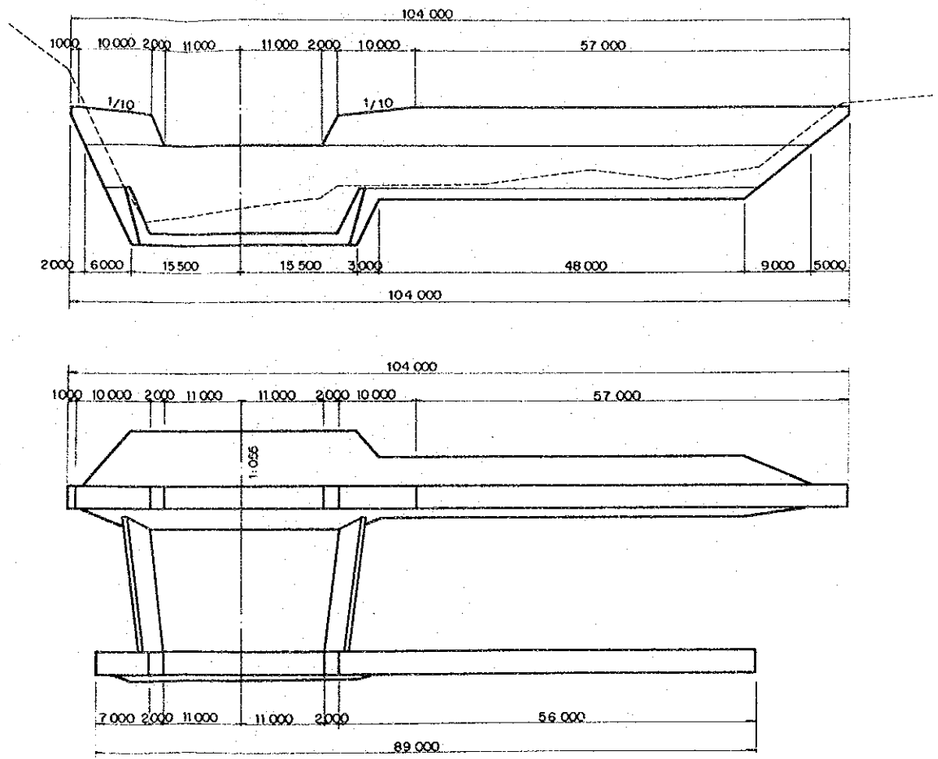


Drawing 7 General Plan of Consolidation Dams in S. Cibanjaran

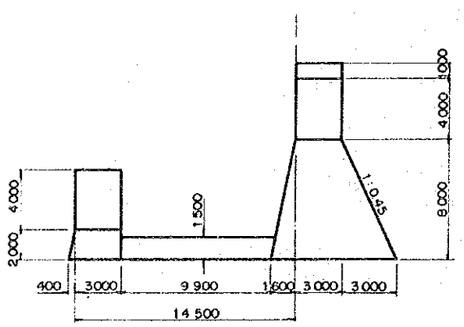
CBJ – 4 S=1/400



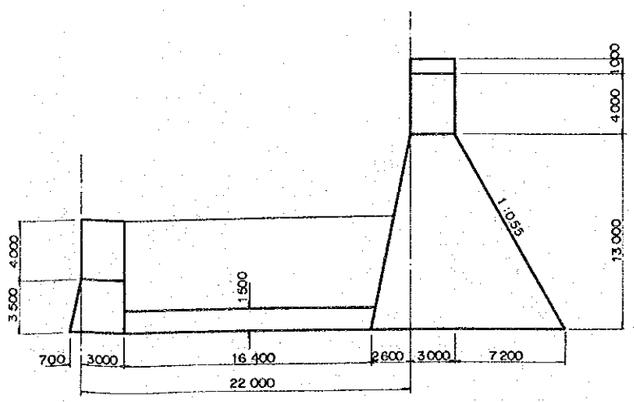
CBJ – 5 S=1/400



S=1/200

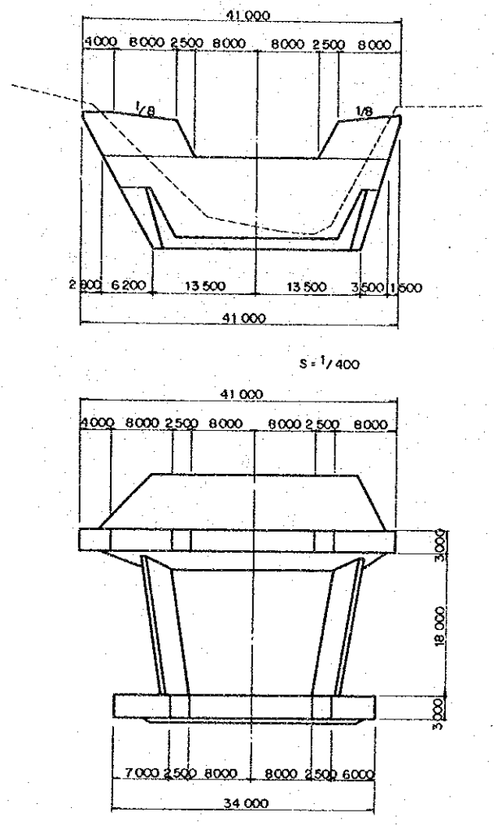


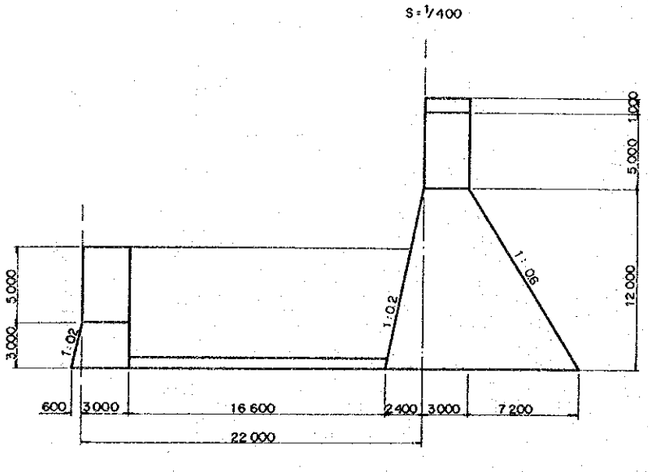
S=1/200



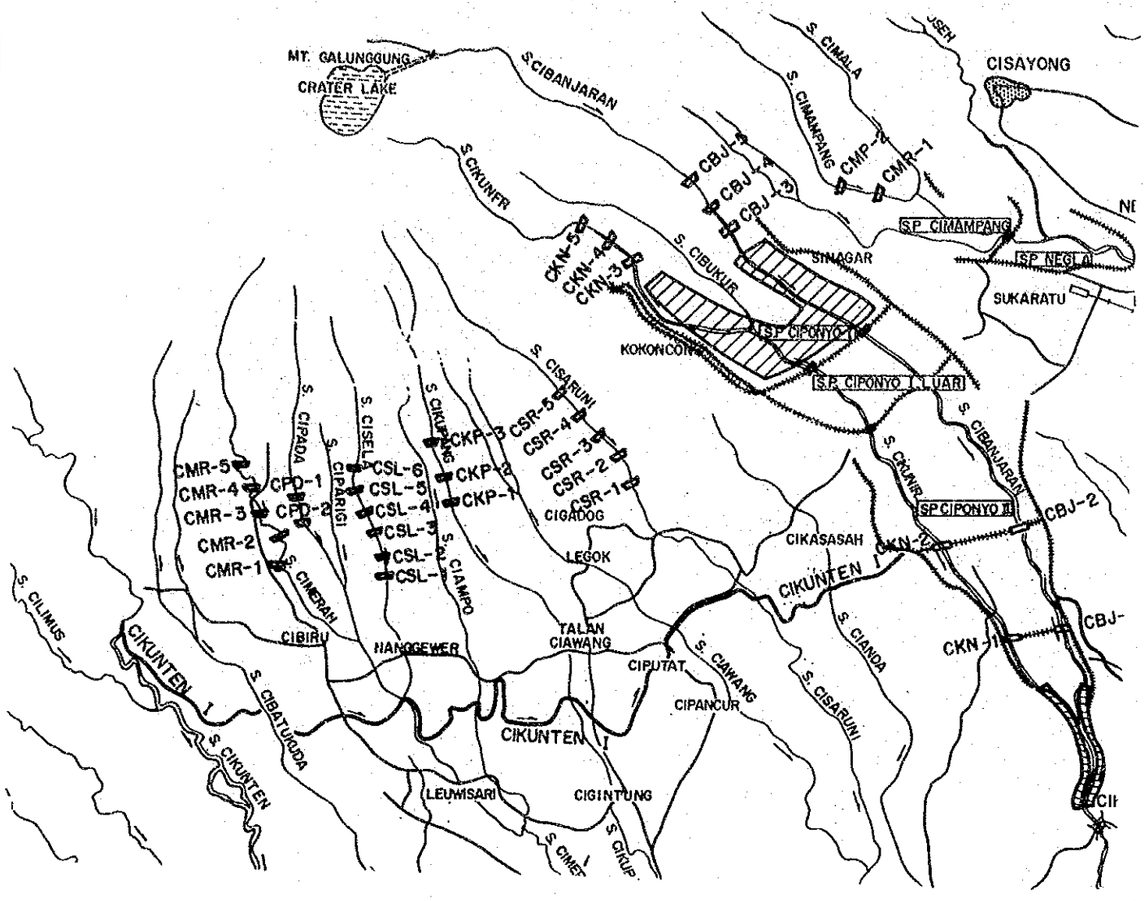
Drawing 8 General Plan of Check Dam on S. Cibanjaran

CMP-1
(CMP-2) S=1/400





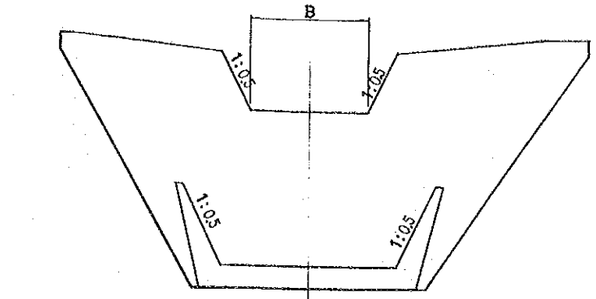
Drawing 9 General Plan of Check Dam on S. Cimampang



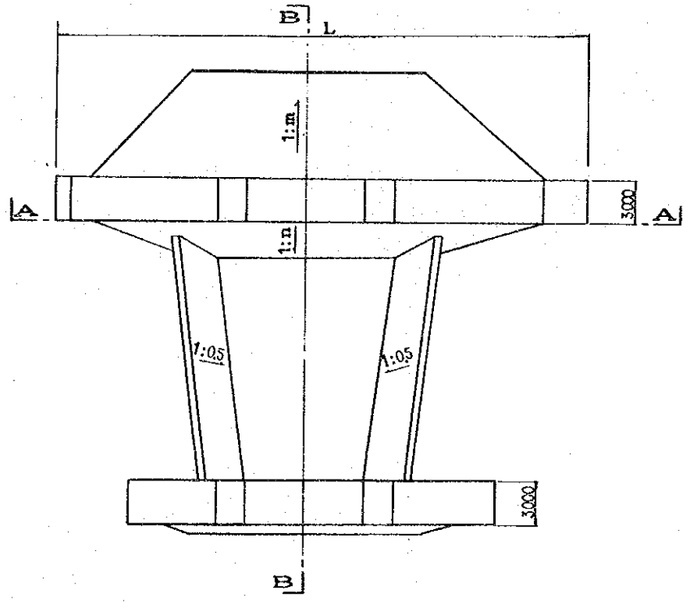
Outline of Check Dam Works in Southern Slope of Mt. Galunggung

Name of River	Name of Facility	Location No.	Design Peak Flood Discharge (m^3/s)	Dam Specification					
				Height :H (m)	Length :L (m)	Width of Crest (m) :B	Down Stream Slope:1: n	Up Stream Slope :1: m	Apron :L' Length (m)
S. Cisaruni	CSR - 1	2/100	110	7.0	30.5	12.0	1:0.2	1:0.40	13.0
	CSR - 2	1/600	104	11.5	31.0	12.0	1:0.2	1:0.50	19.5
	CSR - 3	3/100	99	22.0	56.0	12.0	1:0.2	1:0.85	34.5
	CSR - 4	3/500	76	22.0	55.0	8.0	1:0.2	1:0.85	34.5
	CSR - 5	3/900	51	18.0	51.0	6.0	1:0.2	1:0.85	28.5
S. Cikupang	CKP - 1	2/200	82	7.0	27.0	8.0	1:0.2	1:0.40	13.0
	CKP - 2	3/200	67	12.0	39.0	8.0	1:0.2	1:0.55	20.5
	CKP - 3	3/800	51	17.0	36.0	8.0	1:0.2	1:0.85	27.0
S. Cimerah	CHR - 1	2/095	150	7.0	28.5	10.0	1:0.2	1:0.45	14.5
	CHR - 2	3/110	150	9.5	30.0	10.0	1:0.2	1:0.55	18.0
	CHR - 4	5/000	143	22.0	63.0	10.0	1:0.2	1:0.90	36.0
	CHR - 5	6/300	57	17.0	53.0	6.0	1:0.2	1:085	27.0
S. Cisera	CSL - 1	2/000	106	7.0	31.0	12.0	1:0.2	1:0.40	13.0
	CSL - 2	2/400	94	7.0	28.0	10.0	1:0.2	1:0.40	13.0
	CSL - 3	3/000	82	12.0	36.0	8.0	1:0.2	1:0.60	20.5
	CSL - 4	3/400	74	22.0	51.0	8.0	1:0.2	1:0.85	34.5
	CSL - 5	4/000	54	22.0	62.0	5.0	1:0.2	1:0.85	34.5
	CSL - 6	4/600	27	17.0	52.0	5.0	1:0.2	1:0.80	25.5
S. Cipada	CPD - 1	2/100	44	15.0	51.0	4.0	1:0.2	1:0.85	24.0
	CPD - 2	2/800	31	15.0	53.0	4.0	1:0.2	1:0.75	22.5

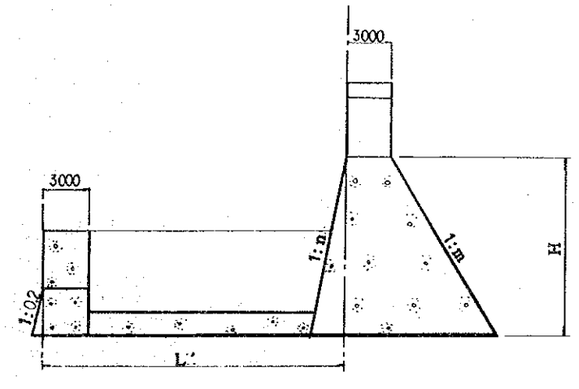
SECTION A-A



PLAN

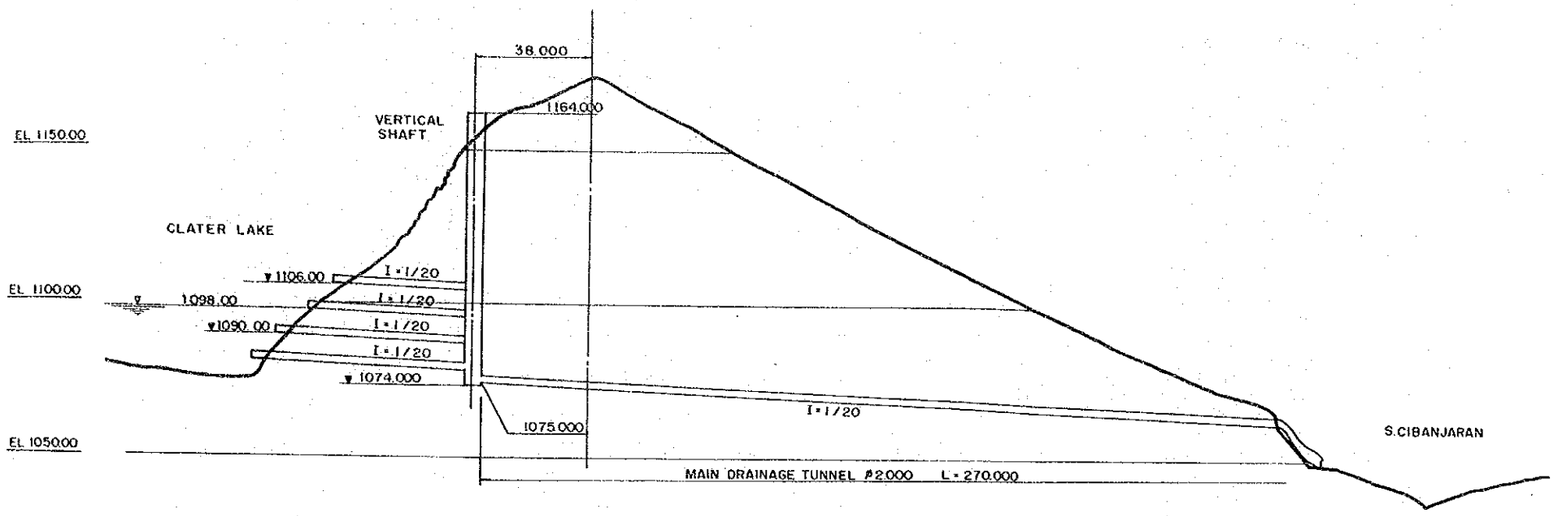


SECTION B-B

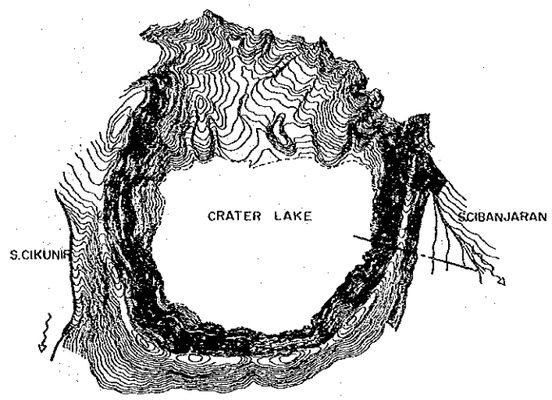


Drawing 10 General Plan of Check Dam Works in Southern Slope of Mt. Galunggung

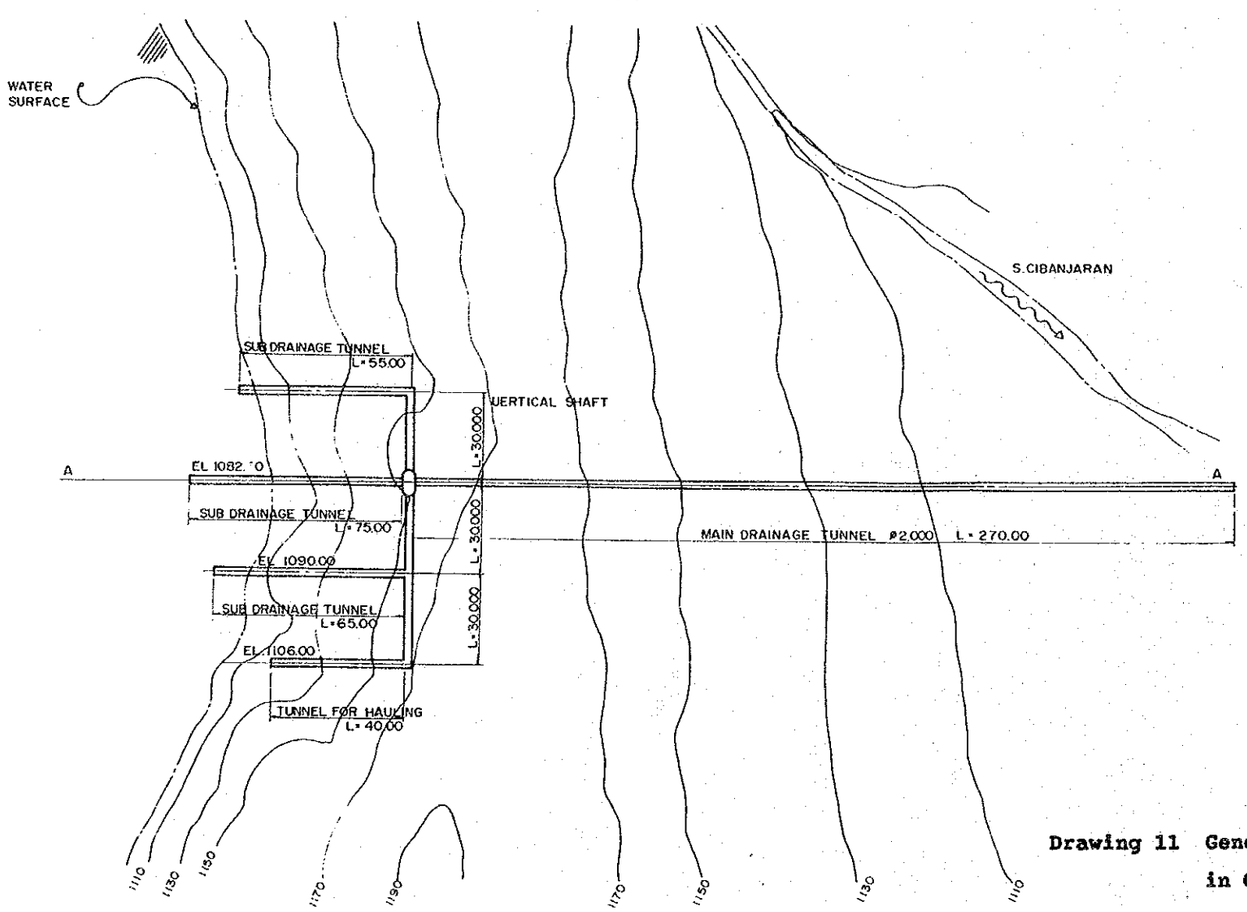
SECTION A-A (SCALE 1:1.000)

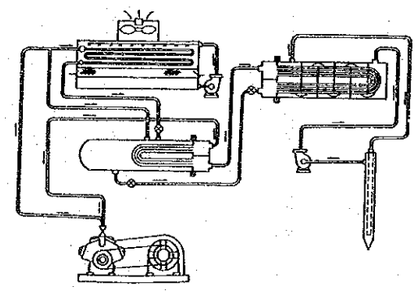


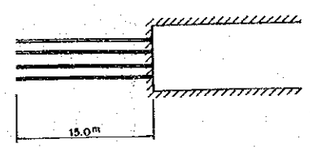
MAP OF FACILITY LOCATION OF DRAINAGE TUNNEL



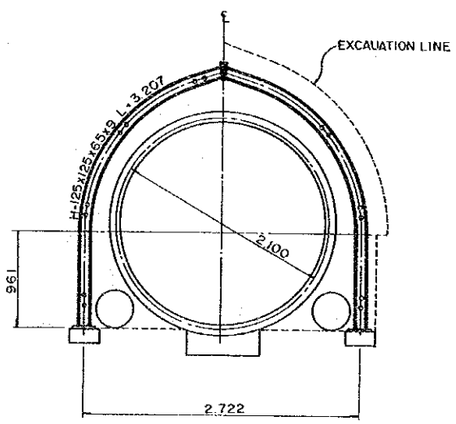
PLAN (SCALE 1:1.000)







TYPICAL SECTION OF DRAINAGE TUNNEL



Drawing 11 General Plan of Drainage Tunnel in Crater Lake