THE STUDY REPORT
ON
THE REHABILITATION AND MODERNIZATION OF
THE CEMENT PLANT OF ISLAND CEMENT CORPORATION
IN
THE REPUBLIC OF THE PHILIPPINES

SEPTEMBER, 1986

JAPAN INTERNATIONAL COOPERATION AGENCY

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PREFACE

In response to the request of the Government of the Republic of the Philippines, the Government of Japan decided to conduct a study on the Rehabilitation and Modernization of the Cement Plant of Island Cement Corporation and entrusted the study to the Japan International Cooperation Agency (JICA). JICA sent to the Philippines a survey team headed by Mr. Ryo Toyabe, ONODA ENGINEERING AND CONSULTING CO., LTD., from January 20 to February 8, 1986.

The team exchanged views with the officials concerned of the Government of the Philippines and conducted a field survey in the Project-related areas including Metro Manila and Antipolo. After the team returned to Japan, further studies were made and the present report has been prepared.

I hope that this report will serve for the development of the Project and contribute to the promotion of friendly relations between our two countries.

I wish to express my deep appreciation to the officials concerned of the Government of the Republic of the Philippines for their close cooperation extended to the team.

September, 1986

Keisuke Arita
President
Japan International Cooperation Agency

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FOREWORD

- Purpose and Development of This Study -

The Republic of the Philippines started its industrialization in the 1950's and the ratio of manufacturing industries in GNP reached 23.2% in the 1970's.
However due to narrow market and excess capacity, the ratio found it hard to grow and remains at 24.7% as of 1984.
While the ratio of all the mining and manufacturing industries including mining, construction, utilities and manufacturing in GNP is 34.1% exceeding 26.2% of agricultural industries.

On the other hand, a number of plants have been constructed through the economical cooperation of Japan in ASEAN countries including the Philippines.

But those plants are mostly suffering from low operation rate and high production costs due to timeworn facilities and lack of spare parts.
Under such circumstances, the Government of the Republic of the Philippines requested the Government of Japan to conduct the study on the Rehabilitation and Modernization (hereinafter referred to as "the Study") of the cement plant of Island Cement Corporation (hereinafter referred to as "ICC") in April, 1985.

In the response to the request of the Philippines, the Japan International Cooperation Agency (hereinafter referred to as "JICA") despatched a preliminary survey team in September, 1985 to discuss and sign with the Board of Investments (hereinafter referred to as "BOI") on the Implementation Arrangement for conducting the survey.

Based on the Arrangement, JICA has carried out the survey during a period of 20 days starting from the end of January, 1986.

That is, after grasping the overall background of the project to carry out:

(1) diagnosis of Antipolo plant of ICC

(2) formulation of rehabilitation and modernization program assuming that wet long kiln system is converted to dry system

(3) present situations and future prospects of supply and demand of cement in the Philippines

(4) financial analysis and economic evaluation of the project

and then based on the overall consideration on the results obtained to judge the feasibility of the project as well as to give recommendation for implementation of the project.

The field investigation was started on 20th January, 1986 and progressed favourably throughout the whole period thanks to the positive cooperation extended by BOI, ICC and other Departments concerned and completed on 8th February. After returning home of the team, arrangement and analysis of the results of field investigation, laboratory test of samples collected at field, diagnosis of the plant, formulation of rehabilitation and modernization program and financial analysis and economic evaluation were conducted, and finally this report was completed in May 1986.

The field investigation is outlined as follows:

(1) Investigation at ICC's cement plant

Investigation of raw material quarry
Investigation of plant equipment and facilities
Investigation of plant control

(2) Investigation of cement market

Marketing method of ICC - present situation and future policy
Present situation of cement market in the Philippines
Investigation on future prospect of cement market in the Philippines

(3) Investigation of electricity supply

Investigation at National Power Corporation and Manila Electric Company
Investigation at Doroles substation

(4) Investigation for financial analysis and economic evaluation

Collection of cost information
Collection of information on financing
Investigation of taxation and incentive

(5) Itinerary of the field survey

The survey team carried out the field survey during a period of 20 days from January 20 to February 8, 1986.
The offices visited and places surveyed during the period are described as follows.

Remarks:

Abbreviation of places

MNL: Metro Manila, APL: Antipolo

Abbreviation of Offices of the Government and Private Company

BOI	:	Board of Investments
NEDA	:	National Economic and Development Authority
DBP	:	Development Bank of the Philippines
MOF	:	Ministry of Finance
PCIA	:	Philippine Cement Industry Authority
BOMG	:	Bureau of Mines & Geo-sciences
MPWH	:	Ministry of Public Works and Highways
NCSO	:	National Census and Statistics Office
PHILCEMCOR	:	Philippine Cement Manufacturers Corporation
MERALCO	:	Manila Electric Company
ADB	:	Asian Development Bank
ICC	:	Island Cement Corp.
AICDC	:	A.I. Construction & Development Corporation
JETRO	:	Japan External Trade Organization
NPC	:	National Power Corporation
URPO	:	Urban Roads Project Office

Day's order	Date	Day	Work description	Places
1	Jan.20	(M)	Field survey team left Tokyo and arrived at Manila	MNL
			Meeting at Japanese Embassy and JICA Manila office	
2	Jan.21	(T)	Meeting at BOI on survey schedule with ICC staff	MNL
			Meeting at ICC head office	
3	Jan.22	(W)	Meeting at and inspection of ICC cement plant	APL
4	Jan.23	(Th)	(A) Meeting at DBP, NEDA	MNL
			(B) Study at ICC cement plant	APL
5	Jan.24	(F)	(A) Meeting at ICC head office, BOI, NEDA library, NCSO	MNL
			(B) Study at ICC cement plant	APL
6	Jan.25	(Sat)	(A)(B) Study at ICC cement plant	APL
7	Jan.26	(Sun)	(A)(B) Data arrangement	MNL
8	Jan.27	(M)	(A) Meeting at ICC head office and AICDC	MNL
			(B) Meeting at NPC	
9	Jan.28	(T)	(A) Meeting at PHILCEMCOR, BOI, MOF	MNL
			(B) Meeting at MERALCO, NPC	
10	Jan.29	(W)	(A) Meeting at PCIA, ICC, BOMG, ADB	MNL
			(B) Meeting at ICC cement plant	APL
			(C) Meeting at MERALCO, NPC, NPC substation	APL

Day's order	Date	Day	Work description	Places
11	Jan.30	(Th)	(A)(B) Meeting at JETRO, MPWH. Preparation of progress report Mr. Okada left Manila for Japan	MNL
12	Jan.31	(F)	(A)(B) Submission of progress report to BOI. Meeting at ICC, Japanese Embassy and JICA Manila office	MNL
13	Feb.1	(Sat)	Data arrangement	MNL
14	Feb.2	(Sun)	Messrs. Toyabe, Kamata, Kojima, Fukui left Manila for Japan	MNL
15	Feb.3	(M)	Meeting at Tariff Commission, URPO	MNL
16	Feb.4	(T)	Meeting at JETRO, ADB, MPWH	MNL
17	Feb.5	(W)	Meeting at ICC, Japan Ex-im Bank, PHILCEMCOR	MNL
18	Feb.6	(Th)	Meeting at JICA, Data arrangement	MNL
19	Feb.7	(F)	Data arrangement	MNL
20	Feb.8	(Sat)	Mr.Kawasugi left Manila for Japan	MNL

SECTION I GENERAL OBSERVATION

I-1 Premise for the Study

This report has been prepared under the following premises.

I-1-1 Raw Materials of Cement

The main raw materials which are being used by ICC, i.e. limestone, high silica clay, low silica clay occur with the following reserves, and so they are sufficient for the operation after the renovation.

(1)	Limestone	56,035,000 ton
(2)	High silica clay	7,640,000 ton
(3)	Low silica clay	1,100,000 ton

I-1-2 Basic Data for Financial Analysis and Economic Evaluation

(1) Price and unit price

The price and unit price as of January 1986 have been used as the basis of calculation and no escalation has been taken into consideration.

(2) Financing

Loan	100% (foreign and local loan)

(3) Loan condition (long term)

	foreign	local
Interest rate	11%/y	12%/y
Repayment	10 years	5 years
Grace period	2 years	2 years
Construction interest	to be included in capital	

(4) Loan condition (short term)

Interest rate 12%/y

(5) Project life

Construction period	:	2 years
Effective operation period	:	20 years

(6) Operation ratio of the plant

To be determined according to the transition of the demand (Refer to Section III)

(7) Annual working day 300 day/y

(8) Taxes and duties

(i)	Income tax	35% to the profit before tax
(ii)	Sales tax	10% of sales revenue

(9) Exchange rate (Official rate as of January 1986)

US$ 1 = Pesos 19.103
US$ 1 = Yen 192.05

(10) Depreciation

	Durable year	Residual value
Machinery and equipment	15 year	1%
Civil and buildings	20 year	1%
Vehicle	5 year	1%
Preoperation expenses & construction interest	10 year	0%

(11) Ex factory price of cement

	40 kg bag
Ordinary portland cement	42.5 Peso/bag
Pozzolan cement	41.5 Peso/bag

(12) Production proportion of cement by kinds

As a results of consultation with ICC, the following cases were adopted to be studied.

	Ordinary portland cement		Pozzolan cement
Case I	50 %	:	50 %
Case II	80 %	:	20 %

(13) Clinker production (100% capacity)

		kiln to be operated
Before renovation	780,000 ton/year	No.1 and 2 kiln
After renovation	780,000 ton/year	No.1 kiln

(14) Others

Export promotion fund	0.5 Peso/bag

I-2 Summary of the Study

I-2-1 Policy of the Government of the Republic of the Philippines with Respect to the Cement Industries in the Philippines as well as the Rehabilitation and Modernization of ICC

The Governmental authority that is in charge of implementing the policy on the cement industry is PCIA which is one department of BOI.

(1) Price policy

The Government is now setting up the ceiling price against ex-plant price, and based on the ex-plant price, the regional retail ceiling prices are established.

Ordinary portland cement

Ex-factory price	42.50 Pesos/bag (40 kg)
Retail price (Metro Manila)	48.50 Pesos/bag (40 kg)

(Refer to II-1)

(2) Market policy

The Philippines is divided into three areas, i.e. Luzon area, Visayas area and Mindanao area.

The Philippine cement industry has an agreement stipulating that each cement plant, as a rule, can sell its cement only in the area where that plant is located.

(Refer to II-2)

(3) Export policy

The Government is promoting the exportation of cement by subsidiary US$20.25 per ton of cement to be exported.
This subsidy is made by accumulating the funds of 0.5 Peso per bag to be imposed on the demestic sales.
The export is conducted in integrated system in accordance with a guidelines.

(Refer to II-3)

(4) Improvement of cement production technology and quality

PCIA is endevouring to improve the technology of each cement companies through the Technical committee of PHILCEMCOR.

(Refer to II-4)

(5) Policy for the renovation of ICC

In case the demand for cement is recovered and this renovation project is judged by the owners (DBP and PNB) to be profitable, the Government is ready to cooperate the renovation.

(Refer to II-5)

I-2 2 Present Situations and Future Prospects of Supply and Demand of Cement in the Philippines

(1) Outline of present situation of the Philippine cement industry

In the Philippines, at present, there are 18 cement plants.
Since the economic situation in the Philippines is dull the management of cement manufacturers is not easy.

(Refer to III-1)

(2) Production, domestic sales and export

(i) Production

Average annual production of whole country for last 11 years is 4,133,000 tons and that of ICC is 440,000 tons which corresponds to 10.6% of whole country production.

(ii) Domestic sales

Average annual domestic sales of whole country for last 11 years is 3,505,000 tons and that of ICC is 426,000 tons which corresponds to 12% of whole country domestic sales.

(iii) Export

The Philippines is endevouring to export the surplus of production. At present they established the export subsidy system.

(Refer to III-2)

(3) Prospects of demand

(i) Prospects of demand in the Philippines

As a result of examination of demand prospects of cement, the prospects estimated by single correlation with population seems most suitable.

(ii) Export of cement

The Philippines has been exporting cement that corresponds to about 20∿30% of domestic consumption.

The same proportion of cement will probably be exported in the future.

(iii) Market situation in the future

The total of item (i) and (ii) mentioned above is the whole demand, ICC's share after the renovation is calculated as 11% of the above amount as it is.
ICC's renovation, therefore, has little effect on cement industry in the Philippines.

(Refer to III-3)

I-2-3 Outline of ICC and Environment of Antipolo

(i) Outline of ICC

Antipolo plant of ICC was originally constructed in 1966 by Marinduque Mining Industrial Corporation (MMIC).
Due to the dullness of MMIC, the ownership of ICC was transferred from MMIC to DBP and PNB.

At present the plant has two wet process kilns with annual clinker production capacity of 780,000 ton.

(Refer to IV-1)

(ii) Environment of Antipolo

ICC's cement plant is situated in Tagbac Barrio in the vicinity of Antipolo.
This place is located about 40km to the east of Metro Manila and easy of access.
There occur main cement raw materials in surrounding hills and so the place is favorably located.
The weather is almost the same as Metro Manila.

(Refer to IV-2)

I-2-4 Diagnosis of Management of ICC

(1) Operation of the cement plant and associated facilities

Due to the quiet market, the plant is operating on low rate and so generally they are conducting easy operation.

(i) Raw materials

The plant has much stocks of raw materials and so the control is quite easy.

(ii) Burning

Heat consumption is as high as 1,450 kcal/kg-cl.
This is due to fluctuation of slurry moisture content, low scondary air temperature, and improper burning method. There are problems in the dust desposition and slurry control.

(iii) Cement grinding

Present production is lower than the rated capacity.
The process control method requires to be checked.

(iv) Packing

The maintenance of packing machines are not good.
The actual packing quantity is around a half of the rated capacity.

(v) Water supply

The industrial water is taken from River Tagbac.
No problem exists both in quantity and in quality but circulating use is necessary during dry season.

(vi) Electricity

The electrical unit consumption is high in the mill department. The frequency and period of interruption of power supply are great.

(Refer to V-1)

(2) Maintenance of the cement plant and associated facilities

The number of employees of Maintenance division is 110 and they think much of maintenance works.
The maintenance of equipment is carried out by the Maintenance division jointly with the Production division.
One of two production lines is almost always suspended and so the maintenance works is conducted easily and the soundness of equipment is good.

Insufficient repair works are found in raw material receiving department, raw material grinding department, and packhouse.
The maintenance of electrical equipment is good but that of local control panels are not good.

(3) Various controls

(i) Process control

Each process is controlled with the control standard value. In order to promote the process control favourably, it is necessary to conduct efficient and steady operation of each equipment with sufficient performance.

(ii) Quality control

The quality control of raw materials, materials in process, and final products are conducted by controlling the process concerned comparing the test results of sample obtained through standard sampling and testing method with the standard figures.

The cement quality produced in this plant is good and acceptable.

(iii) Environmental control

The rules and regulations of National Pollution Control Commission was established in 1978.
No specific control has been done in this plant. The environmental control especially that for dust is necessary from now on.

(iv) Safety control

The person in charge of safety control is appointed in this plant. However safety rules are not established and require to be established.

(v) Cost control

Routine cost control except control of unit consumption is not conducted.
As big items electricity and fuel cost are mentioned, but their remarkable reduction can not be expected through routine control.
For this the renovation is required.

(Refer to V-3)

(4) Training and research activity

(i) Training

Various kinds of training were conducted both in- and out-plant.

At present, ICC is not conducting any specific training probably due to the reason that there was not sufficient time after the resumption of operation by new company.

(ii) Research activity

The Quality and process control department is in charge of the research activity.

The research on new raw materials and new kind of cement are being carried out.

(Refer to V-4)

(5) Purchasing practice and inventory control of spare parts

Proper stocks of spare parts is determined considering their consumption, frequency and delivery period.

At present, the stocks are controlled in accordance with "standard amount of use" but this method is not always to be satisfied.

Further improvement is required.

(Refer to V-5)

(6) Financial condition of the cement plant

(i) Establishment

ICC was just established on October 8, 1984 separately from MMIC.

(ii) Condition of profit and loss

According to monthly profit and loss condition by November 1985, in spite of monthly sales revenue is Pesos 23,000,000 the monthly ordinary loss reaches as much as Pesos 6,300,000.

It is because the proportion of electrical cost and fuel cost in the production cost are quite high and together with depreciation deteriorate the profit and loss.

(iii) Current cement production cost

The production cost which is 46.19 Pesos per bag is exceeding by 3.7 Pesos per bag over the ex-factory ceiling price of 42.5 Pesos per bag.

In the production cost the sum of fuel cost and electricity cost occupies about 52% and depreciation about 20%.

(iv) Assets of ICC

Beside its capital of Pesos 15,000,000, ICC owes DBP and PNB about Pesos 1,209 million with no interest in compensation for the transfer of plant.

(v) Financial control of ICC

The financial control is conducted both by the plant and head office systematically and effectively.

(Refer to V-6)

(7) Marketing capacity

ICC consigns cement for sales to AICDC.
AICDC is presently planning the establishment of bulk cement centers and the company is dealing with various kinds of building materials.
So AICDC has sufficient marketing capacity.

(Refer to V-7)

(8) Administration of the plant (Manning plan)

Antipolo plant of ICC is organized of three divisions such as Maintenance, Production, Administration and staff groups such as AVP group office, Engineering/Mining, and Quality and process control. Number of employee is 348 at present.

(Refer to V-8)

I-2-5 Technical Diagnosis of the Existing Facilities of ICC

(1) Conditions of raw material quarries

(i) Raw material quarries

ICC owns the raw material quarries of limestone, high silica clay, and low silica clay in the surrounding area of the plant.

(a) The limestone is quarried by bench cut system
The reserves reach 56,000,000 ton.

(b) The high silica clay is quarried by ripping or blasting. The reserves reach 7,600,000 ton.

(c) The low silica clay is quarried by ripping or blasting. The reserves reach 1,100,000 ton and some amount not yet determined.

Other raw materials such as pyrite cinder, pozzolana, gypsum are procured from suppliers.

(ii) Quality of raw materials

(a) Characteristics of raw material being used

- Limestone, high silica clay, low silica clay, and pyrite cinder are suitable as the raw materials for cement manufacturing and gypsum and pozzolana as the additives.

- Industrial water:
  It is suitable as industrial water.

- Coal:
  Both imported coal and local coal are of suitable quality as fuel of burning process for clinker production.

Raw materials mentioned above are suitable for dry process with NSP kiln system.

(b) Test results of raw materials and products

The samples of limestone, high silica clay, low silica clay, pyrite cinder, pozzolana, gypsum, cement, and industrial water collected by the survey team were tested.

All the raw materials were of good quality and cement is of favourable quality too.

Further, burnability test and grindability test of raw mix were carried out. It is confirmed from the results of tests that ICC's raw mix has almost the same burnability and grindability as that of raw mix used in cement plants in Japan.

(Refer to VI-1)

(2) Conditions of the processing, offsite and auxiliary facilities

(i) Raw materials receiving

This section covers all the equipment from raw material receiving hopper to raw material storage through crushers.

These equipment seems to operate with the rated capacity.

(ii) Storage

This is the storage for limestone, clays, gypsum, pozzolana, clinker. The building is a common storage in one house.

(iii) Raw material grinding

This section covers all the equipment from raw material storage to slurry basin.

Among the equipment, those for raw mix preparation and water addition are not satisfactorily operated.

(iv) Clinker burning

This section covers all the equipment from slurry feeder to clinker storage.

Among the equipment that for desposition of kiln dust and No.1 cooler (with regards to its cooling capacity) come into question.

(v) Cement grinding

This section covers all the equipment from receiving hoppers of clinker, gypsum and pozzolana to Kinyon pump.

Although actual operation results of grinding mill is somewhat low, it has a capacity of 70 t/h if maintained well.

(Refer to VI-2)

(3) Conditions of the facilities for storage and shipping of cement

This section covers all the equipment from cement silo to packing machine.

As the supply of cement to packing machine is carried out by manual control, the supply is apt to be unsteady and seems to reduce the capacity of packing machine.

(Refer to VI-3)

I-2-6 Study on the Process of ICC

(1) Present process scheme

(i) Supply of raw material

Main raw materials are exploited at ICC's own quarries and transported to the plant by contractors.

(ii) Raw material grinding

Raw material is ground by wet grinding process.
Problems exist at raw mix preparation and moisture control.

(iii) Burning

The process is wet process long kiln but its heat consumption is higher than normal figures and dust treatment is being problem.

(iv) Cement grinding

Pozzolan cement is produced in addition to ordinary portland cement.
No exclusive hopper for pozzolana is available and it is under construction.

(v) Packing and shipping

The actual capacity of packing machine is only a half of specification.

The examination of the equipment is required.
(Refer to VII-1)

(2) Possibility of conversion of the present process scheme into dry process utilizing the new suspension preheater system

No technical problem is foreseen in conversing the plant from a wet process to a dry process.

(i) Burning

No.1 kiln is converted to dry process with NSP system with a capacity of 2,600 t-cl/day.

(ii) Raw material grinding

A shaft type raw mill is newly installed.

(iii) Cement grinding

All the equipment are left as they are but the maintenance is to be thoroughly conducted.

(iv) Packing and shipping

The capacity of discharging cement from cement silo is increased and automatic control system is adopted for the extraction of cement.

(Refer to VII-2)

I-2-7 Study on Electric Power Source to the Antipolo Plant of ICC

(1) Electric power supply system in the Philippines

Electric power resources is developed by NPC, but the power supply to the consumers is conducted by MERALCO in the neighbourhood of Metro Manila and by NPC and Electric Cooperative in rural areas.

(Refer to VIII-1)

(2) Electrical installation in the Philippines

(i) Power generating plant

The total power generating capacity reaches as much as 5,196MW in 1984.

(ii) Transmission lines

The total length of transmission lines and the installation capacity of substations reaches 10,979 circuit km and 11,418MVA respectively.

(Refer to VIII-2)

(3) Power demand and supply in the Philippines

(i) Energy generation

The energy generation set a new record of $18,666 \times 10^6$kWh in 1984.

(ii) Conditions of energy consumption

The energy consumption by region, by consumer, and by month are described in the main report.

(Refer to VIII-3)

(4) Development of power resources in the Philippines

The energy generation capacity in 1984 reached about 2.4 times of that in 1977.

(Refer to VIII-4)

(5) Forecast of power demand in the Philippines

According to NPC the growth rate of demand during the period from 1985 to 1990 and from 1990 to 1995 are estimated to be 6.0%/year and 6.2%/year respectively.

(Refer to VIII-5)

(6) Electricity charges in the Philippines

(i) Electricity charge of NPC

The electricity charge of NPC is determined so that the cost of energy generation will directly reflect on the charge which is composed of basic unit price, fuel cost adjustment, steam cost adjustment, and foreign currency exchange rate adjustment.

(ii) Price system of MERALCO

The price system of MERALCO is basically the same as NPC. The sales charge for industrial users are remarkably higher than that of NPC due to the subsidizing policy for general consumers.

	NPC	MERALCO	
Electricity unit price	1.2496	2.5817	Peso/kWh

(Refer to VIII-6)

(7) Power conditions surrounding the plant

Number of consumers in Antipolo area was 9,634 as of 1985 and among them the industrial consumers were 31 and in Teresa area the number was 1,908 and 9 respectively.
In these area power interruption is quite frequent.
The frequency of power interruption in 1985 were 30 to 50 which is very large.

(Refer to VIII-7)

(8) Present condition of power consumption in Antipolo plant

The power demand of Antipolo plant averages 13,000~ 15,000kW monthly which decreases to 9,000kW when cement demand decreases. Electric unit consumption is 140kWh per ton cement which is rather high.

(Refer to VIII-8)

(9) Study on conversion of electricity source to Antipolo plant

The plan to directly supply electrical power in 230kV from Dolores substation of NPC was studied.

As construction cost the amount of Pesos 87,600 x 10^3 is required. Since the sales price of power decreases less than half, cost reduction is quite high.

Before implementation, the consent of authorities/parties concerned is necessary.

(Refer to VIII-9)

I-2-8 Study on the Improvement and Recommendation for Management after Rehabilitation and Modernization of ICC

(1) Improvement of process operation control

As control system, manual control system was adopted instead of sophisticated computer control system.
For effective control, the control of raw material and burning department are to be made from central control system.

(Refer to IX-1)

(2) Improvement of quality control

As the process is converted from wet to dry, special care is necessary for maintaining the homogeneity of raw meal.
Mixing proportion is changed somewhat due to lower fuel consumption.

(Refer to IX-2)

(3) Improvement of environmental protection

Regardless whether existing or new, all equipment should be controlled in accordance with the rules and regulations of NPCC (National Polution Control Commission)

Especially the care must be taken in preventing dust generation.

(Refer to IX-3)

(4) Improvement of energy efficiency and plant running efficiency

NSP system is adopted through the renovation, which will reduce the heat consumption of kiln to below 800 kcal/kg-cl.

Long consecutive operation must be executed by strengthening the control organization.

(Refer to IX-4)

(5) Improvement of maintenance practice

The maintenance is to be conducted so that the operation ratio is raised with even low maintenance cost.
For new equipment, it is necessary to train workers, prepare maintenance manuals, and organize a suitable maintenance program).

(Refer to IX-5)

(6) Improvement of education and training

After the renovation, the most modern operation technology is required for raw mill and NSP system.

For this purpose preparation of operation manuals and technical training of operating staff are necessary.

(Refer to IX-6)

(7) Improvement of safety control

The following measures are to be promoted.

- To organize a safety and health committee
- To establish regulations for safety and health
- To establish standards for safety works
- To examine and improve all the plant facilities
- To hold safety conference periodically

(Refer to IX-7)

(8) Improvement of organization and manning plan

After renovation, the equipment connecting raw mill, raw meal silos, kiln, and coal mill are operated together, and so a total systematic control is necessary.

Based on this point, the organization is changed to a certain extent. Number of employee will increase from current 348 to 360 due to the increase of the Production division (12 employees) mainly caused by increase of packhouse workers.

(Refer to IX-8)

I-2-9 Formulation of Rehabilitation and Modernization Program of ICC

(1) Rehabilitation and modernization (renovation) plan

The contents of the renovation are at first to convert existing wet process to the most advanced dry process NSP system, thereby reducing heat consumption, reducing running cost, and increasing the efficiency of employee and then to convert the electric power source for reducing the electrical cost.

The basis of renovation plan in the cement plant is:

(i) to adopt a raw material grinding equipment with manpower saving system,

(ii) to convert to the most advanced NSP system, and

(iii) to adopt a central control system by integrating raw material grinding, burning and coal supplying department.

(Refer to X-1)

(2) Capital requirement

(i) Total capital requirement

The total capital requirement for the renovation is shown in Table 1-2-1.

Table 1-2-1 Total Capital Requirement

(1,000 Pesos)

	Foreign portion	Local portion	Total
Fixed capital	415,818	304,210	720,028
Working capital	0	5,154	5,154
Total	415,818	309,364	725,182

(ii) Financing plan

(a) Long term loan : 100% of the total capital requirement

(b) Short term loan :

(Refer to X-2)

(3) Implementation schedule

Before concluding the contract on the renovation works, a preparation period of 10 months, i.e. 2 months for selection of consultant and 8 months for selection of contractor, is necessary.

The renovation works is divided into works in the Philippines and works outside the Philippines.

Work schedule requires 24 months for execution.
Therefore total period for works is 34 months including preparation period.

(Refer to X-3)

I-2-10 Evaluation

(1) Financial analysis

(i) Basic concept

The profitability of capital requirement is judged by comparing financial situation after implementing the renovation with that before implementing the renovation.

(ii) Basic premises

Refer to I-1 and XI-1-2.

(iii) Disbursement schedule of total capital requirement

Table 1-2-2 Disbursement Schedule

(1,000 Pesos)

Year	-2	-1	Total
Amount	157,583	567,599	725,182

(iv) Sales plan

Sales volume at full operation

Case I	939,760 ton/year
Case II	861,880 ton/year

(v) Production cost

Table 1-2-3 Production Cost

1,000 Pesos/year

Item \ Case	Case I		Case II	
	before renovation	after renovation	before renovation	after renovation
Direct cost	636,134	395,263	660,573	405,039
Fixed cost	86,679	156,806	92,009	156,761
Total	722,813	552,069	752,582	561,800
Unit cost	1,026	783	1,078	805

Note: 1. The above figures are that of the fifth year after starting operation.

2. Unit cost is expressed by Pesos/ton cement.

(vi) Evaluation

(a) Profitability

The following method was applied for profitability analysis.

FIRROI was calculated based on the difference of cash flow between the case when renovation is implemented and the case when not implemented.

Table 1-2-4 FIRROI of Base Case

(%)

	Case I	Case II
FIRROI (before tax)	33.3%	35.5%
FIRROI (after tax)	28.8%	31.6%

Judging from the above table, the profitability of the renovation is high.

(b) Break-even point

The break-even point in case the renovation is implemented is shown in Table 1-2-5.

Table 1-2-5 Break-even Point

Item \ Case	Case I		Case II	
	Year*	%	Year*	%
Break-even point	19	36.0	19	40.5

* This means the year after completion of the renovation.

Judging from the above table, the break-even point drops and this shows that the renovation is quite effective.

(c) Pay out year

Pay out of Case I and Case II are 3 year 3 months and 3 year 0 month respectively which shows that the recovery of capital can be made in early time.

(vii) Sensitivity analysis

Sensitivity analysis was conducted on the base case on the following factors by varying the figures.

Sales price, Cost for renovation works, Direct cost, Operation rate, Interest, Equity.

(viii) Case study

Case study was conducted on the following two cases.

Case A : Case in which only the conversion of electrical power source is implemented.

Case B : Case in which only the conversion to dry process is implemented.

Table 1-2-6 Results of Financial Analysis
(Case study)

(%)

	Base Case (I)	Case A	Case B
FIRROI (before tax)	33.3	>100.0	17.5
FIRROI (after tax)	28.8	92.5	16.9

(ix) Others

FIRROI was calculated on cash flow in case the renovation is implemented.

Table 1-2-7 Financial Internal Rate of Return

(%)

	Case I	Case II
FIRROI (before tax)	35.6	34.5
FIRROI (after tax)	31.3	30.6

In this case the profitability is calculated to be quite high too.

(Refer to XI-1)

(2) Economic evaluation

The economic evaluation of the renovation is described below.

(i) Improvement of international payments

By implementing the renovation, the cement manufacturing process is converted from wet to dry thus reducing fuel consumption as well as foreign currency payments, even though foreign loan for the renovation and its interest must be paid in foreign currency.
By deducting the latter from the former the total foreign currency savings for 20 years is calculated as follows.

Pesos $658 \sim 747 \times 10^6$

(ii) Ensurance of local employment

Though implementing the renovation, the employment of Antipolo area in regards to the personnel related to ICC is assured for a long period.

(iii) Economic internal rate of return (EIRR)

EIRR of the renovation in Case I and Case II are calculated to be 28.9% and 31.8% respectively and show high economic profitability.

(Refer to IX-2)

I-2-11 Conclusion and Recommendation

(1) Conclusion

Since Antipolo plant of ICC consume much fuel due to its wet process and paying higher unit electricity cost because the electricity is supplied by MERALCO.

As these two items are greatly suppressing its financial situation the renovation plan mainly consisting of the conversion from wet process kiln to dry process NSP kiln is considered as a countermeasure.

After examining thoroughly based on the premise stated in I-1, this renovation project is judged to be feasible both in technically and economically.

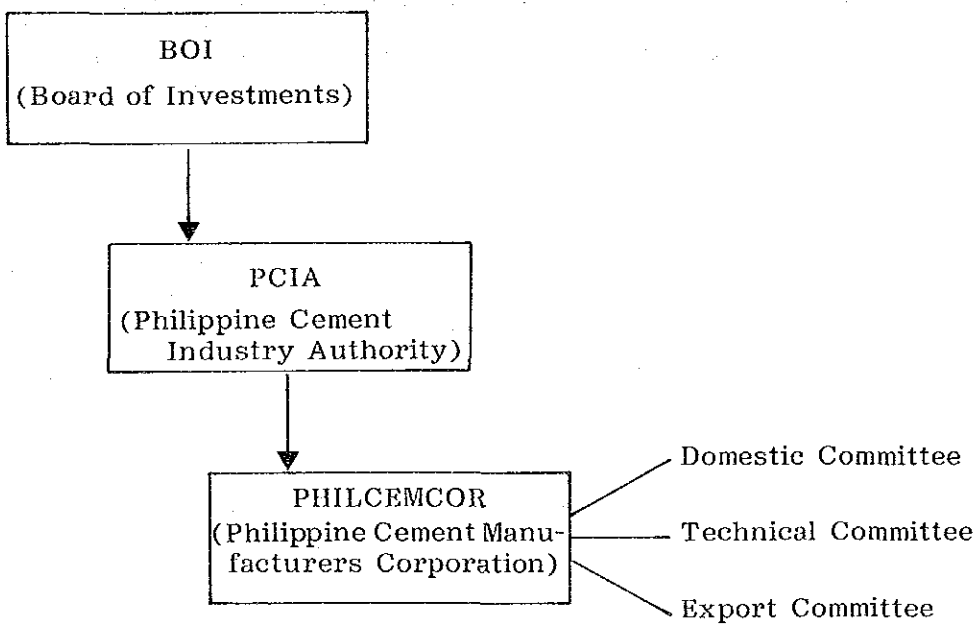
(2) Recommendation

The recommendation is made on the following items.

Capital requirement, Construction cost of the renovation, Conversion of electric power source, Appointment of technical consultant, Training of operation staff.

SECTION II POLICY OF THE GOVERNMENT OF THE PHILIPPINES WITH RESPECT TO THE PHILIPPINE CEMENT INDUSTRY AS WELL AS THE REHABILITATION AND MODERNIZATION OF ISLAND CEMENT CORPORATION

The Government body in charge of implementing the Government policies on industries in the Philippines is the Board of Investments (BOI) and, as to the cement industry, the Philippine Cement Industry Authority (PCIA), as one of BOI's departments, is directly controlling the industry.
PCIA is regulating the cement industry through price control, market rationalization, stable supply, improvement of production technology and of cement quality, plant rehabilitation and expansion, etc.
The Philippine cement industry has its own industry organization, namely, the Philippine Cement Manufacturers Corporation (PHILCEMCOR), through which PCIA is implementing the Government policies to all the cement manufacturers in the Philippines. PHILCEMCOR is functioning with three committees, viz. Domestic, Technical and Export Committees.



II-1 Price Policy

The Government is now regulating the cement price by means of setting up a ceiling price on ex plant price and retail price.

According to the ceiling prices which became effective on June 15, 1984 with Directive No.25 which amended Directive No.22 issued on December 27, 1983, the ex plant price is set up as ₱42.5/bag (40kg) including sales tax of 10%.

Based on the ex plant price, the regional retail ceiling prices are established by adding distributors' margins and handling charges. For instance, ₱48.5/bag (40kg), the retail price for National Capital region consists of the above ex plant price ₱42.5, wholesaler's margin ₱1.2, retailer's margin ₱1.5 and handling cost ₱3.3.

Moreover, such sales tax included in the ex plant price was raised at the end of 1985 from 5% to 20%. However, the rate was soon reduced to 10% in January 1986, because it was likely that such high sales tax rate of 20% would very much affect the cement manufacturers' profitability as far as the retail ceiling prices were set up.

The said regional retail ceiling prices were established in 45 regions of the country ranging from Region I to Region XII.

According to Directive No.25, these retail ceiling prices are as enumerated in Table 2-1-1.

Table 2-1-1 Regional Retail Ceiling Price Per Bag (40kg)

NATIONAL CAPITAL REGION	48.50 (Peso)
REGION I	
La Union/Pangasinan	48.40
Ilocos Sur	49.40
Abra	49.80
Benguet	50.80
Mountain Province	50.80
Ilocos Norte	50.80
REGION II	
Ifugao	55.20
Nueva Vizcaya	50.80
Isabela	52.50
Kalinga/Apayao	55.20
Cagayan	55.20
Batanes	64.80
REGION III	
Bulacan	48.40
Nueva Ecija/Pampanga/Tariac	49.10
Bataan	50.50
Zambales	50.80
REGION IV	
Laguna/Batangas/Rizal	48.40
Cavite	49.55
Aurora/Quezon	50.80
Palawan	55.00
Marinduque/Mindoro	55.70
Rombion	55.70
REGION V	
Albay/Camarines Norte/Sur/Catanduanes/Masbate/ Sorsogon	53.60
REGION VI	
Negros Occidental/Capiz/Iloilo	52.60
Aklan	53.60
Antique	53.60

REGION VII	
Cebu	48.40
Bohol	52.35
Negros Oriental	52.35
REGION IX	
Basilan	52.90
Zamboanga del Norte	52.90
Zamboanga del Sur	52.90
REGION X	
Surigao del Norte	48.40
Misamis Oriental	49.40
Agusan del Norte	50.10
Agusan del Sur	50.10
Bukidnon	50.10
Misamis Occidental	50.10
REGION XI	
Davao	48.40
South Cotabato	50.70
Surigao del Sur	49.10
REGION XII	
Lanao del Norte/Iligan City	48.40
Lanao del Sur/Marawi City	50.10
North Cotabato	50.70
Sultan Kudarat	50.10

II-2 Market Policy

At present, the Philippine cement industry has an agreement stipulating that cement produced by Luzon-based plants should be sold only in Luzon area and cement produced by Visayas and Mindanao-based plants be sold only in Visayas and Mindanao areas (Refer to Fig.3-1-1). This agreement seems to have been made to avoid uneconomical transportation considering the geographical distribution of cement plants in the Philippines.

This agreement will be necessary for the Philippine cement industry which must rationalize transportation together with cement distributors both placed under circumstances as described in II-1, namely under price control.

In order to keep the stable supply of cement, the Government, however, issued a circular in October, 1983, informing that cement sales outside the agreed area may be exceptionally admitted for the region where supply may become short owing to some reasons.

In addition, the Government has been always paying attention to the cement supply and demand situation so as not to run short of cement supply all over the country. For example, the Government is estimating domestic consumption in 1986 as 3,700 thousand tons by positively assuming an increase of 1,000 thousand tons compared with last year's domestic consumption of 2,700 thousand tons.

II-3 Export Policy

The Government has been controlling the cement industry to promote the exportation of the surplus cement.

However, since export has been fairly low in price, a subsidizing system has been set up to compensate the exporters by subsidizing US$20.25 per ton of cement to be exported utilizing the accumulated funds of ₱0.5 per bag to be imposed on the domestic sales. This system has been adopted since 1972.

Accordingly, the Government is consolidating cement export through PCIA and PHILCEMCOR in line with its export guidelines. According to the guidelines, it was stipulated that all enquiries to cement export should be referred to the Export Committee for consolidation, acknowledgement and reply, and that prior approval of the Export Committee should be obtained before negotiation of price and other conditions, and also that final export contracts should be made in the name of PHILCEMCOR. In cases of tenders, the exporting company should obtain a written authority from PHILCEMCOR, duly approved by PCIA, to participate in the tender. Where the contract is concerned, the exporting company should have PHILCEMCOR prepare the contract between PHILCEMCOR and the buyer for submission to PCIA for approval.
The Philippine cement industry is thus conducting such consolidated export in accordance with the above export guidelines.

II-4 Improvement of Cement Production Technology and Quality

In the organization of PHILCEMCOR, there is a Technical Committee through which the member companies are endeavouring to mutually improve their technology and to exchange the information on the latest technology at the technical conferences such as the Cement Symposium and the like, which are to be presided in turn by one of Asian countries. In addition, PCIA is endeavouring to improve and equalize the cement quality of each member companies by means of making periodical tests at the Philippine Cement Central Laboratory, which is directly controlled by PCIA.
Table 2-4-1 shows an example of the above test reports on cement collected from PHILCEMCOR member companies.

Table 2-4-1 Cement Central Laboratory

Summary of CCLAB Results

Period Covered: May '84 - Apr. 85

Plant	No. of Samples		Blaine		Compressive Strength (kg/cm^2)						Chemical Analysis					
			(m^2/kg)		3 Days		7 Days		28 Days		C_3S(%)		SM		LSF	
	Phy	Che	Av	Sd	Av	Sd	Av	Sd	Av	Sd	Av	Sd	Av	Sd	Av	Sd
A	5	4	353	40.3	196	27.0	295	40.4	386	42.1	62	6.7	2.2	0.17	0.88	0.026
B	8	6	383	41.2	225	23.8	292	27.3	377	24.0	60	2.8	2.1	0.10	0.98	0.017
C	11	11	320	23.7	206	23.9	278	32.2	364	28.3	56	6.3	2.0	0.08	0.97	0.030
D	9	5	363	29.9	139	39.5	207	48.0	350	49.2	44	12.7	2.4	0.15	0.89	0.061
E	7	7	332	11.9	161	27.3	242	31.2	347	32.4	51	7.1	2.1	0.12	0.93	0.027
F	12	12	351	18.9	191	24.1	248	30.0	330	33.4	50	5.1	2.2	0.15	0.93	0.024
G	12	11	370	20.0	171	32.8	238	42.9	328	45.3	50	7.7	2.1	0.11	0.93	0.032
H	12	9	300	15.6	166	21.7	236	25.3	324	48.2	52	13.7	2.3	0.14	0.94	0.040
I	8	7	328	13.6	135	27.3	200	41.2	324	40.6	43	13.8	2.3	0.20	0.89	0.044
J	12	12	323	18.5	147	28.7	220	39.7	320	36.9	51	8.9	2.2	0.11	0.93	0.040
K	9	6	362	21.7	172	27.0	230	36.0	305	43.2	48	18.5	1.9	0.08	0.94	0.048
L	8	3	360	37.6	146	31.1	206	34.0	298	21.6	37	17.1	2.1	0.17	0.88	0.051
M	7	5	340	20.0	154	36.7	216	46.6	297	61.0	58	5.9	2.2	0.13	0.96	0.024
N	6	3	347	17.4	122	21.5	186	40.4	285	48.7	54	27.1	1.9	0.15	0.96	0.121
O	12	0	363	32.8	119	35.4	159	50.2	253	62.0	-	-	-	-	-	-
Average					163	28.5	230	37.7	326	39.8						

II-5 Policy for the Rehabilitation and Modernization of Island Cement Corporation

It was expected by the Government that annual production of the whole cement industry would reach 6,300 thousand tons by the year 1990 after economic recovery.

Based upon the above expectation, there was a possibility that demand will excess the production capacity of the existing plants which equipment are becoming obsolute.

Accordingly, BOI was planning to establish new cement plants with annual capacity of 1,000 thousand tons.

However, since the recent cement market has been dull mainly owing to the recent economic decline in the Philippines, the above plan has been modified to a rationalization program with which larger wet process kilns are to be converted into the dry process, semi-dry process kilns or SP kilns.

According to what was found by visits to Government bodies and agencies, it was found that the Government will support the rehabilitation and modernization plan of Island Cement Corporation since the plan will be in line with the above program, providing that recovery of cement demand will be as expected and that ICC's shareholders, namely, Development Bank of the Philippines and Philippine National Bank will deem it economically viable to proceed with the said rehabilitation and modernization (hereinafter referred to as "renovation").

The present production is in excess of annual consumption. So, PCIA is administrating the cement industry to direct the surplus cement to export, which, however, does not go well due to low export price.

Moreover, the industry is now under a dull market where it is rather difficult for the industry to estimate even the coming year's cement demand, while PCIA is worrying about the adjustment of such situation.

However, PCIA has no objection to proceed with such renovation for a certain increase of production, if the recovery of cement

demand will be expected and the economic situation will be recovered to the extent that increased production by the renovation will be absorbed.

SECTION III PRESENT SITUATION AND FUTURE PROSPECTS OF SUPPLY AND DEMAND OF CEMENT IN THE PHILIPPINES

III-1 Outline of Present Situation of the Philippine Cement Industry

In the Philippines, at present, there are 18 cement plants, out of which 11 plants are located in Luzon area and 7 plants in Visayas and Mindanao areas.

The present total annual capacity of these 18 plants is estimated as on the scale of 6,000 thousand tons.

Since the production of 3,662 thousand tons was recorded in 1984, it can be said that the total operation rate was at the level of 60% as a whole.

The machinery and equipment of these plants are generally outdated, having 6 kilns of 1950's, 20 kilns of 1960's, 5 kilns of 1970's and 1 kiln of 1980's.

There are 5 plants with inefficient wet process in Luzon area, and 2 plants with such process in Visayas and Mindanao areas.

The average annual production during the past 11 years (1974∿1984) is calculated as 4,133 thousand tons, and the production in 1984 turned out to be 3,662 thousand tons mainly owing to recent decline of cement demand in the Philippines. The production in 1985 (January to November) was only 2,817 thousand tons.

The Philippine cement industry has made efforts to export a certain extent of surplus cement coming from recent dull cement market. However, the export has been low in price, which led the industry to establish a subsidizing system for export promotion.

The cement demand in the Philippines has not increased for the last decade of years because of the recent decline in the Philippine economy.

Accordingly, the annual domestic sales was 3,505 thousand tons on the average during the said period (1974∿1984), and the total sales including the export was 4,079 thousand tons per year on the average during the same period.

As to the domestic sales during the above period, the annual domestic sales continued on a scale of 3,000∿3,500 thousand tons except the year 1983, when the domestic sales of 4,400 thousand tons was recorded as a peak of annual domestic sales, and also 73% of the domestic sales during the said period has been sold and consumed in Luzon area.

In addition to dullness of domestic cement market stemming from the recent decline in the Philippine economy, the problem of old plants and of energy as well as the ceiling price of cement set up by the Government are all affecting the cement plant operation in the Philippines. Therefore, unless the cement manufacturers improve their equipment and severely control their production cost and the like, they will be unable to run their plants profitably. Actually, 3 plants in Luzon area and 2 plants in Visayas and Mindanao areas are on intermittent operation or shut down.

Meanwhile, the cement export is being executed in line with the export guidelines, and the domestic sales is free in principle. However, according to the agreement made among the cement manufacturers, cement manufactured by Luzon-based plants is to be sold only in Luzon area and that of Visayas and Mindanao-based plants is to be sold only in Visayas and Mindanao areas. It is likely that this agreement is abided by the cement manufacturers so as to avert the uneconomical transportation owing to the location of their cement plants.

The transportation of cement in Luzon area is carried out by the trucks up to 90% and some plants in Northern Luzon are using railroads, too, while plants in Visayas and Mindanao are using barges as well as trucks. In the Philippines, two types of cement, ordinary cement (ASTM Type I) and pozzolan cement (PSA Type P) are being produced, and at present the latter is about 20% of the total cement production. APOCEM (Apo Cement Corporation) is the first manufacturer to start producing pozzolan cement, and now all the cement plants except FORTUNE (Fortune Cement Corporation) are producing this type of cement.

Accordingly, data of the Philippine cement industry referred to in this report represents data including such two types of cement.

Table 3-1-1 Cement Production, Domestic sales and Export

Year	Area	Production	Domestic Sales			Export	Total Sales
			Private	Government	Total		
1974	Luzon	2,515	1,926	177	2,103	438	2,541
	Vis/Min	970	568	44	612	326	938
	Total	3,485	2,494	221	2,715	764	3,479
1975	Luzon	3,157	2,523	206	2,729	420	3,149
	Vis/Min	1,193	712	84	796	382	1,178
	Total	4,350	3,235	290	3,525	802	4,327
1976	Luzon	2,955	2,212	290	2,502	348	2,850
	Vis/Min	1,274	765	112	877	359	1,236
	Total	4,229	2,977	402	3,379	707	4,086
1977	Luzon	2,753	2,234	205	2,439	328	2,767
	Vis/Min	1,359	701	136	837	494	1,331
	Total	4,112	2,935	341	3,276	822	4,098
1978	Luzon	2,857	2,299	151	2,450	420	2,870
	Vis/Min	1,344	791	150	941	403	1,344
	Total	4,201	3,090	301	3,391	823	4,214
1979	Luzon	2,753	2,476	90	2,566	108	2,674
	Vis/Min	1,187	904	65	969	170	1,139
	Total	3,940	3,380	155	3,535	278	3,813
1980	Luzon	3,194	2,526	233	2,759	385	3,144
	Vis/Min	1,322	837	51	888	409	1,297
	Total	4,516	3,363	284	3,647	794	4,441
1981	Luzon	2,749	2,346	165	2,511	258	2,769
	Vis/Min	1,259	890	114	1,004	212	1,216
	Total	4,008	3,236	279	3,515	470	3,985
1982	Luzon	2,969	2,570	69	2,639	295	2,934
	Vis/Min	1,424	1,008	135	1,143	296	1,439
	Total	4,393	3,578	204	3,782	591	4,373
1983	Luzon	3,122	2,976	78	3,054	77	3,131
	Vis/Min	1,437	1,199	147	1,346	53	1,399
	Total	4,559	4,175	225	4,400	130	4,530
1984	Luzon	2,399	2,270	8	2,278	38	2,316
	Vis/Min	1,263	1,006	104	1,110	103	1,213
	Total	3,662	3,276	112	3,388	141	3,529

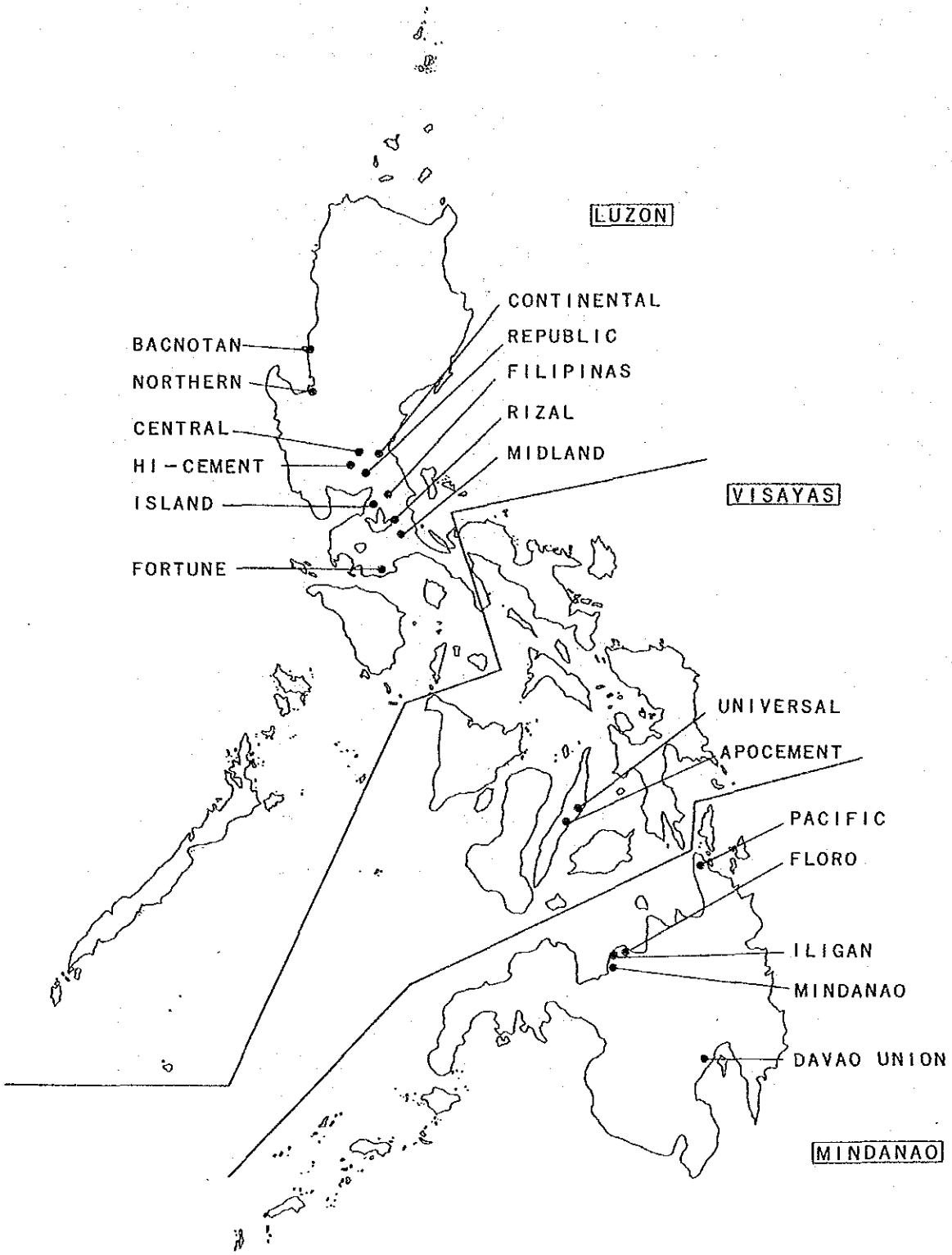
Source: PHILCEMCOR

Table 3-1-2 Production Capacity

Plants	Number of Kilns	Process	Kiln Year	Capacity (1,000 t-cl/y)	
				Original	Re-rated
Luzon Area					
Island	2	W	1966, 68	780	620
Northern	2	D	1969, 69	660	620
Filipinas	2	SD	1964,64,66	615	434
Republic	4	D	1956,58,63,68	579	433
Fortune	1	D	1970	330	377
Continental	1	D	1972	405	331
Hi-Cement	1	W	1967	302	310
Midland	1	W	1967	450	300
Rizal	3	W	1953,57,63	324	274
Bacnotan	3	W	1954,60,64	261	241
Central	1	SD	1968	150	139
				4,856	4,079
Vis/Min Area					
Davao, Union	2	W,D	1967, 83	504	375
Floro	1	D	1971	450	412
Iligan	1	D	1970	300	309
Pacific	1	W	1967	210	216
Universal	3	SD,SD W	1958,64,70	644	206
Mindanao	1	D	1960	150	165
Apocemco	1	W	1960	122	82
				2,380	1,765
				7,236	5,844

W = Wet, D = Dry, SD = Semi-dry Source: PHILCEMCOR

Fig3-1-1 DISTRIBUTION OF PHILIPPINE CEMENT PLANTS



III-2 Production, Domestic Sales and Export

III-2-1 Production

(1) Production of cement plants in the Philippines

The average annual cement production in the Philippines was 4,133 thousand tons during the period of the last 11 years (1974∿1984), 69% of which was produced by Luzon-based 11 plants.

During the above period, annual cement production has been keeping a level of 4,000∿4,500 thousand tons except those of the year 1974 and 1979.

The recent production was 3,662 thousand tons in 1984 and 2,817 thousand tons in 1985 (January to November).

Since the annual production capacity re-rated in 1984 was 5,844 thousand tons according to PHILCEMCOR, the operation rate in 1984 was 63% as a whole.

(2) Production of Island Cement Corporation (ICC)

During the period of the past 11 years (1974∿1984), ICC's average annual production has been on a scale of 400∿450 thousand tons except 380 thousand tons in 1978, and ICC's production toned down to 228 thousand tons in 1984 owing to the decrease in operation rate subsequent to the managerial separation from Marinduque Group in the said year.

However, ICC's production in 1985 (Jan.∿Nov.) increased by 15% compared with that in 1984 (Jan.∿Nov.), while the whole Philippine cement production decreased by 17% in the same period. ICC's average production during the above 11 years was 440 thousand tons, which corresponds to 10.6% of the whole Philippine production and to 15.4% of that of all the Luzon-based plants.

Table 3-2-1 Cement Production

(1,000 tons)

Year	Luzon-based Plants		Vis/Min-based Plants		Total	ICC's Production
	Production	%	Production	%		
1974	2,515	72	970	28	3,485	421
1975	3,157	73	1,193	27	4,350	549
1976	2,955	70	1,274	30	4,229	424
1977	2,753	67	1,359	33	4,112	419
1978	2,857	68	1,344	32	4,201	380
1979	2,753	70	1,187	30	3,940	442
1980	3,194	71	1,322	29	4,516	502
1981	2,749	69	1,259	31	4,008	442
1982	2,969	68	1,424	32	4,393	592
1983	3,122	68	1,437	32	4,559	436
1984	2,399	66	1,263	33	3,662	228
1974∿84 Average	2,857	69	1,276	31	4,133	440
1985 (Jan.∿Nov.)	1,648	59	1,169	41	2,817	262

Source: PHILCEMCOR

III-2-2 Domestic Sales

(1) Whole domestic sales in the Philippines

The average annual domestic sales during the period of the past 11 years (1974∿1984) was 3,505 thousand tons, and the scale of annual sales has been 3,000∿3,500 thousand tons since 1975. It can be said that during the above period there has been no prominent change in domestic sales except the year 1983 when a peak of 4,400 thousand tons was recorded.

According to the average figures during the said 11 years, 73% of the whole domestic sales was sold and consumed in Luzon area.

On the other hand, the sales to the government was only 7% on the average during the past 11 years according to the data of PHILCEMCOR, which percentage does not represent the actual sales volume for the government, because the above data include only such cement as purchased by the government direct from the cement manufacturers. Although such data do not cover all the government procured cement, we can see at least the tendency that the government demand has decreased year after year, namely, from 10% in 1976 to only 2% in 1985.

In the meantime, as described in III-1, there is an agreement as to the domestic sales that Luzon-based plants can sell their cement only within Luzon area and cement of Visayas and Mindanao-based plants only within Visayas and Mindanao areas, and this agreement seems to be abided by them so as to avert the uneconomical transportation of their cement. Incidentally, the present regional sales activities of each cement manufacturers are such as shown in Table 3-2-3.

The present regional distribution of the domestic sales in Luzon area is as follows:

Northern Luzon	12%
Central Luzon	17%
Metro Manila	55%
Southern Luzon	16%
	100%

As stated above, since 73% of the whole domestic sales is consumed in Luzon area, it follows that about 1,800 thousand tons out of the domestic sales in 1983, namely, 4,400 thousand tons, for instance, is consumed in Metro Manila.

Table 3-2-2 Domestic Sales by Sectors

(1,000 tons)

Year	A Total	B Private	C Government	C/A %
1974	2,715	2,494	221	8
1975	3,525	3,234	291	8
1976	3,379	2,977	402	12
1977	3,277	2,935	342	10
1978	3,391	3,090	301	9
1979	3,535	3,380	155	4
1980	3,646	3,363	283	8
1981	3,515	3,236	279	8
1982	3,782	3,578	204	5
1983	4,400	4,175	225	5
1984	3,388	3,277	111	3
1974 ∿ 84 Average	3,505	3,249	256	7
1985	2,678*	2,634	44	2

* Luzon 1,785
Vis/Min 893

Source: PHILCEMCOR

Table 3-2-3 Regional Sales Activities

Region	Cement Company	Sales Activity (%)
Northern Luzon	Bacnotan	80
	Northern	60
Central Luzon	Bacnotan	20
	Northern	40
	Republic	20
	Hi-Cement	20
	Continental	20
Metro-Manila	Republic	80
	Hi-Cement	80
	Continental	80
	Island	100
	Rizal	90
	Filipinas	90
	Midland	90
Southern Luzon	Fortune	100
	Rizal	10
	Filipinas	10
	Midland	10
Bicol	Pacific	20
	Universal	30
	Floro	10
	Iligan	5
	Davao Union	5
Visayas	Pacific	55
	Universal	70
	Apocemco	100
	Floro	50
	Iligan	40
	Davao Union	50
Mindanao	Pacific	25
	Floro	40
	Iligan	55
	Davao Union	45

(2) Domestic sales of ICC

During the period of the past 11 years (1974∿1984), the average annual domestic sales of ICC was 426 thousand tons, which occupied a sales share corresponding to 12% of the average domestic sales of all the cement manufacturers during the same period.

ICC's sales to the government was about 5% of ICC's total sales during the said 11 years, while the total sales to the government by all the cement manufacturers was about 8% during the same period. Since ICC's plant is favourably located less than 40km from the center of Manila City, ICC's cement sales market at present is mostly based on Metro Manila.

This favourable location of ICC's plant will contribute to keep such tendency to sell their cement mainly in Metro Manila, the largest cement market in the Philippines.

Meanwhile, the exclusive right to sell ICC's cement has been assigned to A.I. Construction and Development Corporation (AICDC) since ICC's managerial separation from Marinduque Group in 1984. Mainly owing to the said separation and subsequent decrease in plant operation rate, ICC's domestic sales in 1984 turned out to be down to an half (219 thousand tons) of ICC's average annual domestic sales during the said period of 11 years.

However, as seen in Figure 3-2-1, ICC's sales in 1985 increased by 30% compared with that in 1984, while the sales of all the cement manufacturers decreased for these two years, 1984 and 1985. If ICC's plan to establish bulk distribution centers as described in III-2-2(3) is taken into account, it will not be difficult to maintain ICC's traditional sales share of 12% as calculated above based on the historical data.

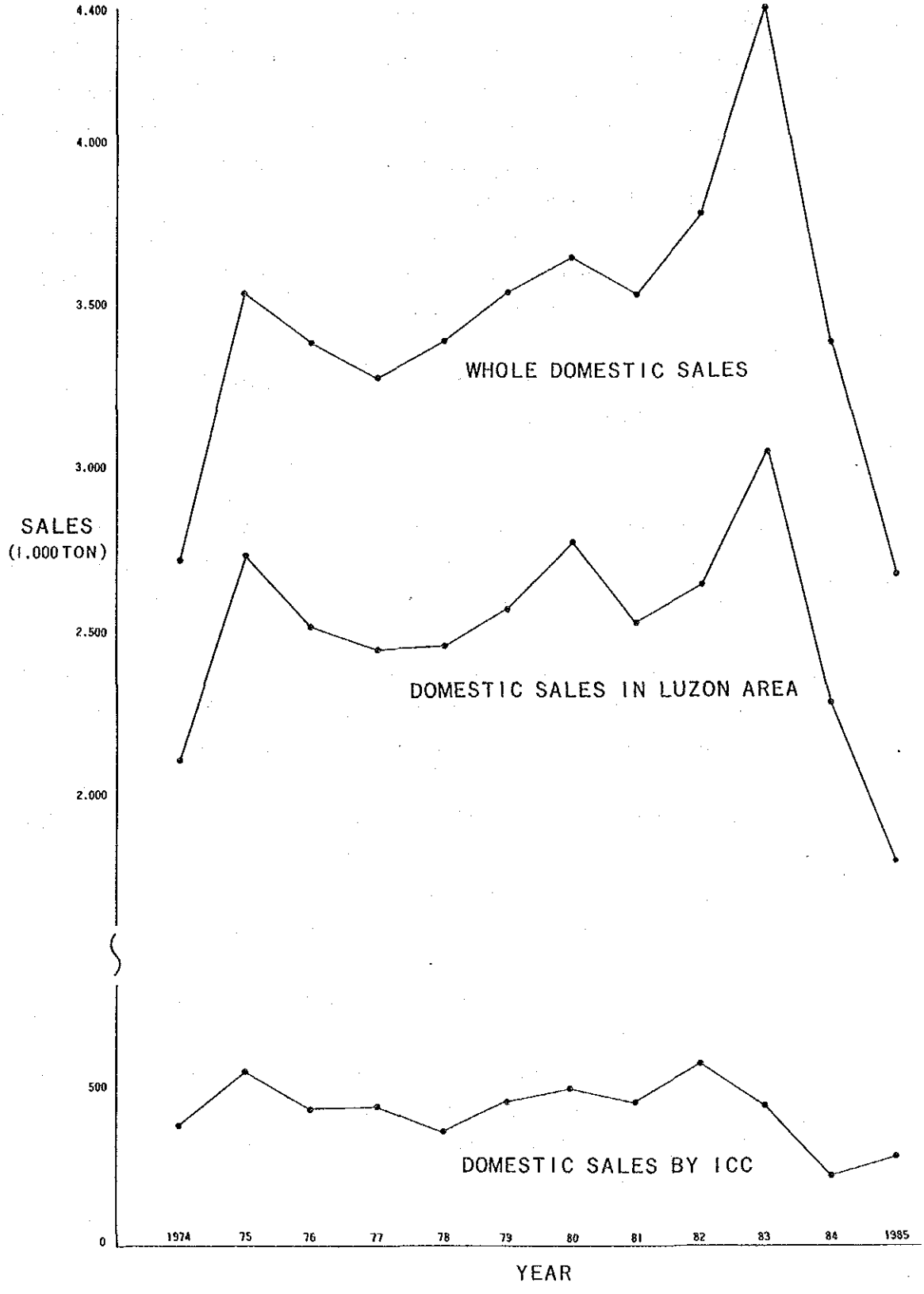
Table 3-2-4 ICC's Domestic Sales by Sectors

(1,000 tons)

Year	A Total	B Private	C Government	C/A %
1974	385	352	33	9
1975	538	516	22	4
1976	414	384	30	7
1977	418	408	10	2
1978	356	348	8	2
1979	431	423	8	2
1980	495	478	17	3
1981	444	420	24	5
1982	557	539	18	3
1983	428	373	55	13
1984	219	219	-	0
1974 ∿ 84 Average	426	405	20	5
1985	287	283	4	1

Source: PHILCEMCOR, AICDC

Fig3-2-1 VICISSITUDES OF DOMESTIC SALES



(3) Bulk distribution center

At present, AICDC has a warehouse (bodega) with storage capacity of about 200,000 bags of cement, which is ICC's property located at Pasig about 15km from ICC's plant taking more than 30 minutes by trucks even in nighttime. It can not be said that this warehouse is very effective as a tool for AICDC's sales promotion.

Delivery from the said plant is usually made by AICDC's own trucks or chartered trucks, but sometimes by large contractors and dealers themselves.

Plant → AICDC's warehouse → dealers, block makers etc.
Plant → Large contractors
Plant → Large dealers → dealers etc.

Bagged cement is mainly transported to the warehouse, and, according to AICDC, the cost of a paper bag will be ₱5, while the present transportation cost is ₱1.5~₱2.0 per bag (40kg).

If cement is supplied to comparatively large users in container bags, the cost of bags will be economised to a considerable extent. Accordingly, AICDC is planning to establish bulk distribution centers at Bulacan, Calamba and the seaside near the Manila Bay, so as to distribute the cement in container bags from such distribution centers.

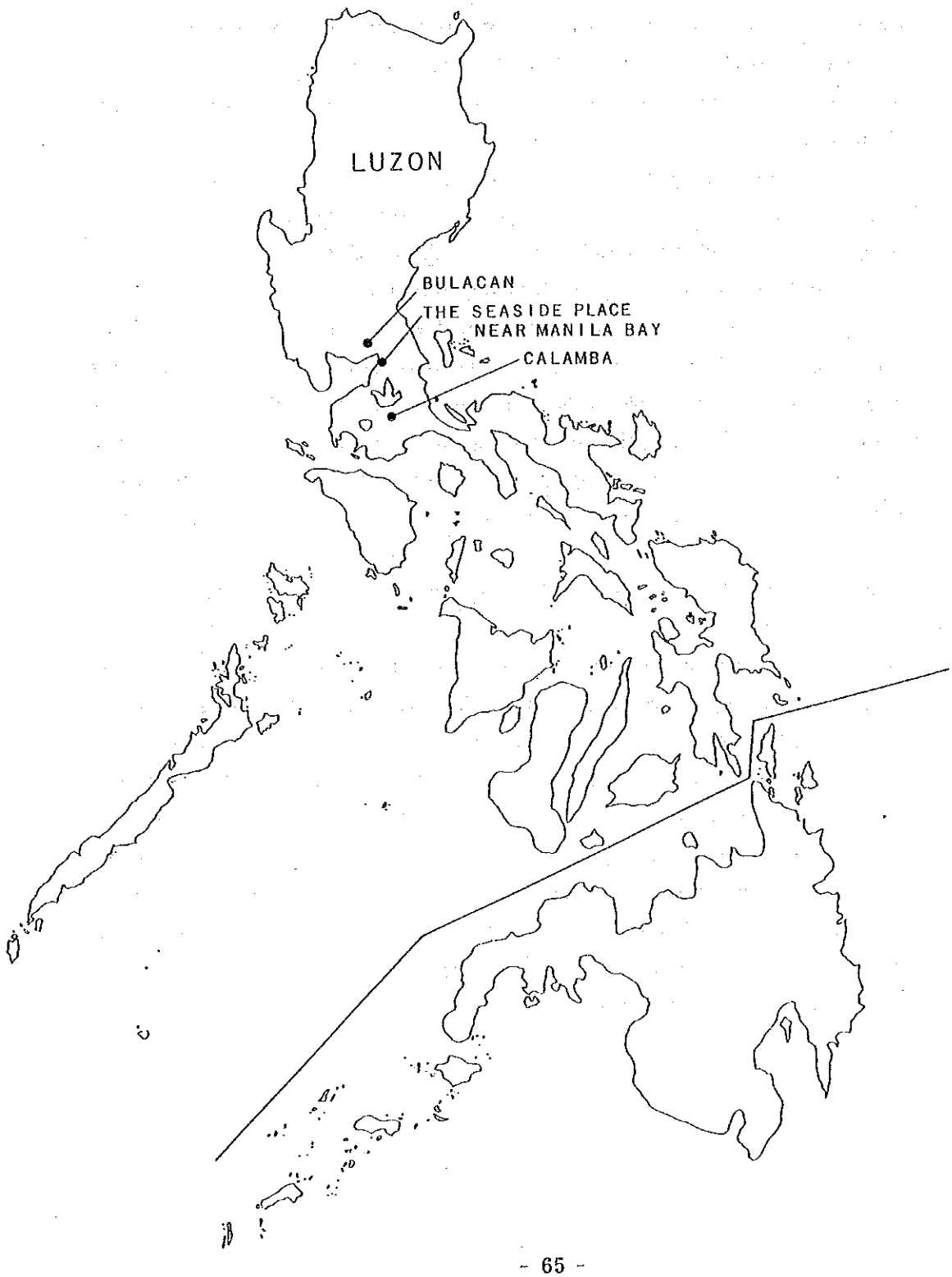
ICC's mode of cement shipment is 90% in bag and 10% in bulk. So, if the said distribution centers and cement supply in container bag from such distribution centers are realized, it will contribute to saving the cost of cement bags rather than the transportation cost.

It can be estimated that the relevant cost will be reduced from ₱5.0 to ₱0.3 per 40kg according to AICDC.

At present, AICDC's sales market is consisting mainly of Metro Manila, but these distribution centers, if materialized,

will enable them to extend their market even to the outlying islands within Luzon area.

Accordingly, it will not be difficult for them to maintain ICC's historical sales share of 12% from now on as mentioned above.



III-2-3 Export

The Philippines imported 9 thousand tons of cement in 1971, since that year there has not been any importation of cement up to now. Under such circumstances as described in III-1, the Philippine cement industry has been making efforts to export surplus cement, realizing the exportation of 700∿800 thousand tons in 1970's. However, the export has been low in price, the average FOB price in 1984 and in 1985 being US$27.64/ton and US$26.45/ton respectively.

As far as the Philippine cement industry is concerned, the export is being carried out in line with the government guidelines and under the name of PHILCEMCOR for consolidation.

For export promotion, the subsidize payment of US$20.25 per ton of export cement is now being applied so as to cover the low export price. Funds for these subsidize payments are raised by imposing ₱0.5/bag (40kg) on the domestic sales of each cement manufacturers. Philippine cement export during the period from 1974 to 1985 is as shown in Table 3-2-5, and the main destinations are Indonesia, Middle East, Bangladesh, and Hong Kong.

According to PHILCEMCOR, the export of 1986 is targeted as 600 thousand tons.

As to export conditions, it can be said that Visayas and Mindanao based-plants are located more favourable than Luzon-based plants, but actual export from Luzon-based plants is nearly equal in tonnage to that from Visayas and Mindanao-based plants during these 11 years (1974∿1984). ICC's export is very little, exporting only 32 thousand tons, 7 thousand tons and 0.6 thousand tons in 1974, 1975 and 1978 respectively.

When ICC's plant location and low export price are considered, it will not be likely that ICC and AICDC will have strong intention to rely on cement exportation.

Table 3-2-5 Export by Destination (1974 - 1985)

(1,000 tons)

Destination	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	Total
Middle East	242	324	182	268	227	11	12	11	-	-	-	-	1,277
Indonesia	111	182	294	152	225	-	57	128	205	72	19	-	1,445
Hong Kong	150	23	127	179	101	99	187	104	71	23	-	20	1,084
Bangladesh	98	125	12	66	113	24	249	13	112	12	108	235	1,167
Malaysia	41	59	63	42	17	21	18	7	-	-	-	-	268
Brunei	15	40	24	30	40	22	53	28	7	-	-	-	259
Central America	-	-	-	35	-	-	-	-	-	-	-	-	35
Vietnam	20	-	-	27	55	-	-	25	55	-	-	-	182
Singapore	68	33	-	2	-	-	-	-	5	-	-	-	108
Sri Lanka	-	-	-	20	-	-	62	-	-	-	-	-	82
Australia	1	-	-	-	-	9	1	-	-	-	-	-	11
US Trust Territories	17	15	3	-	1	1	3	-	-	-	-	-	40
New Caledonia	1	2	1	-	-	-	-	-	-	-	-	-	4
New Guinea	-	-	1	-	-	-	-	-	-	-	-	-	1
Pakistan	-	-	-	-	24	-	-	25	12	-	-	-	61
Thailand	-	-	-	-	9	84	61	-	-	-	-	-	154
South Pacific Island	-	-	-	-	8	-	-	-	-	-	-	-	8
India	-	-	-	-	4	7	76	110	110	15	-	-	322
Nepal	-	-	-	-	-	-	14	15	14	8	6	20	77
Laos	-	-	-	-	-	-	-	6	-	-	-	-	6
China	-	-	-	-	-	-	-	-	-	-	9	112	121
Cambodia	-	-	-	-	-	-	(0.05)	-	-	-	-	-	(0.05)
Total	764	803	707	821	824	278	793	472	591	130	142	387	6,713
Average FOB(US$/ton)	(35.27)	(34.41)	(27.73)	(27.49)	(34.53)	(42.11)	(43.23)	(43.98)	(60.36)	(42.73)	(27.64)	(26.45)	

Source: PHILCEMCOR

III-3 Demand Forecast

The transitions of cement production, domestic sales and export in the Philippines are such as described in III-2, but for the purpose of making a demand forecast in this report, Production + Import - Export will be taken as Domestic Consumption (Domestic Demand).

The domestic demand ascertained as above, from the data covering the past 16 years (1969∿1984), is as shown in Table 3-3-1, which is utilized as basic data of the demand forecast in this report.

III-3-1 Demand Forecast of Cement in the Philippines

Demand forecasts of cement in the Philippines were made by the trend analysis, correlation analysis, estimation based on similar cases and the forecast prepared in the Philippines.

On the other hand, a study was made on large public projects which will stimulate cement demand.

(1) Trend analysis

Trend analysis was made by using formula such as linear equation and linear exponential equation.

Respective equations and correlative coefficients are shown as below, and as to the fitness, the linear equation is better than the linear exponential equation.

Five-year moving average of the domestic consumption during the period from 1969 to 1984 was used as basic data for the trend analysis.

Table 3-3-1 Production, Import, Export and Domestic Sales in the Philippines

(1,000 tons)

	A Production	B Import	C Export	Domestic Consumption (Demand)		
				A+B-C	5-Year Moving Average	Consumption Per Capita (kg)
1969	2,649	249	-	2,898		70
1970	2,448	7	56	2,399		66
1971	2,808	9	288	2,529	2,701	67
1972	3,160	-	328	2,832	2,665	73
1973	4,059	-	1,213	2,846	2,895	71
1974	3,485	-	764	2,721	3,094	66
1975	4,350	-	802	3,548	3,185	83
1976	4,229	-	707	3,522	3,292	81
1977	4,112	-	822	3,290	3,480	73
1978	4,201	-	823	3,378	3,515	73
1979	3,940	-	278	3,662	3,518	77
1980	4,516	-	794	3,722	3,620	80
1981	4,008	-	470	3,538	3,831	72
1982	4,393	-	591	3,802	3,802	75
1983	4,559	-	130	4,429		85
1984	3,662	-	141	3,521		64

Source: PHILCEMCOR
CEMBUREAU

(i) Linear equation

$y = 108.315t + 2,595.788$ ..... (1)

$r = 0.95800$

where, y : estimated annual cement consumption (in thousand tons)

t : years elapsed from 1971

r : correlative coefficient

(ii) Linear exponential equation

$y = 2,635.570 \times 1.034^{t}$ ..... (2)

$r = 0.94206$

(2) Correlative analysis

(i) Population

This analysis was carried out on the basis of the simple correlation between the five-year moving average of the past domestic consumption and the population, and the result is as follows:

$y = 0.916 \times 10^{-4}x - 725.146$ ..... (3)

$r = 0.97639$

where, y : estimated annual consumption (in thousand tons)

x : population (in thousand persons)

According to the data contained in the Philippine Year Book(1985), the estimated population is as follows:

(Thousands)

Year	1985	1990	1995	2000
Est. population	54,668	61,480	68,424	75,224

The cement consumption was estimated based upon the above data.

(ii) GNP

This analysis was made on the basis of simple correlation between the five-year moving average of past domestic consumption and the real GNP at constant 1972 prices, and the result is as follows:

$y : 0.0241x + 1,464.797$

$r = 0.97216$

where, y : estimated annual cement consumption (in thousand tons)

x : real GNP (in thousand pesos)

According to the Five-Year Philippine Development Plan prepared in 1983, the real economic growth rate is expected to be 6.7% on annual average basis during the period 1983∿1987. However, since the said growth rate has not been attained as expected in 1983, this analysis is made on the assumption that the growth rate of 5%, instead of 6.7%, will be realized from now to the year 2000.

Table 3-3-2 shows the transition of population and GNP.

Table 3-3-2 Population and GNP

Year	Population	GNP at Current Prices (million pesos)	GNP at Constant 1972 Prices		
			GNP (million pesos)	Growth Rate (%)	GNP Per Capita (Pesos)
1971	37,703,581*	49,599	52,921	5.77	1,404
1972	38,750,986*	55,526	55,526	4.92	1,433
1973	39,827,488*	71,616	60,881	9.64	1,529
1974	40,933,896*	99,948	64,739	6.34	1,582
1975	42,070,660	114,265	68,530	5.86	1,629
1976	43,212,457*	132,712	72,718	6.11	1,683
1977	44,385,243*	154,083	77,162	6.11	1,738
1978	45,580,959*	178,067	83,070	7.66	1,822
1979	46,827,168*	220,957	88,736	6.82	1,895
1980	48,098,460	264,973	95,597	4.35	1,988
1981	49,346,134*	303,644	96,041	0.46	1,946
1982	50,626,172*	335,416	97,539	1.56	1,927
1983	51,939,414*	379,347	98,767	1.26	1,902

* Estimated

Source: NEDA, PHILIPPINE YEARBOOK(1985)

(3) Estimation based on similar cases

It is very difficult to make a fair comparison when considering several different countries, because they are not alike in terms of their stage of economic development, historical background and geological factors. However, to provide similar cases, we have selected some neighbouring countries in Asia, and the following are their annual increase rate of domestic cement consumption for the period 1974∿1984 according to CEMBUREAU.

China	12.9%
Hong Kong	8.9%
Indonesia	12.8%
Malaysia	12.2%
Korea	9.2%
Singapore	11.2%
Thailand	10.4%

(4) Demand forecast prepared in the Philippines

Forecasts prepared in the Philippines were not available at the time of this report, but one of the forecasts obtained this time is as shown in Table 3-3-3.

Table 3-3-3 Cement Demand Estimated by PHILCEMCOR

(Million tons)

Year	Domestic Demand	Export	Total
1984	3.8	0.8	4.6
1985	4.0	0.8	4.8
1986	4.3	0.8	5.1
1987	5.0	0.8	5.8
1988	5.2	0.8	6.0

(5) Large public projects

According to the Five-Year Philippine Development Plan 1983∿1987, the infrastructure investment is expected as shown in Table 3-3-4.

Table 3-3-4 Infrastructure Investment Requirements (1980 1983 and 1987)

(Million pesos)

Sector	Actual		Estimation	Target		
	1980	1981	1982	1983	1987	1983∿1987
Transport	2,232	3,016	6,279	7,696	9,087	41,137
Communications	11	26	287	1,658	3,368	12,700
Water resources	2,514	3,185	6,966	7,133	9,337	40,494
Power and Electrification	6,332	7,111	9,521	7,943	3,013	28,180
Social/Related Infrastructure	504	513	994	1,512	1,771	8,568
Others	175	95	266	279	522	1,954
Total	11,768	13,946	24,313	26,222	27,098	133,033
Index	100	119	207	223	230	(226)

Source: NEDA, FIVE-YEAR PHILIPPINE DEVELOPMENT PLAN, 1983∿1987

If the cement amount to be consumed in connection with the above infrastructure investment is proportional to the magnitude of infrastructure investment, annual cement consumption to be expected during the period 1983∿1987 will be almost double of that in 1980 and 1981 as seen from the indices put in the above Table 3-3-4.

In addition to the above, there is the official publication titled "Selected Major Development Projects," out of which the projects relative to road construction and pavement are extracted and shown in Table 3-3-5. Annual project costs of these project, if calculated on the assumption that the costs of each projects will be spent equally during their own project schedule, are such as enumerated in Table 3-3-5.

If these projects will be actually implemented according to their schedule, it can be said that cement demand will considerably increase at least from 1987 on.

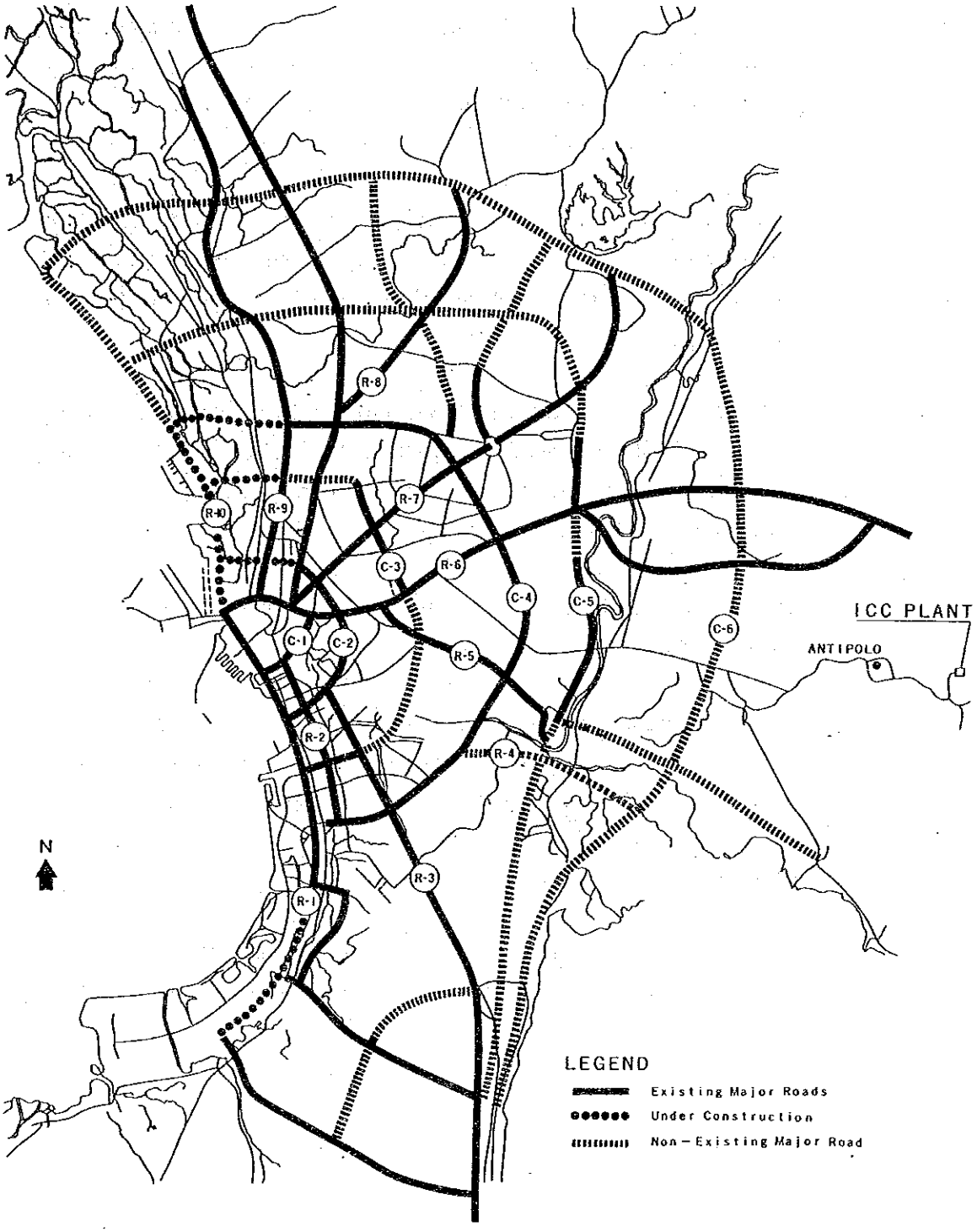
Table 3-3-5 Major Projects of Roads Construction and Pavement

(in million pesos)

Projects	Schedule	Costs	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Molave-Oroquieta and Pagadian Tucuran Roads Project	1985/88	232	58	58	58	58									
4th ADB Roads Improvement (Nationwide)	1987/92	1,360			227	227	227	227	227	225					
Rural Road Improvement Project	1987/91	1,267			253	253	253	254	254						
Laoag-Allacapan Road Improvement Project Step II	1987/91	572			114	114	114	115	115						
Road Disaster Prevention Project	1988/91	494				123	124	124	123						
Metro Manila Circumferential Road Project	1987/90	429			107	107	107	108							
Metro Manila Urban Transport Project (MMUSTRAP)	1987/92	3,577			596	596	596	596	590	597					
Provincial Roads Improvement Project	1991/95	746							149	149	149	149	150		
5th Rural Road Improvement Project	1992/96	1,200								240	240	240	240	240	
MPWH Rural Roads Program	1991/95	497							99	99	100	100	99		
Rural Roads Improvements Project (RRIP) III	1992/97	2,009								334	334	334	335	336	336
5th ADB Roads Improvement Project	1992/96	1,791								358	358	358	358	359	
6th IBRD-Assisted Roads Project	1990/94	2,496						499	499	499	499	500			
T O T A L		16,670	58	58	1,355	1,478	1,421	1,923	2,062	2,501	1,680	1,681	1,182	935	336

Source: SELECTED MAJOR DEVELOPMENT

Fig 3 - 3 - 1 MAJOR ROAD NETWORK IN METRO MANILA



(6) Estimated results

From the above forecasts, future cement consumption is estimated as shown in Table 3-3-6 (Refer to Figure 3-3-2 Cement Demand Forecasts in the Philippines). Among the estimations made in Table 3-3-6, the forecast calculated by equation (3) has been adopted as the basis of this study.
The reasons are as follows:

- Equation (3) is highest in correlative coefficient, and the second lowest in increase rate among the four equations, which is on the conservative side when making an estimation.

- According to the equation (3), annual increase rate during the period of 15 years (1985∿2000) is 2.5%, which is much lower than the increase rates of other Asian developed countries for the past 10 years.

- Estimation by equation (3) is lower than those previously done in the Philippines.

- Cement consumption per capita in case of applying equation (3) will be as shown in column (5) of Table 3-3-6. As seen in Table 3-3-7, this figure in the column (5) is much lower than those of other Asian developed countries, being a little higher than that of Indonesia.

Therefore, if the above reasons are taken into account, it can be said that the cement demand estimated under equation (3) will be fairly feasible.

Table 3-3-6 Cement Demand Forecast

(Unit: ton)

Equation / Year	(1)	(2)	(3)	(4)	(5) Per Capita (kg)
1985	4,220,508	4,357,137	4,282,443	4,186,014	78
1986	4,328,823	4,505,638	4,404,820	4,322,075	79
1987	4,437,138	4,659,201	4,528,664	4,464,939	79
1988	4,545,452	4,817,997	4,653,698	4,614,946	79
1989	4,653,767	4,982,206	4,779,739	4,772,454	80
1990	4,762,082	5,152,011	4,906,422	4,937,836	80
1991	4,870,396	5,327,603	5,028,379	5,111,489	80
1992	4,978,711	5,509,180	5,152,824	5,293,823	80
1993	5,087,026	5,696,946	5,279,962	5,485,274	81
1994	5,195,340	5,891,111	5,409,849	5,686,298	81
1995	5,303,655	6,091,894	5,542,638	5,897,373	81
1996	5,411,970	6,299,520	5,662,538	6,119,002	81
1997	5,520,284	6,514,222	5,784,732	6,355,058	81
1998	5,628,599	6,736,242	5,909,263	6,596,058	82
1999	5,736,914	6,965,829	6,636,177	6,852,621	82
2000	5,845,228	7,203,240	6,165,518	7,122,012	82
2005	6,386,813	8,517,266	6,850,300	8,684,990	82
2010	6,928,388	10,071,066	7,603,135	10,679,784	84

Fig 3 - 3 - 2 CEMENT DEMAND FORECAST IN THE PHILIPPINES

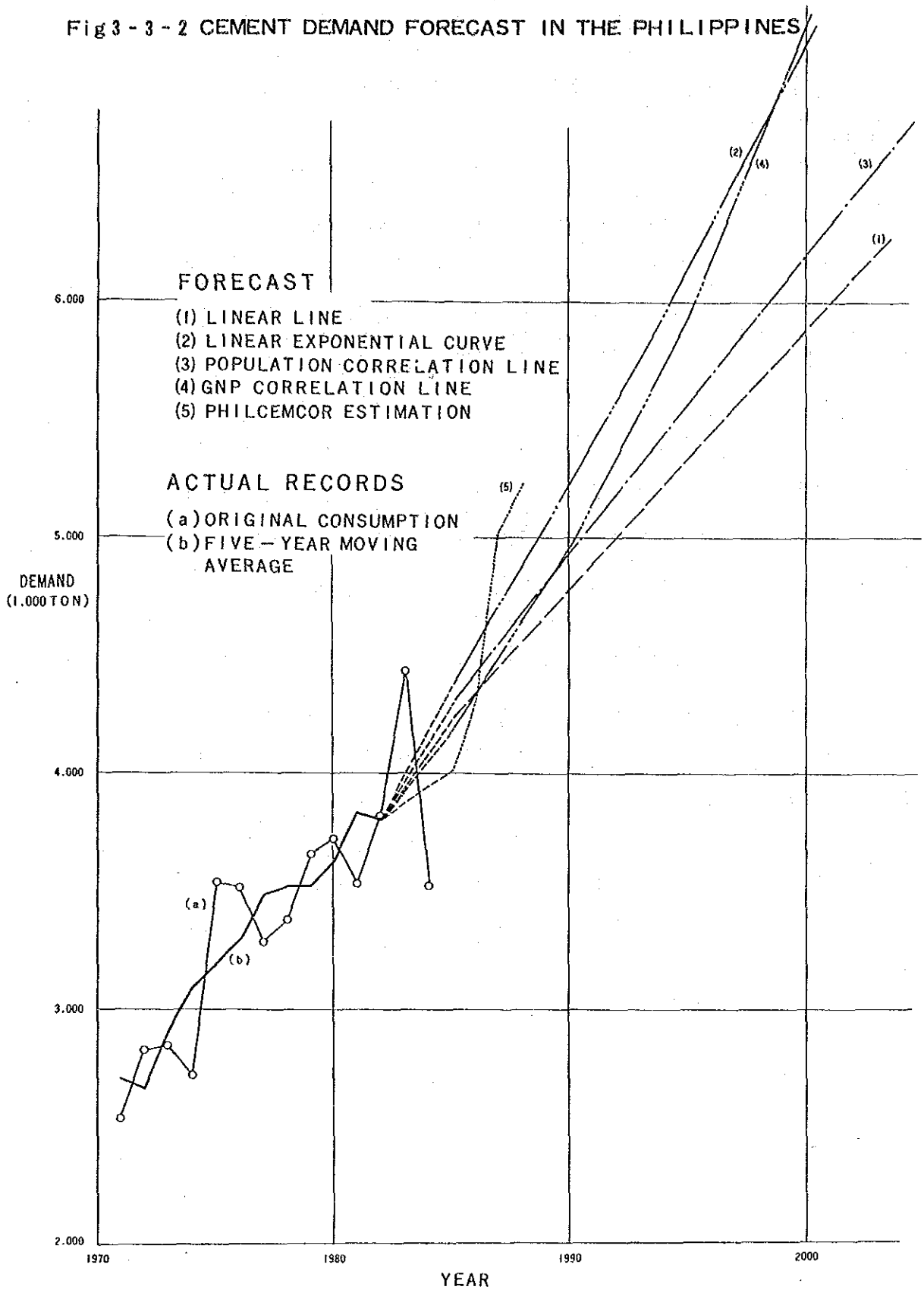


Table 3-3-7 Per Capita Cement Consumption in Asian Countries

(Unit: kg)

	1963	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84
Thailand	30	33	39	49	60	66	68	73	72	74	77	74	79	90	107	116	137	138	133	130	144	161
Indonesia	5	6	7	5	5	6	8	10	12	13	17	20	21	21	22	26	27	36	44	49	54	52
Malaysia	94	98	92	74	62	70	65	66	103	117	130	141	159	151	160	180	203	227	237	316	302	336
Singapore				203	370	451	366	372	426	504	514	541	549	646	557	544	582	587	682	915	1,352	1,374
Philippines	40	44	50	52	67	75	70	66	67	73	71	66	83	81	73	73	77	80	72	75	85	64
Hong Kong	286	328	350	285	167	163	190	221	321	289	289	301	272	357	445	512	473	643	650	918	604	563
Taiwan	115	120	142	149	180	231	252	252	279	313	354	391	405	496	523	591	662	752	684	590	584	561
Korea	40	42	52	65	93	111	138	169	190	174	215	229	243	250	305	403	424	345	321	313	442	456
Japan	290	319	313	361	401	447	477	528	544	616	715	639	547	572	608	689	705	704	659	584	591	587
Nepal	4.2	4.4	7.9	8.7	3.4	6.1	6.6	8.7	7.6	7.8	8.9	12.9	17.1	12.1	-	8	9	10	10	13	13	12
India	20	20	22	22	22	22	25	26	27	28	26	24	26	29	29	32	30	30	33	31	39	39
Bangladesh							(9)	2	2	2	3	4	4	4	(5)	5	8	10	10	11	12	14
Pakistan	19	26	19	19	19	24	24	44	40	39	53	59	47	43	44	55	52	55	49	57	59	60
Sri Lanka	26	24	25	29	25	34	34	31	32	31	35	34	26	27	28	40	45	65	57	54	47	43
Afghanistan	6	9	11	11	8	5	4	6	5	4	5	4	4	7	15	15	26				18	19
Burma	8	7	5	6	7	7	7	6	6	7	7	5	6	7	7	7	11	8	7	6	8	8
Laos				15	18	17	14	16	21	14	9	9	10			17	17					
Cambodia				33	42	26	24	18	5													
Viet Nam	27	26	34	90	75	79	69	49	63	49	42	20	22			20	23	26		11	13	15
China	12	15	22	24	26	29	34	39	47	53	49	44	54	64	68	73	78	80	80	107	105	117
Brunei	120	186	208	337	375	420	474	450	465	484	397	545	798	644	726	490	310	458	458		848	723
Macao	31	85	100	122	56	46	63	70	114	147	240	155	100	113	175	182	315	341	480		563	447

Source: CEMBUREAU

III-3-2 Export Potentiality

As described in III-2-3, the Philippines has been exporting 700∿800 thousand tons per annum in 1970's, this amount corresponds to 20∿30% of the domestic consumption.
Main destinations range from South East Asia to Middle East. It can be said that there will be a possibility to continue exporting from now on to such extent as during the 1970's, if export is promoted utilizing the vantage ground of this country.
Therefore, as for the export, there will be much possibility to export an amount corresponding to at least 18% of the domestic consumption in the Philippines.
Incidentally, export of 1,213 thousand tons was recorded in 1973, which corresponds to about 43% of the domestic consumption in the same year.

III-3-3 Future Market Trend

(1) Total demand and ICC's sales share

When cement demand trend in the Philippines is estimated based upon the equation (3) as treated in III-3-1, the future demand forecast will be as shown in Table 3-3-8.
In the Table, however, export is estimated as 18% of the domestic demand, and ICC's sales share is estimated as 11% of the domestic demand plus export.
ICC's plant operation rates after the rehabilitation and modernization (hereinafter referred to as "renovation") are estimated on the presumption that the renovation will have been completed by the end of 1989, the rates of which will be rather optimistic.
As to the operation rates in the above Table, the wording "Ord./Poz." means a production ratio of ordinary cement and pozzolan cement, and in case of the production ratio being 80/20 or 50/50, the respective plant capacities will be as follows:

Table 3-3-8 Demand Forecast

(1,000 tons)

Year	A Domestic Demand	B Export (18% of A)	C Total (A + B)	ICC's Sales Share (11% of C)	ICC's Operation Rate after the Renovation	
					Ord./Poz. 80/20 *	Ord./Poz. 50/50 *
					(%)	(%)
1987	4,528.7	815.2	5,343.9	587.8	-	-
1988	4,653.7	837.7	5,491.4	604.1	(70)	(64)
1989	4,779.7	860.3	5,640.0	620.4	(72)	(66)
1990	4,906.4	883.2	5,789.6	636.9	74	68
1991	5,028.4	905.1	5,933.5	652.7	76	69
1992	5,152.8	927.5	6,080.3	668.8	78	71
1993	5,280.0	950.4	6,230.4	685.3	80	73
1994	5,409.8	973.8	6,383.6	702.2	81	75
1995	5,542.6	997.6	6,540.2	719.4	83	77
1996	5,662.5	1,001.3	6,663.8	733.0	85	78
1997	5,784.7	1,041.2	6,825.9	750.8	87	80
1998	5,909.3	1,063.7	6,973.0	767.0	89	82
1999	6,036.2	1,086.5	7,122.7	783.5	91	83
2000	6,165.5	1,109.8	7,275.3	800.3	93	85
2001	6,297.3	1,133.5	7,430.8	817.4	95	87
2002	6,431.7	1,157.7	7,589.4	834.8	97	89
2003	6,568.6	1,182.3	7,750.9	852.6	99	91
2004	6,708,1	1,207.5	7,915.6	870.7	100	93
2005	6,850.3	1,233.1	8,083.4	889.2	100	95
2006	6,995.2	1,259.1	8,254.4	908.0	100	97
2007	7,142.9	1,285.7	8,428.6	927.1	100	99
2008	7,293.4	1,312.8	8,606.2	946.7	100	100
2009	7,446.8	1,340.4	8,787.2	966.6	100	100
2010	7,603.1	1,368.6	8,971.7	986.9	100	100

* Ord./Poz. = Ordinary Cement/Pozzolan Cement

Ordinary/Pozzolan	Plant capacity
80/20	861,880 ton/year
50/50	939,760 ton/year

(2) ICC's rehabilitation and modernization and its influence on the domestic cement industry

As described in Section X, ICC's renovation plan is to aim at converting the existing No.1 kiln (capacity 1,300 t-cl/d, Wet process) into the dry process kiln with NSP (New Suspension Preheater) having a capacity of 2,600 t-cl/d.
The other existing No.2 kiln (also wet process) will not be run after completion of the renovation because of high production costs (especially that of fuel).
Therefore, it can be said that ICC's total production capacity will not increase substantially even after the renovation.
Besides, the completion of the renovation will probably fall on the beginning of the year 1990 at the earliest, and ICC's sales share is calculated based on 11%, the percentage of which is a little less than those of the last decade and the present. Therefore, ICC's renovation will not infringe the conventional sales share of other local cement manufacturers.
As shown in Table 3-3-9, the indicated production capacity of ICC is about 11% of the total indicated production capacity of the local cement industry, which is nearly equal to that of ICC's sales share.

Table 3-3-9 Indicated Production Capacity of ICC in the Whole Cement Industry

	Indicated Production Capacity (1,000 t-cl/y)	
	Original	Re-rated (1978)
A. Whole Cement Industry	6,893	5,650
B. ICC	780	600
C. ICC's Share (B/A x 100)	11.3%	10.6%

Therefore, it can be said that there will be no substantial influence on the domestic cement industry coming from ICC's renovation, because ICC's renovation plan will be implemented aiming at the production capacity to keep the past and actual sales share as well as production share taking full account of the whole cement demand estimated for the Philippines.

Moreover, the average operation rate of the whole Philippine cement industry is calculated as shown in Table 3-3-10 in case of the cement demand forecast in Table 3-3-8 and the indicated production capacity.

Table 3-3-10 Average Operation Rate of Whole Cement Industry
(Estimation)

Year	Total Demand (1,000 tons)	Average Operation Rate	
		with Original Capacity (%)	with Re-rated Capacity (%)
1990	5,789.6	76	93
1995	6,540.2	86	100
2000	7,275.3	96	100
2005	8,083.4	100	100
2010	8,971.7	100	100

(Note)

	Original Capacity	Re-rated Capacity (1978)
Clinker (t-cl/y)	$6,893 \times 10^3$	$5,650 \times 10^3$
*Cement (t/y)	$7,617 \times 10^3$	$6,243 \times 10^3$

* Production ratio of Ordinary/Pozzolan = 80/20

III-3-4 Summary

In case that domestic demand in the Philippines will move as shown in Table 3-3-8 and no remarkable change will occur in other circumstances, 5,800 thousand tons of cement is expected as the total demand in the year 1990, when, even after the renovation, as to ICC's operation rate, 74% or 68% will be required in case of 20% or 50% of pozzolan cement production ratio respectively.

Therefore, ICC's operation rate will continue increasing to become 93% or 85% in the year 2000 and 100% or 95% in the year 2005 according to the said production ratio of pozzolan cement.

In addition, no substantial influence from ICC's renovation will affect the domestic cement industry, as far as the renovation is implemented aiming at plant rationalization with the production capacity to cover their past and present sales share as well as production share in the Philippine cement industry.

In conclusion, therefore, this rehabilitation and modernization plan will be worthy of implementing without any delay.

SECTION IV OUTLINE OF ICC AND ENVIRONMENT OF ANTIPOLO

IV-1 Outline of Island Cement Corporation

(1) Formal name

Island Cement Corporation
Abbreviation: ICC
Address of the head office:
2283 Pasong Tams Ext., Makati, Metro Manila
Tel. 86-40-11 to 22
Address of the plant:
Barrio Tagbac, Antipolo, Rizal

(2) Establishment of the company

Antipolo plant of ICC was originally constructed by Marinduque Mining Industrial Corporation (MMIC).

1964	:	Acquisition of quarry and plant site
1965 - 1966	:	Civil works and installation of machinery
Dec.29, 1966	:	Start of No.1 kiln's operation
Jan.19, 1967	:	Start of No.1 cement mill's operation
Jan.30, 1967	:	First shipment of cement
Feb.4, 1967	:	Official inauguration
1968 - 1969	:	Construction of No.2 line
Nov.17, 1969	:	Firing of No.2 kiln
Jan.5, 1970	:	No.2 cement mill's operation (100% capacity)

MMIC had owned cupper mining division, nickel production division and cement production division. Due to the dullness of companie's business especially the slump of nickel production division, the company had to give independence to each division.

Thus the ownership of ICC was transferred from MMIC to the two (2) government owned banks, the Development Bank of the Philippines and the Philippine National Bank in October, 1984. At the same time, A.I. Construction and Development Corp. (AICDC) who provided the working capital for resuming the operation was appointed as a sole distributor.

On the other hand, ICC reduced the employee of Antipolo plant from about 900 persons to about 360 persons.

(3) Capital

Authorized capital	Peso 20,000,000.-
Paid-up capital	Peso 15,000,000.-

(4) Composition of capital

DBP	56%	(Peso 8,550,000.-)
PNB	43%	(Peso 6,450,000.-)

(5) Directors (As of January 1986)

Rolando M. Zosa	President	(from DBP)
Victor G. Villar		(from DBP)
Ofelia I. Castell		(from DBP)
Felipe S. Ramirez		(from PNB)
Telesforo S. Cedo		(from PNB)

(6) Employee

Head office	75
Plant	*348

Note: * When two kilns are operated simultaneously 25 temporal workers will be employed.

(7) Outline of plant

(i) Mode of production:

Wet system with long kiln

(ii) Official production capacity:

1,300 t/d x 2 lines = 2,600 t-clinker/d
300 d/y operation = 780,000 t-clinker/d

(iii) Products:

Ordinary portland cement	Portland Type I
Pozzolanic cement	Portland-pozzolan Type IP

Note: Pozzolanic cement has been produced since July 1985 and sold under the brand of "Isla Cement."

(iv) Others:

Heavy oil had been used for kiln burning from the establishment of the company to 1982, but fuel conversion from heavy oil to coal was executed in January 1983 for No.1 kiln and in March of the same year for No.2 kiln respectively.

IV-2 Environment of Antipolo

(1) Outline

ICC's cement plant is situated in Tagbac Barrio which is in the vicinity of Antipolo, Rizal Province.
This place is located about 40km to the East of Metro Manila with which it is linked by paved roads and so is easy of access.
It takes about one hour from Manila to the plant except during morning and evening rush time.
So the plant is quite favorably located towards a big cement consuming city, Metro Manila.
Tagbac is an ordinary little barrio in the foothills of Rizal and is the place in the shade of the famous town, Antipolo to which annually in May devotees and tourists flock in.
MMIC who was planning the cement business was looking for a site which would be located in a suitable range from the consuming city, Manila and would have, in its vicinity, the main raw material deposits for cement manufacturing.
The circumstances that Tagbac happened to meet these two requirements ideally led it to be developed as the site of cement plant.
Now a number of barrio's inhabitants are working for the plant and at the same time limestone, dacite and diorite are being quarried in its surrounding hills.

(2) Weather

The weather in Philippines varies mountains and plateau in each area. The difference of meteorological condition mainly depends on the air current of the area.
In the western part of Lwzon where Antipolo is located, there are two seasons in a year, namely dry season from November to April and wet season of the rest of year.

The meteorological data of Manila, of which Antipolo is a neighbouring town, are shown in Table 4-2-1.

Table 4-2-1 Meteorological Data of Manila

(monthly average)

Month	1	2	3	4	5	6	7	8	9	10	11	12	Aver-age	Peri-od
Temperature (°)	25.4	26.1	27.2	28.9	29.4	28.5	27.8	28.1	28.0	27.8	27.3	26.4	27.3	1951∿ 1960
Participation (mm)	18	7	6	24	110	236	253	480	271	201	129	156	1791	1951∿ 1960
Humidity (%)	79	74	68	67	71	79	83	86	86	84	83	82	78	1951∿ 1960

wet season

The above table shows that in the rainy season temperature is high, it rains much, and humidity is high and in dry season vice versa.

The temperature reaches to peak in May but not much difference is observed through the year.

The participation is the lowest in the months of February and March and the highest in August.

The humidity is almost the same through the year, but a little lower in March and April.

SECTION V DIAGNOSIS OF MANAGEMENT OF ICC

The wet long kiln system is adopted in this plant. This system together with the Lepol system was widely adapted during the period from 1955 to 1965. The No.1 line of this plant was commissioned in 1966 and the No.2 line in 1969. The wet long kiln does not have auxiliary equipment such as waste heat boiler, so operation is simple and it is suitable large production and for automation. Therefore it was the main system adopted during that period. The heat consumption is 1,300-1,500 kcal per kg clinker and this system is suitable for long stable operation.

V-1 Operation of the Cement Plant and Associated Facilities

The operation of this plant during last year (Jan.-Dec.1985) is shown in Page . Owing to poor market condition, operation was restricted and No.1 kiln operated for less than 40 days while the total operation of No.2 kiln was 177 days. Therefore, for all departments, operation of one line of the two lines was sufficient for necessary production.

V-1-1 Raw Material Department

The raw material storage was under full storage condition.

	Storage capacity (tons)	Clinker equivalent (tons)	Days of stock at 1,300t-cl/d (days)
Limestone	52,400	35,000	27
High silica clay Low silica clay	10,400	40,000	31
Pyrite cinder	6,600	220,000	169

From these figures, it can be seen that the lowest amount of stock was for 27 operating days for limestone which was 35,000 ton-clinker equivalent to last years maximum monthly production of 32,300 tons allowing stoppage of raw materials for over one month.

V-1-2 Burning Department

A wet long kiln is generally simple to operate and if burning is correctly controlled, a long stable operation is possible.
Last years operation of this plant shows that continuous operation of more than 60 days was very few. Since operation data when kiln was stopped are not available, it is not clear whether the shutdown was caused by market condition or by operational trouble. In any event, frequent shutdown will raise repair and maintenance cost as well as disrupt the mechanism of the equipment leading to an increase of inspection and maintenance work.
Especially, the consumption of bricks estimated to be about 540 tons last year would amount to a unit cost of 30 Peso/ton-clinker which is very large.
Furthermore, heat consumption which should be about 1,350 kcal/kg-clinker was about 1,370-1,520 kcal/kg-clinker (monthly average) for this plant and the yearly average was about 1,450 kcal/kg-clinker which is quite large. The reasons for this high heat consumption are listed and described below.

- The standard content of moisture in kiln feed is set at 34%, but actually the moisture frequently exceeded the standard being mostly 34-36% while for short period being 33-39% (1% moisture increase will increase heat consumption by 25-26 kcal/kg-clinker).

Such fluctuation in moisture will result in fluctuation of fuel fired in the kiln disrupting the stability of kiln as well as reducing the quality of clinker and burning efficiency.

- The temperature of secondary air from the cooler for firing is low. The heat efficiency will improve by raising secondary air temperature and if a good control is maintained on the air volume in the cooler, the secondary air temperature can be maintained at more than 850°C. However, the secondary air temperature seldom exceeded 800°C and fluctuated widely between 550°C-800°C. This fluctuation and low temperature of secondary air greatly affects heat efficiency. If secondary air temperature is raised to 850°C, heat consumption may be reduced by about 40 kcal/kg-clinker.

- For the kiln burner, a direct coal firing system which carries coal and air (air for drying and grinding coal in the mill) directly to the kiln burner is adopted. The direct system is simple and easy to operate, but it is difficult to reduce heat loss and to control heat, so it is not suitable for reducing heat. The heat consumption is about 50-80 kcal/kg-clinker lower in the indirect system.

- The daily operation log of the plant shows that temperature in the burning zone fluctuates widely 1,100-1,350°C. The standard is set at 1,400°C but there are few records showing temperature up to 1,400°C. Since errors exist in pyrometer, the actual temperature is not clear, but the problem is this wide fluctuation. Many factors would cause this fluctuation such as skill of the operator, fluctuation of kiln feed composition and control of coal grinding. The operation standard should be reviewed.

In this plant, dust treatment has been a problem, and kiln dust (180-200 t/day) is being disposed outside the plant.

The original plant was designed to feed the kiln dust collected in the electric precipitator into the kiln together with the slurry, but this raised slurry viscosity and created balls in the kiln so this dust feeding equipment was immediately removed. Later water was added to the dust converting it to a slurry and feeding this slurry into the kiln, but it was not successful. Dust was also blown into the kiln together with the primary air, but this was abandoned too because of many troubles so, today dust is being disposed.

It is not clear whether feeding dust slurry into the kiln was actually impossible, since this operation was not observed, but this method should be technically possible. In any case, dust disposal creates a big loss.

The type of cooler at this plant is different between the No.1 kiln and No.2 kiln. The cooler for No.1 kiln is a travelling grate type which is seldom used for clinker cooler.

In this type of cooler, the clinker bed hardly changes from cooler inlet to cooler outlet while being conveyed on the grate.

Therefore, the cooling air passes through the clinker bed in the same route and does not cool the entire clinker bed. The cooling effect is very poor and red heated clinker still remains at cooler outlet.

This gives a bad influence on both the cooler and the equipment after the cooler. Problems on the cooler include structural problems owing to heat strain such as deformation of grate support beam and side plate causing many mechanical troubles therefore long continuous operation is difficult.

The total storage capacity for slurry is 14,300 tons (storage tank 700m^3x5, blending tank 700m^3x4, slurry basin 4,000m^3 x2).
Slurry is pumped through pipes which is a simple operation, but the pipes are subject to heavy wear, also the slurry must be constantly mixed during storage to prevent segregation.

All pieces of equipment for handling slurry must be cleanly washed when they are to be shutdown for a long period because slurry will become coated to the equipment.
An operation and maintenance standard should be established since these simple actions should be taken during daily operation.

V-1-3 Cement Grinding

The capacity of the cement mills is 70 tons/hour x 2 mills, but the operation of both mills averaged 63 tons/hour last year and although operation for a short period reached 70 tons/hour, the level of operation was low. Since the capacity is sufficient, process control should be reviewed to improve mill output.

V-1-4 Cement Packing

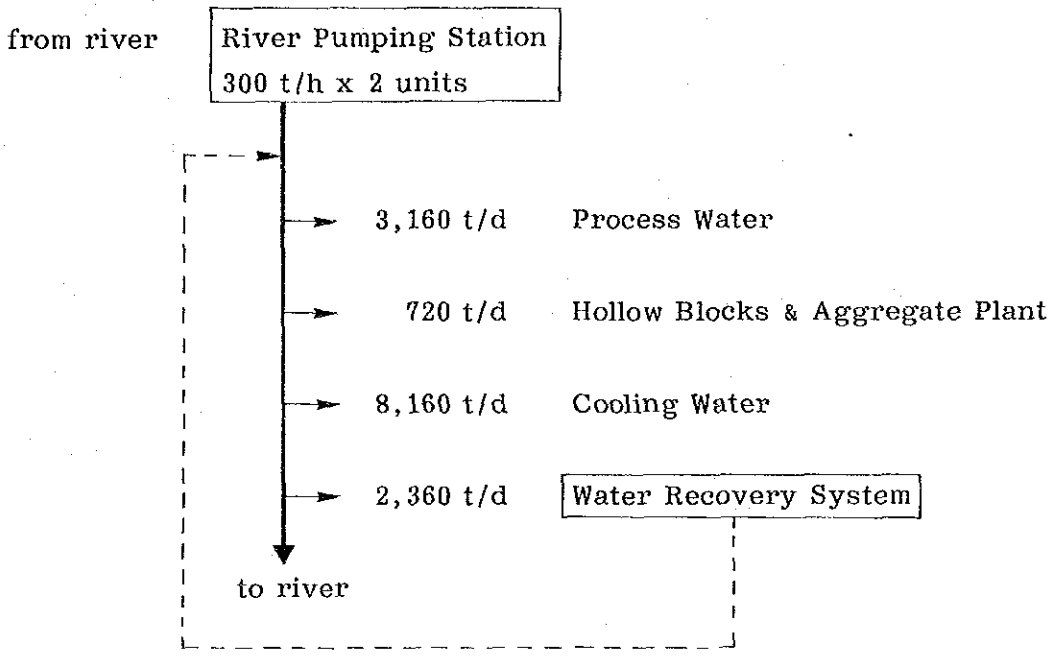
Last year, the packer operated for a total of 13,000 hours and from the number of packed cement for each month, the output per packer is observed to be 20 tons/hour - 26 tons/hour. Since the capacity of packer is 48 tons/hour, it means that the packer is operating at only half of its capacity. The causes which may be considered are mainly maintenance of packer, skill of packerman and idle time during loading, but a detailed study could not be made at this time due to the lack of time. In any event, the present packing efficiency is very poor.

There are 6 packers of 48 tons/hour capacity in the packing house and if they operated 13,000 hours as in last year, a shipment of 520,000 tons should be possible. If 2,600 tons/day of cement are to be shipped after renovation and if all packers are operated at an averaged of 11-12 hours daily, this amount can be shipped provided trucks are constantly available during this period. However, trucks will not always be available constantly,

so 2 working shifts (16 hours) and storage for bagged cement should be considered. Furthermore, operation system should be reviewed for securing an average packing operation of at least 40 tons/hour for each packer.

V-1-5 Water Supply

Industrial water is pumped from the nearby Tagbac river with the following water supply system.



Since water supply from the Tagbac river during dry season will be insufficient, a pond with a recovery system is provided in the plant. Water supply to all departments is sufficient, so there is no problem. Water sample was tested in Japan and water quality was found to be satisfactory for use as industrial water (refer to VI-1).

No. : 1/1

Name of Project : Island Cement Renovation Project

Date : Feb-28-1986

OPERATION DATA ON 1985

Item		1985 JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	Total
Limestone Received	T	-	24,251	59,968	35,307	58,392	34,073	51,384	21,830	50,580	32,570	-	26,520	394,880
Operated Time	H	-	110	206	139	213	148	255	106	200	176	-	126	1,679
	T/H	-	220	291	254	274	230	202	206	253	185	-	210	235
Hi Silica	T	-	2,078	4,592	8,360	7,750	670	8,270	4,118	6,630	7,700		2,286	52,454
Lo Silica	T	-	837	1,562	-	3,450	5,797	124	3,044	877	93		2,435	18,222
Pyrite Cinder	T	-	-	-	-	-	99	395	830	400	-		641	2,365
Operated Time	H	-	40	93	98	114	73	131	121	130	157		66	968
	T/H	-	73	66	85	98	90	67	66	61	50		81	75
Raw Mill														
No.I Production	T	-	4,278	5,335	-	4,872	1,786	1,452	23,925	35,670	28,164	-	-	105,482
Operated Time	H	-	42	52	-	40	16	13	212	330	283	-	-	988
	T/H	-	102	103	-	122	112	112	123	108	100	-	-	107
No.II Production	T	12,787	54,748	35,419	30,430	63,739	45,653	43,536	7,527	27,610	8,756	4,246	30,282	354,733
Operated Time	H	101	496	317	238	516	373	370	66	245	80	39	252	3,093
	T/H	127	110	112	128	124	122	118	114	123	109	110	120	115
Kiln No.I														
Production	T	-	-	-	-	-	-	17,540	31,560	-	-	-	-	49,100
Operated Time	H	-	-	-	-	-	-	373	572	-	-	-	-	945
	day							15.5	23.8					39.4
	T/H							47	55					
Kiln No.II														
Production	T	3,390	35,229	21,817	21,750	33,740	28,264	23,161	-	1,760	25,370	-	16,297	211,778
Operated Time	H	90	664	358	578	604	530	494	-	63	527	-	341	4,248
	day	3.8	27.7	39		25.2	22	20.6	-	2.6	22	-	13.1	177
	T/H	38	53	48		56	53	47	-	28	48	-	48	49.8
Oil Consumption	M^3	40	38	11	39	83	68	64	105	89	23	-	16	575
Rubber Consumption	T	-	-	-	-	-	-	-	-	9.2	197	-	251	458
Coal Consumption	T	914	9,054	6,043	5,340	8,468	7,150	6,072	4,488	8,552	6,391	-	4,300	66,742
Heat Consumption	kcal/kg-cl	1,373	1,454	1,421	1,512	1,520	1,420	1,443	1,445	1,400	1,373	-	1,495	1,441.5
Power Consumption	kW/t-cl	171	182	145		134	133	131	144	237		-	136	157
Cememt Mill No.I														
Production	T	4,851	18,299	20,170	23,700	9,432	18,683	15,490	17,632	3,780	11,145	1,398	-	144,580
Operated Time	H	74	318	332	374	151	310	249	271	57	169	21	-	2,325
	T/H	66	58	61	63	62	60	62	65	66	66	67	-	62.2
Cement Mill No.II														
Production	T	-	-	9,889	12,000	30,563	7,679	8,586	498	21,600	14,077	12,495	21,041	138,428
Operated Time	H	-	-	162	190	493	130	137	7	346	209	195	316	2,185
	T/H	-	-	61	63	62	59	63	71	62	67	64	67	63.4
Total Production	T	4,851	18,299	30,059	35,700	40,000	26,362	24,076	18,130	25,380	25,222	13,893	21,041	283,013
Pack House		-												
Production	T	-				40,283	20,722	24,025	18,981	22,820	24,968	15,271	25,682	
Operated Time	H	-	720	1,288	2,070	2,350	962	1,090	797	864	1,055	603	1,102	12,901
	T/H					17.1	21.5	22	23.8	26	23.7	25.3	22.3	

V-2 Maintenance Condition of Cement Plant and Associated Facilities

There are 110 employees in the maintenance department composed of 4 staff employees, 56 mechanics, 30 electricians and 21 vehicle maintenance workers.

The number of employees for maintenance are large when compared to cement plants in other developing countries which shows that the plant is placing importance on maintenance and repair work. At this plant metal fabrication (excluding large equipment), replacement of parts, machining parts (under ϕ800mm) and repair of general electrical equipment are performed similar to other cement plants. Manufacturers installation and repair of large equipment is contracted to steel works in Manila.

The maintenance of equipment is conducted under a system of coordination between the operation department and the maintenance department. The operation department checks the operation of equipment during patrol and if parts necessary for repair are found, the operation department requests the maintenance department to repair such parts. In case of breakdown during operation which require immediate repair, the operation department in cooperation with the maintenance department or by itself will repair the equipment.

Under this system, maintenance and repair can be performed systematically as well as quickly and the system at cement plants in Japan is mostly of this type.

Since under present operation condition one of the two lines is almost constantly shutdown, it is quite easy to perform necessary repair periodically. Owing to this maintenance and repair system, the condition of present equipment which is 16 - 18 years old are observed to be quite good. However, repetition of breakdown, insufficient repair and unrepaired parts were observed, which were obviously caused by insufficient technical investigation, poor material and parts, also poor repair.

Such conditions were especially observed in raw material receiving department, grinding department and packing department. If such condition continues, operation efficiency will drop, furthermore, leakage and emission of material and dust will build up making it difficult to inspect the equipment, and will also lead to other troubles.

The build up of dust is quite large even now.

Scheduling and executing maintenance activity, upgrading repair technique and performing careful repair.

V-3 Various Controls

V-3-1 Process Control

(1) Process control method

ICC has the control standard compiled as attached hereto, which includes items necessary to regulate the standard control figures and those to be recorded in the operation logs. These standard figures are referred to respectively in the form of the operation logs. However, these are no operation manuals, and accordingly in the operation logs there are found such data as deviated from the said standard figures.

(2) Important items for process control

(i) Stockyard for raw materials

As described in V-1-1, the receiving plan of the raw materials can be made separately from the production process, since capacity of stockyard for the raw materials is considerably big.
On the other hand, type of the stockyard is not such a type of blending yard as employed prevailingly in recent cement plants. Therefore, special attention should be paid to quality fluctuation of raw materials so as to ensure the quality control.

(ii) Raw material feeding

The feeders are not of such type as constant weigh feeder with full automatic control system.
Accordingly, this will cause quality fluctuation of the raw materials in addition to such problem as referred to in (i) above.

(iii) Capacity of slurry tanks and basins

The capacity will cover the operation of 4 - 5 days in case of the operation by one kiln, and the tanks and basins are attributing to homogenization of raw materials. But, in case of the operation by two kilns, the coverage will decrease to the operation of only 2 days.

(iv) Supply of pulverized coal

As described in V-1-2, supply of pulverized coal to kiln burner is carried out by the direct supply system. This is one of the important factors which will cause fluctuations in burning process.
In order to ensure a more stable control on the kiln system, it will be required to employ the indirect supply system, through which the coal can be dried and ground for storing and later the coal supply and necessary air volume can also be regulated.

(v) Heat consumption

It is needless to say that there is a necessity to save the heat consumption to a great extent by means of converting to dry process. This is the most important motive of the survey of this time.

(vi) Dust recovery

The plant has made incessant efforts to recover the dust. However, these efforts were in vain owing to the limitation coming from the nature of wet process.

In this regard, there are some plants where they are employing a method to feed the dust into the place after the chain zone, as one of countermeasures for the above problem. Anyhow, the dry process has a merit to utilize the dust collected as long as there will be no problem in method of recovery of the dust.

(vii) Cement mill and packer

There are found such problem as described in V-1-3 and V-1-4.

(3) How to proceed with process control

In order to strengthen control on the whole process, it is necessary to make each equipment run effectively and stably so that the performance can be optimized and fluctuation can be minimized. For this, it is required that operation data should be technically studied so as to establish countermeasures for optimizing the operation.

In case of cement mill, for instance, since its capacity more than 70 t/h according to its specification, an adequate charging volume of grinding media as well as its distribution of size should be further studied.

Such being the actual situation of the plant, it is recommended that rearrangement and analysis of the operation data should be made utilizing the statistics.

This is always needed for a good operation of the plant irrespective of execution of the rehabilitation and modernization of the plant.

PROCESS CONTROL

Crusher Section

1. LST

Primary Crusher

Feed size - 800mm x 1,070mm x 1,620mm (max)

Product size - 250 max

Secondary Crusher

Feed size - 250m (max)

Product size - 25mm (max)

LST Purity - 85% $CaCO_3$

2. Silica Crusher

Feed size - 450mm (max)

Product size - 25mm (max)

High Silica Purity - 60% SiO_2

Low Silica Purity - 50% SiO_2

Note: (1) The purity of different materials are determined by Quality Control.

(2) Sampling is undertaken at the Quarry areas.

(3) All activities are recorded in daily log sheet.

Raw Grinding

Rod Mill and Compeb Mill

Feed size of raw material - Approximately 90% minus 25mm.

Product Fineness - 82% - 85% minus 200 mesh

Water Content of slurry - 34 - 36%

Note: (1) The mixture of raw feed such as limestone, silica and pyrite cinder are determined by Quality Control.

(2) The slurry content is determined by Quality Control. The production personnel do the usual inspection of slurry and control the quantity of water added introduced into the mill (34-35%).

(3) Ammeter readings, temperature of bearings, stator coil to big motors, water content of slurry, fineness of slurry are recorded in daily log sheet.

(4) Productions are recorded in the daily log sheets.

Raw Storage and Blending

Under the supervision and direction of Quality Control.

Burning

- Control of kiln operation from Slurry Basin up to Clinker storage yard.
- Recorded in the log sheets are the following:

(1) Moisture content of slurry feed (34-35%)

(2) Clinker liter weight (1,200-1,300)

(3) Free Lime (Supplied by Quality Control)

(4) $CaCO_3$ of slurry feed (Supplied by Quality Control)

(5) Fineness of slurry feed (Supplied by Quality Control)

(6) Ammeters reading

(7) Dampep opening

(8) Draft readings

(9) Kiln speed & feed (max 1.0rpm, 1,300MPD)

a) Burning Zone - 1,200 - 1,400°C

b) Chain Section - 750 - 850°C

c) Secondary Air - 600 - 800°C

d) Exhaust Gas - 195 - 210°C

e) Waste Gas from Cooler - 100 - 200°C (kiln 2)

- 150 - 250°C (kiln 1)

(10) Coal fineness (85%), moisture of raw coal (10% ave), moisture of pulverize coal (1%), coal consumption

(11) Clinker production

(12) Target Heat Rate in K-cal/kg clinker ($\frac{1,450K\text{-cal}}{kg\text{-clinker}}$)

Finish Grinding Section

1. Feed size of clinker - approximately 90% minus 25mm
2. Control of Finish Grinding Section
3. Recorded in the daily log sheet are the following:
    (1) Material feed to mill. The mix is directed by Quality Control.
    (2) Ammeter readings
    (3) Temperature of bearings, stator coil, dust collector inlet
    (4) Draft of air separators
    (5) Fineness of product (determined by Quality Control)
    (6) Blaine (2,800-3,000) determined by Quality Control
    (7) Liter Weight of Clinker feed
    (8) % re-circulating load at Air Separators (400%-500%)

Production

Packhouse

- Control of packing operation from cement silo up to unloading areas.
- The following are recorded in the daily log sheet
    (1) Empty Paper Bag
        - Beginning Balance
        - Received empty paper bags
        - Inventory of empty paper bags at the end of shift
        - Broken bags (less than 1%)
    (2) Operating time of packers
    (3) Number of underweight bags
    (4) Production
        a) direct loading
        b) stockpiled (pallet)
        c) bulk

V-3-2 Quality Control

V-3-2-1 Organization

The Quality and Process Control Department which is an independent staff department is in charge of the quality control. They are conducting the quality control with 23 staffs headed by a superintendent referring to physical test and chemical analysis carried out in the laboratory.

V-3-2-2 Outline of Quality Control

The quality control is performed along the following steps as the same as in ordinary cement plant.

(1) Collecting samples

To collect samples of raw materials, slurry, clinker, coal and cement

(2) Test

To conduct necessary tests of the samples

(3) Control

To compare the test results with the control standard and take necessary action if abnormal value is found.

In this case to inform the Production Division of the test results and ask to take necessary adjustment.

Through the above mentioned control, the quality of cement, final product, is kept in acceptable range and the fluctuation seems small.

The actual method of quality control and comment on ICC's quality control are described as below.

V-3-2-3 Testing Method and Sampling

(1) Raw material

(i) Limestone, dacite, diolite

- Sampling point : the conveyors right after the crushers
- Frequency : at least once a shift
- Test items : moisture contents for each material $CaCO_3$% for limestone
- Composite sample : Daily samples of each material are collected and composited at the end of the week for complete chemical analysis.
- Others ; The quarries/deposits are visited every one or two weeks for sampling and testing purposes.

(ii) Pyrite cinder, gypsum

- Sampling point : truck
- Frequency : every truck load
- Test items : Moisture contents for daily composite sample
  Chemical analysis for weekly composite sample

(iii) Pozzolana

- Sampling point : truck
- Frequency : every truck-load
- Test items : Moisture contents for daily composite sample
  Complete chemical analysis and test for pozzolanic activity index for weekly composite sample

(2) In-process materials

(i) Slurry

Sampling point	Frequency	Test items
Raw mill	hourly	% $CaCO_3$
		% moisture contents
	every two hours	% fineness - 200M
Slurry and blending silo	two hours after filling up or collection;	% $CaCO_3$
		% moisture contents
	hourly samples until homogenized	% fineness - 200M
Slurry basins and paddle mixers	hourly	% $CaCO_3$
		% moisture contents
	every 4 hours	% fineness - 200M
	weekly composite	complete chemical analysis

(ii) Clinker

Sampling point	Frequency	Test items
Kiln	every half-hour	liter weight
	8-hour composite	free lime
	daily composite	complete chemical analysis
	every 4 hours	sieve analysis
	every 2 hours	temperature
Finish mill	hourly	liter weight
	8 hour composite	free lime
	every 2 hours	temperature

(iii) Coal

Sampling point	Frequency	Test items
Storage area	every truckload	proximate analysis
	composited daily	calorific value
		ash analysis
		% sulfur
Drag chain below coal silo	hourly	proximate analysis
	daily composite	calorific value
		ash analysis
		% sulfur
After coal mill/ dryer	hourly	fineness - 170M/2 hours
	8 hours composite	% moisture contents
	daily composite	proximate analysis
	weekly composite	calorific value
		% sulfur

(iv) End product (cement)

Sampling point	Frequency	Test items
Finish mill	*hourly*	*pat test (setting time)*
		boil test
		fineness(every 2 hours)
		Blaine specific surface (2 hours)
		LOI/2 hours
		temperature
	4 hours composite	% SO_3
	once per shift	circulating load
	daily composite	complete physical test
		partial chemical test
	weekly composite	complete physical and chemical analysis
Packhouse	every 2 hours	setting time, LOI, fineness and boil test
	daily composite	setting time and fineness
	weekly composite	complete physical and chemical analysis
Bulk silos	every truckload	setting time and fineness
	daily composite	setting time and fineness
	weekly composite	complete physical and chemical analysis

V-3-2-4 Control Standard Value of Major Items

ICC is adopting the control standard values of major items as follows.

(1) Slurry

Fineness -200M		82 ∿ 85%
Moisture content		34 ∿36%
$CaCO_3$		76.0 ∿76.2%

(2) Clinker

Liter weight		1,200 ∿ 1,300 g/ℓ
Chemical composition	SM	2.1 ∿ 2.4
	IM	1.5 ∿ 1.8
	LSF	0.90 ∿0.95

Note: IM is controlled according to burnability of raw meal.

(3) Coal

Fineness -170M	85%
Calorific value	>9,500 BTU/Lb

(4) Cement

SO_3	2.0 ∿ 2.3%
Fineness	3,000∿3,200 cm^2/g

V-3-2-5 Comments on Quality Control

(1) Quality of End Product (Cement)

The monthly average of the results of weekly test by ICC of bagged cement (Ordinary Portland Cement: OPC) produced in 1985 are shown in Table 5-3-1.

Table 5-3-1 Test Results of Bagged Cement

Month	Blaine (cm^2/g)	Compressive strength (kg/cm^2)			Moduli		
		3 day	7 day	28 day	C_3S	SM	LSF
1	3,590	164.0	233.7	313.4	45.7	2.04	0.91
2	3,360	158.0	230.6	302.0	43.5	2.14	0.90
3	3,320	164.9	228.5	308.4	50.3	1.94	0.94
4	3,420	189.4	250.8	319.3	53.1	2.12	0.94
5	3,410	181.0	233.6	305.1	43.4	2.27	0.90
6	3,480	158.2	226.3	320.0	42.0	2.03	0.90
7	3,330	156.3	230.0	320.6	41.0	2.12	0.89
8	3,390	157.4	243.5	327.0	37.9	2.25	0.94
9	3,380	167.0	252.8	344.0	40.8	2.23	0.90
10	3,480	169.9	254.2	333.5	43.8	2.09	0.90
11	3,630	152.3	220.4	311.0	37.1	2.24	0.87
12	3,700	164.4	229.0	332.8	41.4	2.30	0.88
Average	3,460	165.2	236.1	319.8	43.3	2.03	0.91

Further, the test results of ICC's OPC (1983∿85) conducted by the Central Laboratory of PHILCEMCOR are shown in Table 5-3-2.

Table 5-3-2 Test Results of ICC's Cement by PHILCEMCOR

Period	Order	No. of Sample		Blaine	Compressive strength (kg/cm^2)			Moduli		
		Physical	Chemical	(cm^2/g)	3day	7day	28day	C_3S (%)	SM	LSF
Nov'83 ∿ Oct'84	5/17	8	8	3,380	150	215	312	46	2.2	0.91
Jan'84 ∿ Dec'84	6/18	7	7	3,340	148	216	310	47	2.1	0.91
Feb'84 ∿ Jan'85	7/15	6	6	3,290	151	219	314	46	2.1	0.91
Mar'84 ∿ Feb'85	6/15	6	6	3,330	144	219	322	46	2.2	0.91
Apr'84 ∿ Mar'85	7/15	7	6	3,320	151	226	325	46	2.2	0.91
May'84 ∿ Apr'85	5/15	7	7	3,320	161	242	347	51	2.1	0.93

The test results of the spot sample of OPC collected during site survey is described in VI-1-2-2 and a part of it is shown in Table 5-3-3.

Table 5-3-3 Test Results of Spot Sample of OPC

Jan., 1985	Blaine (cm^2/g)	Compressive strength			Chemical analysis		
		3 day	7 day	28 day	C_3S	SM	LSF
Spot sample	3,170	165	250	353	58	2.3	0.95

Note: The compressive strength is converted to ASTM from JIS test. (kg/cm^2)

Comparing Table 5-3-1, 5-3-2 and 5-3-3, it can be pointed out that ICC's OPC is maintaining almost steady quality.

Especially 28 days strength is 320 kg/cm^2 on the average which is quite acceptable.

The order of quality is always occupying the 5th to 7th among 15 to 18 cement manufacturers in the Philippines.

(2) Chemical analysis of ICC

Monthly average chemical analysis of kiln feed and clinker by ICC in 1985 are shown in Table 5-3-5 and 5-3-6 respectively.

SM and IM in these tables are extracted and shown in Table 5-3-4.

Table 5-3-4 SM and IM of Kiln Feed and Clinker

(average in 1985)

	SM	IM
Kiln feed	1.90	2.39
Clinker	2.14	1.79
Coal ash	1.34	7.10

When clinker is formed, coal ash is mixed to kiln feed, and so judging from the moduli of coal ash of the above table, SM of clinker should be lower than that of kiln feed and IM of clinker higher than that of kiln feed.
However the results show adversely.

The reason of this lies in whether

(i) the samples of kiln feed and clinker don't represent process, or

(ii) the chemical analysis method is not proper.

This matter should be studied in the future.

The same kind of problem exists in the chemical analysis of raw materials.

(3) Preparation of slurry

The slurry made in a raw mill is transferred into a slurry silo where the chemical composition of slurry is checked and necessary correction is made.

The corrected slurry is transferred into a slurry basin from where it is conveyed to a kiln.

Since the slurry is mixed or corrected in the silo and basin, its homogeneity is very good and this is the feature of wet process.

After the renovation the process is converted to dry process and so in order to maintain the good homogeneity of raw meal, improvement of raw material feeders and construct of blending silo are required.

Table 5-3-5 Test Results of Raw Mix (Kiln Feed) [1985]

Sample	Chemical Composition (wt %)								Moduli		
	L.O.I	SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	SO_3	Total	SM	IM	HM
Feb. 2nd	35.48	12.82	5.22	1.70	44.13	0.66	0.16	100.17	1.85	3.07	2.24
15th	34.87	12.06	4.12	1.86	44.45	0.51	0.03	97.50	2.02	2.22	2.46
Mar. 15th	35.99	11.40	5.70	0.86	44.56	0.58	0.02	99.11	1.74	6.63	2.48
Apr. 30th	35.65	11.66	5.43	1.73	44.20	0.84	0.09	99.60	1.63	3.14	2.35
May 15th	35.46	14.36	4.10	1.90	43.49	0.40	0.03	99.74	2.39	2.15	2.14
29th	35.47	11.60	5.04	1.78	43.70	0.45	0.11	98.15	1.70	2.83	2.37
Jun. 15th	35.74	12.98	4.48	2.54	43.36	0.42	0.25	99.77	1.85	1.76	2.17
30th	34.95	11.62	2.41	2.37	44.13	0.57	0.05	96.10	2.43	1.02	2.69
Jul. 15th	35.91	12.42	3.31	2.01	42.50	0.31	0.18	96.44	2.33	1.65	2.40
Aug. 31st	35.87	11.26	4.85	2.53	43.37	0.90	0.09	98.87	1.53	1.92	2.33
Sep. 15th	35.39	12.44	4.29	2.03	43.46	1.46	0.09	99.16	1.97	2.11	2.37
30th	36.01	11.78	3.78	2.64	43.09	1.58	0.03	98.91	1.83	1.43	2.37
Oct. 15th	35.58	11.14	4.27	1.81	44.41	1.17	0.02	98.40	1.83	2.36	2.58
24th	36.12	11.54	4.45	2.71	42.63	1.31	0.11	98.87	1.61	1.64	2.27
Dec. 25th	35.53	11.68	4.18	2.18	44.09	1.26	0.16	99.06	1.84	1.92	2.44
Ave.	35.60	12.05	4.38	2.04	43.70	0.83	0.09	98.69	1.90	2.39	2.38
Sd	0.36	0.84	0.84	0.48	0.65	0.42	0.07	-	0.28	1.31	0.14

Table 5-3-6 Test Results of Clinker [1985]

Sample	Chemical Composition (wt %)								Moduli				F.CaO
	L.O.I	SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	SO_3	Total	SM	IM	HM	LSF	(wt%)
Jan. Ave.	0.33	21.08	7.04	4.05	66.05	0.91	0.58	100.04	1.90	1.73	2.05	94.31	1.73
Feb. Ave.	0.35	21.19	6.65	3.59	65.54	0.85	0.40	98.57	2.09	1.88	2.08	94.42	0.89
Mar. Ave.	0.30	21.23	6.63	3.78	65.79	0.60	0.35	98.68	2.03	1.75	2.08	94.46	0.63
Apr. Ave.	0.34	21.63	6.63	3.51	65.82	0.51	0.40	98.84	2.13	1.89	2.07	93.21	0.89
May Ave.	0.30	21.83	6.57	2.80	65.90	0.65	0.32	98.37	2.34	2.35	2.11	93.41	1.25
Jun. Ave.	0.39	21.57	6.15	3.60	65.19	0.92	0.34	98.16	2.21	1.71	2.08	93.21	1.25
Jul. Ave.	0.31	21.75	6.42	3.63	65.79	0.68	0.33	98.91	2.16	1.77	2.07	92.99	1.12
Aug. Ave.	0.42	21.65	6.09	3.87	65.12	1.16	0.24	98.55	2.17	1.57	2.06	92.75	1.03
Sep. Ave.	0.30	21.55	6.29	3.66	65.26	1.47	0.27	98.80	2.17	1.72	2.07	93.20	0.88
Oct. Ave.	0.34	21.38	6.40	3.81	65.18	1.56	0.35	99.02	2.09	1.68	2.06	93.34	1.17
Nov. Ave.	-	-	-	-	-	-	-	-	-	-	-	-	-
Dec. Ave.	0.40	22.30	6.06	3.30	65.57	1.36	0.37	99.36	2.39	1.84	2.07	91.79	1.17
Ave.	0.34	21.56	6.45	3.60	65.56	0.97	0.36	98.84	2.14	1.79	2.07	93.37	1.09
Sd	-	-	-	-	-	-	-	-	0.11	0.17	0.037	1.61	-

V-3-3 Pollution Control

V-3-3-1 Environment Control Standard in the Philippines and Actual Situation of ICC's Plant

In the Philippines, there is a standard stipulated in 1978 by National Pollution Control Commission, which consists of standard concerning air pollution, quality of water, noise and the like.

As far as ICC is concerned, any special control and countermeasures against pollution are not actually executed. Moreover, measurement of dust is not carried out having set up no control figure on it.

Such situation of ICC's plant may be coming from the reason why the plant is located fairly far from human habitations, where there are little problem in this regard.

V-3-3-2 Future Countermeasures

According to the cases experienced in the developing countries, it can be said that the environment problem will become apparent much earlier than generally expected.

Therefore, whether the plant renovation will be implemented or not, ICC should take countermeasures especially as to the following:

- Establishment of the measuring method
- Observance of the environmental standard

V-3-3-3 Except of the Pollution Control Regulations

The rules and regulations of pollution control issued by the National Pollution Control Commission on June 5, 1978 is attached hereto.

RULES AND REGULATIONS OF THE NATIONAL POLLUTION CONTROL COMMISSION (1978)

CHAPTER I GENERAL PROVISIONS AND ADMINISTRATIVE PROCEDURES

ARTICLE I General Provisions

Section 1. Title

These Rules and Regulations shall be cited as the Rules and Regulations of the National Pollution Control Commission (1978).

Section 2. Scope

These Rules and Regulations shall apply to all territories of the Philippines. They shall govern the proceedings before the Commission relative to hearings, plans, specifications, designs and other data for sewage works and industrial waste disposal systems, the filing of reports, the issuance of permits and other matters for the proper implementation and enforcement of P.D.984, as well as such other acts, decrees, letters of instructions and memorandum circulars as may now or hereafter be administered, enforced and/or implemented by the Commission.

Section 3. Construction

These Rules and Regulations shall be liberally construed to carry out the national policy to prevent, abate and control pollution and to assist the parties in obtaining just, speedy and inexpensive determination of every action, application or other proceedings.

Section 5. General Definitions

(i) "Pollutant" means any substance, whether solid, liquid or gaseous, which directly or indirectly;

(1) alters the quality of any segment of the receiving environment so as to affect or tend to affect adversely any beneficial use thereof;

(2) is hazardous or potentially hazardous to health;

(3) imparts objectionable odor, noise, temperature change, or physical, chemical or biological change to any segment of the environment; or

(4) is in excess of allowable limits or consentrations or quality standards specified, or in contravention of the condition, limitation or restriction prescribed in the permit issued by the Commission.

(j) "Pollution" means any alteration of the physical, chemical and biological properties of any water, air and/or land resources of the Philippines, or any discharge thereto of any liquid, gaseous or solid wastes, or any production of unnecessary noise, or any emission of objectionable odor, as will or is likely to create or to render such water, air and/or land resources harmful, detrimental or injurious to public health, safety or welfare, or which will adversely affect their utilization for domestic, industrial, agricultural, recreational or other legitimate purposes.

CHAPTER II AIR QUALITY STANDARDS AND RULES AND REGULATIONS RELATING TO AIR POLLUTION CONTROL

Section 58. Maximum Permissible Emission Standards for Visible Emission and Particulate Matter

(c) Any trade, industry, process, industrial plant or fuel-burning equipment emitting solid particles, except those referred to in paragraph (b) of these Regulations. The concentration of solid particles at the point of emission of existing sources shall not exceed 500 mg/scm. For new sources the maximum permissible emission limit for particulate matter shall be 300 mg/scm.

* scm: Nm^3

According to the Regulations, the concentration of solid particles, which has the most close relation with this type of renovation project, is as follows:

Not more than 500 mg/Nm^3	:	at the point of emission of the existing plant
Not more than 300 mg/Nm^3	:	at the point of emission of the new plant

V-3-4 Safety Control

At the cement plant it is general that various kinds of large and small machinery and equipment are operating night and day ranging from the mining to the shipping department, and in the wide premises of the plant, there are found few people working there.

Therefore, safety control is very important even when in periodical stoppage.

According to PHILCEMCOR, each of its member companies are to organize a safety control section, through which the safety control should be conducted in accordance with the safety control regulations.

Although there is no safety control section, ICC's plant has personnel in charge of safety control, who are now drafting safety control regulations based upon the mining safety control regulations.

Such being the actual situation of ICC's plant, data regarding safety as well as actual state of accidents are not recorded.

Accordingly, it is necessary to further enhance the employees' concern about the security through periodical security week and movement to minimize the accident.

As to the related facilities, ICC's plant has a clinic where nurses are always stationing for medical care in the event of accident.

V-3-5 Cost Control

As shown in Table 5-6-4, higher items of present production costs at ICC's plant are ₱320/ton (abt. ₱13/bag) for power, ₱270/ton (abt. ₱11/bag) for fuel and ₱100/ton (abt. ₱4/bag) apart from ₱230/t (abt. ₱9/bag) for depreciation.

At present, ICC's plant is not especially controlling in detail the usual costs, but it will be a matter of the first importance that the said higher items of costs for power and fuel should be reduced.

However, since reduction of the above costs for power and fuel are dominated respectively by the condition that power is supplied by MERALCO and the condition stemming from the nature of wet process, the efforts to reduce such costs will not be much effective.

Such being the situation, the survey of this time is considered to be significant in the sense of finding out a possibility to settle the above problem.

Incidentally, ICC's plant is now planning to generate the power utilizing the existing diesel engine at the plant.

This is one of countermeasures to reduce the costs, which will contribute to save the power to be consumed at the plant.

V-4 Training and Research Activities

V-4-1 Training

The training of employee has been conducted described as follows with much effect.

(1) 1980:
In-plant training for key person of operation
Standard training curriculum is attached to this article.

(2) 1982 ∿ 1983:
Three engineers were despatched to United Kingdom to be trained at the cement plant of Blue Circle.

Mr. Felnando	:	Production Div. Manager
Mr. Kabiling	:	Kiln Dept. Superintendent
Mr. Luna	:	Quality and Process Control Dept. Superintendent

(3) 1984:
One engineer was despatched to Turkey to attend the group training of cement technology course held by UNIDO.

Mr. Leyva	:	Mill Dept. Superintendent

Refer to the curriculum attached.

At present, ICC is not conducting any specific training, probably, due to the reason that they have not enough time to do it after the resumption of operation by new company.

V-4-2 Research Activities

As stated in V-8, ICC appoints 3 staffs of the quality and process control department to be in charge of research and development.

The present themes are as follows.

(1) Preparation of production of high early strength cement (Type III)

(2) Test of raw material collected from new raw material deposit

STANDARD TRAINING CURRICULUM FOR ENGINEERS AND OPERATORS

There is regular training of key personnel in the operations.

EXAMPLE:

(a) Local or In-Plant Training
In-Plant Training Program for KEY BURNING PERSONNEL

COURSE OUTLINE

Lesson 1.0 Introduction
- 1.1 Historical

Lesson 2.0 Portland Cement
- 2.1 What is portland cement?
- 2.2 What is portland cement clinker?
- 2.3 Chemical composition of the clinker and cement
- 2.4 Standards for portland cement

Lesson 3.0 Geology
- 3.1 Lime component
- 3.2 Siliceous component
- 3.3 Corrective materials

Lesson 4.0 The Burning of Portland Cement
- 4.1 Reactions occuring in cement burning
- 4.2 Thermo-chemistry of cement formation

Lesson 5.0 Liquid Fuels - Fuel Oils
- 5.1 Viscosity
- 5.2 Specific Gravity
- 5.3 Heating Value
- 5.4 Flame Temperature

5.5 Preparation of Fuel Oil
5.6 Combustion of Fuel Oil
5.7 Atomization of Fuel Oil

Lesson 6.0 Clinker Cooling
6.1 The capacity of clinker cooling
6.2 Soundness and clinker cooling
6.3 Cooling and resistance to chemical attack
6.4 Cooling and grindability of the clinker

Lesson 7.0 Kiln Lining
7.1 Mechanical strength
7.2 Refractoriness
7.3 Resistance to temperature changes
7.4 Resistance to chemical attacks
7.5 Thermal expansion or stability of volume
7.6 Thermal conductivity
7.7 Resistance to abrasion
7.8 Porosity
7.9 Installing refractory lining in rotary kilns

Lesson 8.0 Combustion Engineering
8.1 Combustion equations
8.2 Air required for combustion
8.3 Excess air in combustion
8.4 Heat balance in wet process kilns
8.5 Orsat analysis
8.6 Incomplete combustion
8.7 False Air

Lesson 9.0 S.O.P. of kiln Operation
9.1 Heating up of kiln after rebricking
9.2 Normal shutdown of kiln
9.3 How to handle power interruptions

9.4 How to handle equipment breakdown

9.5 Starting up after power outages or equipment breakdown

9.6 How to handle red spots

9.7 How to handle cycling operation

9.8 How to handle nose rings, fire rings, build-ups

Lesson 10.0 Proper operation of the EP

Lesson 11.0 Proper operation of the Clinker Coolers

(b) Some of our Engineers were sent abroad to attend CEMENT TECHNOLOGY COURSE OR GROUP TRAINING PROGRAM IN THE FIELD OF CEMENT INDUSTRY.

EXAMPLE:

In-Plant GROUP TRAINING GROUP sponsored by UNIDO.

CURRICULUM:

1. Industrial Feasibility Studies
    a) Feasibility Study
    b) Methodology of capacity and site selection
    c) Manpower Planning
    d) Time value of money
    e) Marketing and care study

2. Management
    a) Planning, organizing, controlling, informing and elaborating shift plans
    b) Supplying raw materials and fuels
    c) Calculating stocks
    d) Calculating material consumption

3. Principles of Cement Chemistry & Cement Grinding
    a) Phase diagram
    b) Raw mix preparation
    c) Reactions is Rotary Kiln and clinker specifications
    d) Temperature profile
    e) Types of milling circuits
    f) Types of dust collectors and electro filters
    g) Grindability and mill charging
    h) Chemistry of cement setting
    i) Mill commissioning operations and monitoring

4. Physical Operations
    a) Quarry operation, size reduction, stockpiling and homogenizing
    b) Raw meal grinding
    c) Rotary kiln operation
    d) Heat transfer, fuels and combustion
    e) Material and energy balance
    f) Gas-solid separations, cyclones and electrostatic precipitators

5. Electrical Installation & Maintenance

   a) Structural elements of electrical engineering
   b) Electrical motors, controls and factor improvement
   c) Maintenance of electrical equipments

6. Instrumentation & Process Control

   a) Maintenance and repairment
   b) Electrical energy saving
   c) Measurement and control system

7. Quality Assurance

   a) Quality standards, clinker chemistry
   b) Control of product and production

8. Maintenance

   a) Policy and background of maintenance in general
   b) Maintenance strategy in cement plants
   c) Maintenance organization in cement plants
   d) Maintenance of mechanical equipment
   e) Spare parts and control stock

V-5 Purchasing Practice and Inventory Control of Spare Parts

Inventory control of spare parts is a serious matter in plant operation. The inventory is determined from the frequency of spare parts replacement and the length of procurement period.

At the plant, a table showing the frequency of spare parts replacement for each equipment is prepared which gives the standard amount of spare parts consumption, but actually inventory of many parts were short while inventory of other parts were excessive.

The necessary inventory for ordinary consumable parts is relatively easy to determine, but durable parts are more difficult and must be determined referring to records of past repairs. Generally, the operators will desire a large amount of inventory to feel safe, however, keeping a large inventory is expensive and should be avoided. Therefore, replacements of spare parts should be constantly recorded and reviewed to update the standard amount of spare parts consumption to reflect the actual condition of the plant.