6-8 Preliminary Study of Water Supply

6-8-1 Present Condition

Water is supplied from the Irrawaddy 10 km away from the plant and sent to the plant through a pipeline for both drinking and industrial water. Drinking water is filtered and purified at the water purification plant located close to the plant and supplied to company houses and the plant. This water purification plant is not included in this expansion project since it has a sufficient capacity even after the plant is expanded.

6-8-2 Study of Water Consumption

(1) Water consumption of existing facilities

(i) Cooling water

Wet type raw grinding mill	23.6 t/h
Cement mill	17.28 "
Kiln	67.16 "
Compressor	27.29 "
Total	135.33 t/h (3,247.92 t/d)

Amount of cooling water required = 3,247.92 x 0.2 = 650 t/d

(ii) Water for mixing raw materials (40%) = 46.66 t/h

46.66 t/h x 19 h/d ≒ 900 t/d

(iii) Drinking water

0.152 t/man x 1,500 men ≒ 230 t/d

(iv) Total water consumption

650t + 900t + 230t = 1,780 t/d

(2) Estimated water consumption by additional facilities

Cooling water	650t
Water for mixing raw materials	900t
Drinking water	200t
Total	1,750t/d

6-8-3 Study of Water Intake Pump

(1) Capacity of existing water intake pump

Capacity	100 t/h
Head	130 m
Motor	75 kW
No. of pumps	2

(2) Water pipe: 200 mm dia. x 9.6 km

6-8-4 Study of Water Pipe

° Q: Required capacity 1,780 + 1,750 = 3,530 t/d (0.041 m^3/s)

° A: Cross section of water pipe $0.7854 \times 0.2^2 = 0.031\ m^2$

° V: Velocity (m/s)

° hf: Lost water head (m)

$$V = \frac{0.041}{0.031} = 1.32\ m/s < 2\ m/s,\ OK$$

$$hf = 0.02 \times \frac{9,600 \times 1.2}{0.2} \times \frac{1.32^2}{2 \times 9.8} = 103\ m < 130\ m,\ OK$$

Q = 3,530 t/d > 100 t/h x 24 = 2,400 t/d Not sufficient

As aforementioned, the capacity of existing pumps is insufficient. And in addition water of the Irrawady contains much mud. It is expected that the resistance of the pipeline may increase with the segmentation of mud in the pipes. In view of this, it is desirable to install additional pumps and a new pipeline. The water consumption is considered to be reasonable at the figure of 2 t/t-cement.

6-8-5 Study of the Quantity of Flow of the Irrawady

The water level of the Irrawady varies considerably in the dry season and the rainy season. The records of Kchangin area are as follows:

° Highest water level: 23.42m (based on sea level)

° Lowest water level: 10.48m

° Difference in level: 12.94m

Especially in the rainy season, the condition of river bed severely changes as the river carries down a large amount of silt.

According to the corsssectional drawing of the river and the data we obtained on the velocity of the river measured by the Burmese Government during dry season in Dec. 1977 and Jan. 1978, we now make a review of the quantity of flow in the vicinity of the mill water intake point. (Refer to attached drawing C-14 and C-15.)

Table 6-8-1

Date of measurement	Crosssectional area of river A (m^2) ... (1)	Velocity V (m/sec) ... (2)	(1) x (2)
Dec. 1977	2,280	0.45	1,026
Jan. 1978	2,304	0.45	1,036

The above figures require a certain compensation due to the reasons that the velocity given in the above data show the surface velocity and the velocity of flowing water at the edge portion of a river is slower than that of the other portions of the river.

Assuming compensation rate is 30%, the following can be obtained.

Dec. 1977 $Q = 1,026 \times (1-0.3) \fallingdotseq 720\ m^3/sec.$

$(\fallingdotseq 2.6 \times 10^2\ m^3/h)$

Jan. 1978 $Q = 1,036 \times (1-0.3) \fallingdotseq 725\ m^3/sec.$

$(\fallingdotseq 2.6 \times 10^6\ m^3/h)$

The above estimation shows no problem in collecting water of about 150 m^3/h which will be required by the plant after expansion from this river even in the dry season.

6-9 Supply of Fuel (Natural Gas)

The mill is supplied with natural gas from Shwepyitha gas field of Miyama Oil Corporation. The gas field is situated in the downstream area of the Irrawady about 8 miles away from Kyangin and it has abundant gas deposits.

At present, Shwepyitha gas field has 126 wells and of those 44 wells are actually being used.

Collected natural gas is sent to a control room through a pipeline of 8" in diameter at a pressure of 400 psi (28 kg/cm^2), and gas is reduced in volume and pressure at the control room and then sent to Kyangin Cement Mill through an exclusive pipeline of 6" in diameter at a pressure of 100 psi (7 kg/cm^2). In addition, gas is supplied to a thermal power plant (16,250 kW x 3 sets) from where power is supplied to the cement mill.

Judging from the abundant gas deposit in the above gas field there will be no problem in obtaining fuel even after the expansion of the plant.

The preparation of natural gas pipelines is not within the scope of the expansion project. The plant will simply receive the supply of gas from MOC.

6-10 Electric Power

(1) Present situation of power supply in Kyangin

A gas turbine power generating plant has been constructed in Myanaung for the purpose of promoting the development of industries in the west bank area of the Irrawady and the power plant utilizes natural gas supplied from Shwe pyitha gas field situated about 20 km to the east of the Kyangin cement mill. The mill directly receives power from the power plant through an extra-high voltage power transmission line.

The power generating plant (Myanaung Gas Turbine Power Generating Plant of the Electric Power Corporation) has a total capacity of 48,750 kW with 3 units of 16,250 kW power generator equipped and it has a sufficient capacity to supply power to Kyangin cement mill after its expansion.

(2) Power required by this project and cost of electric energy

The power unit consumption and average power of the existing facilities are 130 kWh/t-cl' and 4,300 kW respectively. The same figures can be applied to the additional facilities since they are the same production capacity.

The rate of power consists of only the charge for electric energy and no demand charge is payable. Electric energy charge is 0.17 KS/kWh. Consequently, the cost of electric energy for the additional facilities will be as follows:

0.17 KS/kWh x 130 kWh/t-cl' = 22.10 KS/t-cl'

= 21.15 KS/t-cement

(3) The electric system to be employed in this project is to be the same as that in the existing plant

Extra-high voltage (incoming)	AC 66 kV, 50 Hz, 3 phase 3 wire system, 1 circuit
High voltage	AC 6.6 kV, 50 Hz, 3 phase 3 wire system
Low voltage motor power	AC 400 V, 50 Hz, 3 phase 3 wire system
Control, lighting	AC 230 V, 50 Hz, single phase 2 wire system DC 100 V

6-11 Specifications of Main Machinery and Equipment

6-11-1 Limestone Primary Crushing Department at Quarry Site

Table 6-11-1

No.	Name of Equipment	Description	Q'ty
A-0	Unloading Hopper	° Type: Concrete construction ° Size: 5mW x 5mL x 4mH ° Accessories: Hopper Liner Chain Curtain	1
A-1	Apron Feeder	° Capacity: Nor. 300t/h Max. 400t/h ° Size: 2,200mmW x 6,000mmL ° Electric motor: 37kW VSM ° Accessory: Scraper	1
A-2	Scalping Screen	° Capacity: Nor. 300t/h Max. 400t/h ° Size: 2,130mmW x 3,600mmL (7' x 12') ° Electric motor: 30kW IM	1
A-3	Gyratory Crusher	° Capacity: 300t/h ° Feed opening size: 1,070mm x 2,750mm ° Feed size: -1,000mm ° Product size: -150mm ° Electric motor: 260kW IM	1
A-4	Belt Conveyor	° Capacity: Nor. 300t/h Max. 400t/h ° Size: 1,050mmW x 40mL x 3.5mL ° Electric Motor: 11kW GM	1
A-5	Belt Conveyor	° Capacity: Nor. 300t/h Max. 400t/h ° Size: 750mmW x 365ml x -22mH ° Electric Motor: 30kW GM ° Accessory: Two-way chute	1
A-6	Dust-Collector	° Capacity: 300m^3/min. ° Size: 1,500mmø Cyclone ° Accessory: Rotary feeder 0.4 kW GM	1
A-7	Induced Fan	° Capacity: 350 m^3/min. 150mm Aq ° Electric Motor: 15kW IM	1
A-8	Vibrating Screen	° Capacity: Nor. 300t/h Max. 400t/h ° Size: 1.5mW x 3.6mL ° Grizzly opening: 200mm ° Electric Motor: 19kW IM	1

(to be continued)

No.	Name of Equipment	Description	Q'ty
A-9	Dust Collector	° Capacity: 300m^3/min. ° Size: 1,500mm dia cyclone ° Accessory: Rotary feeder 0.4kW GM	1
A-10	Induced Fan	° Capacity: 350m^3/min. 150mmAq ° Electric Motor: 15kW IM	1
A-11 A-12	Belt Conveyor	° Capacity: 300 t/h ° Size: 750mmW x 80mL x 12mH ° Electric Motor: 30kW GM	2
A-13	Belt Conveyor	° Capacity: 300t/h ° Size: 750mmW x 58mL ° Electric Motor: 15kW GM ° Accessory: Tripper with 2.2kW GM	1
A-14	Ore-Bin	° Type: Concrete construction ° Size: 6mW x 60mL ° Accessory: Gate with 2 air cylinder	10
A-15	Air Compressor	° Capacity: 6.57m^3/min, 7kg/cm^2 ° Electric Motor: 30kW IM ° Accessories: 1-Air cylinder 1-After cooler 1-Air filter, valves	2
A-16	Belt Conveyor	° Capacity: Nor. 300t/h Max. 400t/h ° Size: 750mmW x 30mL x 2.5mH ° Electric Motor: 11kW GM	1
A-17	Belt Conveyor	° Capacity: Nor. 300t/h Max. 400t/h ° Size: 750mmW x 45mL x 2mH ° Electric Motor: 11kW GM	1
A-18 A-19	Belt Conveyor	° Capacity: Nor. 300t/h Max. 400t/h ° Size: 750mmW x 150mL ° Electric Motor: 22kW GM ° Accessories: Tripper with 2.2kW GM	2
A-20 A-21	Limestone Open Stock Yard	° Capacity: 50,000 tons ° Pile size: 35mW x 180mL	2
A-22 A-23	Shovel Loader	° Capacity: 2.6m^3/bucket cap'. ° Engine Output: 205PS	2
A-24	Feed Hopper	° Type: Steel construction ° Capacity: 15 tons ° Size: 4mW x 3.5mL x 1.5mH	1

(to be continued)

No.	Name of Equipment	Description	Q'ty
A-25	Belt Feeder	° Capacity: 10 - 100 t/h ° Size: 750mmW x 5mL x 1mH ° Electric Motor: 3.7kW VSM	1
A-26	Belt Conveyor	° Capacity: 100t/h ° Size: 750mm x 75mL x 14mH ° Electric Motor: 30kW GM	1
A-27	Electric Hoist	° Capacity: 5 tons 12m lift ° Electric Motor: 6.2kW Hoisting 0.8kW Travelling ° Accessories: Hoist rail	1

6-11-2 Limestone Secondary Crushing Department

Table 6-11-2

No.	Name of Equipment	Description	Q'ty
B-1	Unloading Hopper	° Type: Steel construction ° Size: 6mW x 60mL x 5mH ° Accessories: Vibrating Motor	20
B-2	Vibrating Feeder	° Capacity: 100t/h ° Size: 750mmW x 1,200mmL ° Electric Motor: 1.5kW	20
B-3	Belt Conveyor	° Capacity: 400t/h ° Size: 750mmW x 62mL ° Electric Motor: 11kW GM	1
B-4	Belt Conveyor	° Capacity: 400t/h ° Size: 750mmW x 7mL x 1.5mH ° Electric Motor: 7.5kW GM	1
B-5	Belt Conveyor	° Capacity: 400t/h ° Size: 750mmW x 106mL x 23.5mH ° Electric Motor: 45kW GM	1
B-6	Belt Conveyor	° Capacity: 400t/h ° Size: 750mmW x 15mL ° Electric Motor: 5.5kW GM	1
B-7 B-8	Vibrating Screen	° Capacity: 200t/h ° Size: 1.2mW x 3.6mL ° Electric Motor: 7.5kW IM	2
B-9 B-10	Impeller Breaker	° Capacity: 150t/h ° Product size: 20mm under 80% ° Electric Motor: 190kW IM	2
B-11	Belt Conveyor	° Capacity: 400t/h ° Size: 750mmW x 15mL x 1.5mH ° Electric Motor: 7.5kW GM	1

(to be continued)

No.	Name of Equipment	Description	Q'ty
B-12	Belt Conveyor	° Capacity: 400t/h ° Size: 750mmW x 100mL x 25mH ° Electric Motor: 65kW GM	1
B-13	Belt Conveyor	° CapacityL 400t/h ° Size: 750mmW c 215mL ° Electric Motor: 22kW GM ° Accessory Tripper with 2,2kW GM	1
B-14	Limestone Storage Hall	° Type: Roofed storage Hall ° Capacity: 100,000 tons ° Hall size: 50mW x 200mL x 28mH	1
B-15	Reclaimer	° Type: Cantry type double scraper ° Capacity: 50 - 91t/h ° Electric Motor 18.5kW for main scrapper drive 5.5kW for auxiliary scraper drive 3.7/1.23kW for main hoisting 2.2/0.73 kW for auxiliary hoisting 2.2kW varying speed for traveling slow 3.7kW for travelling high 0.75kW for grease pump	1
B-16	Belt Conveyor	° Capacity: 100t/h ° Size: 600mmW x 223mL x 1.5mH ° Electric Motor: 7.5kW GM	1
B-17	Belt Conveyor	° Capacity: 100t/h ° Size: 600mmW x 38mL x 10mH ° Electric Motor: 7.5kW GM	1
B-18	Belt Conveyor	° Capacity: 100t/h ° Size: 600mmW x 55mL x 5mH ° Electric Motor: 5.5kW GM	1
B-19	Belt Conveyor	° Capacity: 100t/h ° Size: 600mmW x 85mmL ° Electric Motor: 5.5kW GM ° Accessory: Tripper with 2.2kW GM	1
B-20	Dust Collector	° Capacity: 600m^3/min ° Size: 2 x 1500mm dia Cyclone ° Accessory: Rotary feeder with 0.4kW GM	1
B-21	Induced Fan	° Capacity: 650m^3/min 200mmAq ° Electric Motor: 27kW IM	1
B-22	Belt Conveyor	° Capacity: 400t/h ° Size: 750mmW x 20mL x 2mH ° Electric Motor: 11kW GM	1

6-11-3 Gypsum Crushing Department

Table 6-11-3

No.	Name of Equipment	Description	Q'ty
C-1	Feed Hopper	° Type: Steel Construction ° Capacity: 15 tons ° Size: 4mW x 3.5mL x 1.5mH	1
C-2	Apron Feeder	° Capacity: 20t/h ° Size: 750mmW x 5mL x 1.3mH ° Electric Motor: 3.7kW GM	1
C-3	Gypsum Crusher	° Type: Jaw Crusher ° Capacity: 20t/h ° Product size: 30mm under 80% ° Electric Motor: 55kW IM	1
C-4	Belt Conveyor	° Capacity: 25t/h ° Size: 600mmW x 8mL x 1mH ° Electric Motor: 1.5kW GM	1
C-5	Bucket Elevator	° Capacity: 25t/h ° Size: 250mmW x 10mH ° Electric motor: 1.5kW GM	1
C-6	Dust Collector	° Capacity: 100m^3/min ° Size: 850mm dia Cyclone ° Accessory: Rotary Feeder with 0.4kW GM	1
C-7	Induced Fan	° Capacity: 120m^3/min x 150mmAq ° Electric Motor: 7.5kW IM	1

6-11-4 Limestone Transport from Quarry Site to Plant Site

Table 6-11-4

No.	Name of Equipment	Description	Q'ty
D-1	Diesel Locomotive	° Rail gauge: 1000mm ° Tractive force: 7.7 tons ° Speed: 22km/h ° Diesel engine: 215PS at 2000 r.p.m.	2
D-2	Ore Car	° Rail gauge: 1000mm ° Loading capacity: 15 tons	24

6-11-5 Raw Material Storage Department

Table 6-11-5

No.	Name of Equipment	Description	Q'ty
E-1	Clay Washing Basin	° Type: Concrete Construction ° Size: 10m dia x 2.5m depth	1

(to be continued)

No.	Name of Equipment	Description	Q'ty
E-2	Clay Tank	° Type: Concrete Construction ° Size: 1.7m x 7.75m x 3m depth 1.9m x 5.5m x 3.2m depth	1
E-3	Clay Washing Mill	° Type: Rotary rake type ° Capacity: 45t/h (Dry material) ° Rake size: 9.4mL x 1.75mH ° Electric Motor: 5.5kW IM	1
E-4	Slurry Pump	° Capacity: 0.7m^3/min 40mAq ° Electric Motor: 30kW	2
E-5	Water Pump	° Capacity: 10t/h 30mAq ° Electric Motor: 3.7kW	2
E-6	Slurry Pump	° Capacity: 10t/h 30mAq ° Electric Motor: 2.2kW	2
E-7	Storage Hall (Extension)	° Type: Concrete Construction ° Extension Size: 25mW x 25mL x 21.5mH ° Capacity: 9000 tons (Limestone)	1
E-8	Overhead Travelling-crane	° Hoisting Load: 8 tons ° Lifting height: 15.5m ° Electric Motor: 2 x 37kW for hoisting 30kW for travelling 7.5kW for traversing ° Incl.: Crane rail with fittings	1

6-11-6 Raw Material Grinding Department

Table 6-11-6

No.	Name of Equipment	Description	Q'ty
F-1	Mill Feed Hopper for Limestone	° Type: Concrete Construction ° Size: 6mW x 6mL x 2.5mD ° Steel Plate Liner for mill feed hopper ° Accessories" Vibrators, Gates	2
F-2	Mill Feed Hopper for Clay and Additive	° Type: Concrete Construction ° Size: 6mW x 6mL x 2.5mD ° Steel Plate Liner for mill feed hopper ° Accessories: Vibrators, Gates	2

(to be continued)

No.	Name of Equipment	Description	Q'ty
F-3	Mill Feed Hopper for Limestone	° Type: Concrete Construction ° Size: 6mW x 6mL x 2.5mD ° Steel Plate Liner for mill feed hopper ° Accessories: Vibrators, Gates	1
F-4	Mill Feed Hopper for Clay and additive	° Type: Concrete Construction ° Size: 6mW x 6mL x 2.5mD ° Steel Plate Liner for mill feed hopper ° Accessories: Vibrators, Gates	2
F-5	Table Feeder for Limestone	° Capacity: 8-40t/h ° Size : 1500mm dia ° Electric motor: 3.7kW GM	2
F-6	Table Feeder for Clay	° Capacity: 2-10t/h ° Size: 1100mm dia ° Electric Motor: 2.2kW GM	1
F-7	Table Feeder for additive	° Capacity: 1-5 t/h ° Size: 800mm dia ° Electric Motor: 1.5kW GM	1
F-8	Table Feeder for Limestone	° Capacity: 8-40t/h ° Size: 1500mm dia ° Electric motor: 3.7kW GM	2
F-9	Table Feeder for Clay	° Capacity: 2-10t/h ° Size: 1100mm dia ° Electric motor: 2.2kW GM	1
F-10	Table Feeder for Additive	° Capacity: 1-5t/h ° Size: 800mm dia ° Electric motor: 1.5kW GM	1
F-11 F-12	Belt Conveyor	° Capacity: 40t/h ° Size: 600mmW x 10mL x 1mH ° Electric motor: 2.2kW GM	2
F-13 F-14	Belt Conveyor	° Capacity: 40t/h ° Size: 600mmW x 10mL x 1mH ° Electric motor: 2.2kW GM	2
F-15 F-16	Raw Grinding Mill	° Type: Open circuit side drive type ball mill ° Capacity: 35t/h (Dry material) ° Fineness: 7% residue on 170mesh Sieve ° Size: 2.5m I.D. x 12.5mL ° Electric motor: 800kW x 750 r.p.m. ° Mill reducer: Power transmission 800kW Reduction ratio 735/172r.p.m.	2

(to be continued)

No.	Name of Equipment	Description	Q'ty
		° Grinding media: Quantity: 100 tons of forged steel ball (125%) ° Inching device: 11kW IM with breake	
F-17	Electric Hoist	° Capacity: 2 tons ° Lifting height: 12m ° Electric motor: 3.7kW for Hoisting 0.75kW for travelling ° 1 set of travelling rail	1
F-18 F-19	Grit Arrester	° Size: 400mmSq. x 1000ml ° Electric motor: 0.75kW GM	2
F-20	Slurry Pump	° Capacity: 0.7m^3/min 42mAq ° Electric motor: 37kW IM	3
F-21	Slurry Distributer	° Type: Totary type ° Electric motor: 0.4kW GM 0.75kW GM	1
F-22	Slurry Blending Tank (Slurry Silo)	° Type: Concrete Constructio- ° Capacity: 75m^3 x each ° Size: 8m dia x 20mH	6
F-23	Slurry Basin	° Type: Concrete Construction ° Capacity: 6900m^3 ° Size: 35m dia x 8mH	1
F-24	Slurry Pump	° Capacity: 2.2m^3/mm 30mAq ° Electric motor: 45kW IM	3
F-25	Slurry Agitator	° Type: Vane and airblow system ° Electric motor: 22kW for bridge drive 5.5kW x 4 sets for Vane drive 0.75 kW for airblow	1
F-26	Slurry Pump	° Capacity: 0.7m^3/min 42mAq ° Electric motor: 37kW IM	3
F-27	Air Compressor for Slurry Blending	° Capacity: 15.84m^3/min ° Pressure: 7kg/cm^2 ° Electric motor: 75kW IM ° Accessories: Suction air filter After cooler Air receiver	7

6-11-7 Rotary Kiln Department

Table 6-11-7

No.	Name of Equipment	Description	Q'ty
G-1 G-2	Slurry Distributor	° Type: Motorized sluice valve ° Size: 125mm dia	2
G-3 G-4	Slurry Feeder	° Type: Scoop wheel type ° Capacity: 400 tons of clinker per day ° Size: 1000mm dia of bucket ° Electric motor: 1-3.7kW for feeder 1-0.4kW for winch	2
G-5 G-6	Rotary Kiln	° Type: Wetprocess with 6 support ° Capacity: 400tons clinker per day ° Size: 3.3m dia x 125mL of shell ° Electric motor: 120kW ° Kiln reducer: 120kW x 1/98.6 ° Emergency driving device: 15kW IM ° Refractories: For rotary Kiln: 415 tons/each For Kiln hood: 22.3 " For Snorke camber: 22.2 "	2
G-7 G-8	Cooling Fan for Kiln Discharge End	° Capacity: 175m^3/min 150mmAq ° Electric motor: 11kW IM	2
G-9 G-10	Dust Coolector	° Type: Multiclone ° Capacity: 2000m3/min at 180°C ° Accessory: Air-lock damper with 1.5kW GM	2
G-11 G-12	Induced Fan	° Capacity: 2350m^3/min at 180°C ° Pressure: 250mmAq ° Electric motor: 170kW IM	2
G-13	Kiln Chimney	° Type: Steel Construction ° Size: 3.5m dia x 60mH ° Refractory for Kiln chimney	1
G-14 G-15	Screw Conveyor	° Capacity: 5t/h ° Size: 250mm dia x 2.8mL ° Electric motor: 1.5kW GM	2
G-16 G-17	Bucket Elevator	° Capacity: 10t/h ° Size: 350mmW x 21.8mH ° Electric motor: 3.7kW GM	2
G-18 G-19	Screw Conveyor	° Capacity: 10t/h ° Size: 250mm dia x 2.2mL ° Electric motor: 1.5kW GM	2

(to be continued)

No.	Name of Equipment	Description	Q'ty
G-20 G-21	Gas Burning Equipment	◇ Capacity: Max. 4300Nm^3/h ◇ Pressure: 2.8kg/cm^2	2
G-22 G-23	Primary Air Blower	◇ Capacity: 120m^3/min at 1200mmAq ◇ Electric motor: 45kW IM	2

6-11-8 Clinker Cooling Department

Table 6-11-8

No.	Name of Equipment	Description	Q'ty
H-1 H-2	Air Quenching Cooler	◇ Type: Horizontal grate type ◇ Capacity: 400 tons clinker per day ◇ Size: 1.68m grate width x 12mL ◇ Clinker temp.: 35°C plus ambient temperature at 400t/h for clinker under 10mm ◇ Electric motor: 15kW for main drive 3.7kW x 2 sets for chain conveyor ◇ Refractory material: Quantity: 53,000kg/each	2
H-3 H-4	Cooling Fan	◇ Capacity: 1100m^3/min at 45°C ◇ Pressure: 250mmAq ◇ Electric motor: 75kW IM	2
H-5	Dust Collector	◇ Type: Multiclone ◇ Capacity: 900m3/min at 180°C ◇ Accessory: Air-lock damper with 0.75kW GM	2
H-7 H-8	Induced Fan	◇ Capacity: 900m^3/min at 180°C ◇ Pressure: 150mm Aq ◇ Electric motor: 45kW IM	2
H-9 H-10	Screw Conveyor	◇ Capacity: 5t/h ◇ Size: 200mm dia x 5mL ◇ Electric motor: 1.5kW GM	2
H-11 H-12	Drag Chain Conveyor	◇ Capacity: 20t/h (Max.) 45t/h ◇ Size: 650mmW x 9mL ◇ Electric motor : 3.7kW GM	2
H-13 H-14	Bucket Elevator	◇ Capacity : 20t/H (Max.) 45t/h ◇ Size : 300mmW X 30.2mH ◇ Electric motor: 5.5kW GM	2
H-15	Belt Conveyor	◇ Capacity : 60t/h ◇ Size : 600mmW x 9mL ◇ Electric motor: 1.5kW GM	1

(to be continued)

No.	Name of Equipment	Description	Q'ty
H-16	Belt Scale	° Capacity : 12 - 60t/h ° Accuracy : 1/200	1
H-17	Belt Conveyor (modification)	° Capacity : 100t/h ° Size : 600mmW x 90.5mL ° Electric motor : 5.5kW GM ° Accessory : Tripper with 2.2kW GM	1
H-18	Storage Hall (Extension)	° Type : Concrete Construction ° Extenstion size : 25mW x 50mL x 21.5mH ° Capacity : 18000 tons (clinker)	1

6-11-9 Finish Grinding Department

Table 6-11-9

No.	Name of Equipment	Description	Q'ty
I-1	Mill Feed Hopper for Clinder	° Type: Concrete Construction ° Size : 6mW x 6mL x 7m depth ° Accessory : Hopper gate	1
I-2	Mill Feed Hopper for Gypsum	° Type : Concrete Construction ° Size : 6mW x 6mL x 7m depth ° Accessory : Hopper gate	1
I-3	Mill Feed Hopper for Clinker	° Type : Concrete Construction ° Size : 6mW x 6mL x 7m depth ° Accessory : Hopper gate	1
I-4	Mill Feed Hopper for Gypsum	° Type : Concrete Construction ° Size : 6mW x 6mL x 7m depth ° Accessory : Hopper gate	1
I-5	Weighing Feeder for Clinker	° Capacity : 8-40t/H ° Size : 750mm x 2.5mL ° Electric motor: 1.5kW Variable speed motor	1
I-6	Weighing Feeder for Gypsum	° Capacity : 0.6 - 3tH ° Size : 750mmW x 2.5mL ° Electric motor: 0.4kW Variable speed motor	1
I-7	Weighing Feeder for Clinker	° Capacity : 8-40t/h ° Size : 750mmW x 2.5mL ° Electric motor: 1.5kW Variable speed motor	1
I-8	Weighing Feeder for Gypsum	° Capacity : 0.6 - 3t/h ° Size : 750mmW x 2.5mL ° Electric motor: 0.4kW Variable speed motor	1

(to be continued)

No.	Name of Equipment	Description	Q'ty
I-9 I-10	Belt Conveyor	° Capacity : 50t/h ° Size: 600mmW x 9.4mL x 1.4mH ° Electric motor: 1.5kW GM	2
I-11 I-12	Finish Grinding Mill	° Type : Closed circuit side drive ° Capacity : 22.5 t/h ° Fineness: 3% residue on 490mesh sieve ° Size : 2.75m dia x 8.219mL ° Electric motor:800kW x 750r.p.m. ° Mill reducer: Power transmission 800kW Reduction ratio 735/172 r.p.m. ° Grinding media: Quantity : 85 tons of forged steel ball (125%) ° Inching device : 11kW IM with brake	2
I-13 I-14	Air Sliding Conveyor	° Capacity : 150t/h ° Size : 350mmW x 4mL x 6° slope	2
I-15 I-16	Air Sliding Conveyor	° Capacity : 150t/h ° Size : 350mmW x 3.5mL x 6° slope	2
I-17 I-18	Bucket Elevator	° Capacity : 150t/h ° Size : 600mmW x.23mH ° Electric motor : 19kW GM	2
I-19	Air Sliding conveyor	° Capacity : 150t/h ° Size : 350mmW x 7mL x 6° slope	2
I-21 I-22	Forced Blower	° Capacity : 20m³/min ° Pressure : 600mmAq ° Electric motor: 3.7kW IM	2
I-23 I-24	Air Separator	° Type : Centrifugal ° Capacity : Nor. 22.5t/h Max. 34t/h	2
I-25 I-26	Screw Conveyor	° Capacity : 50t/h ° Size : 500mm dia x 2.75mL ° Electric motor; 2.2kW GM	2
I-27 I-28	Dust Collector	° Type : Bag filter ° Capacity : 600m³/min at 80°C ° Total area: Approx. 605m²	2
I-29 I-30	Induced Fan	° Capacity : 600m³/min at 80°C ° Pressure : 300mmAq ° Electric motor : 55kW IM	2

6-11-10 Cement Transportation Department

Table 6-11-10

No.	Name of Equipment	Description	Q'ty
J-1	Belt Conveyor	° Type : 45° U-trough type ° Capacity : 60t/h ° Size : 600mmW x 150mL x 15mH ° Electric motor : 15kW GM	1
J-2	Bucket Elevator	° Capacity : 60t/h ° Size : 450mmW x 27mH ° Electric motor : 11kW GM ° Accessory : Two-way chute	1
J-3	Chain Conveyor	° Capacity : 60t/h ° Size : 270mmW x 25mL ° Electric motor : 5.5kW GM	1
J-4	Chain Conveyor	° Capacity : 60t/h ° Size : 270mmW x 30mL ° Electric motor : 7.5kW GM	1
J-5	Chain Conveyor	° Capacity : 60t/h ° Size : 270mmW x 18mL ° Electric motor : 3.7kW GM	1
J-6	Chain Conveyor	° Capacity : 60t/h ° Size : 270mmW x 30mL ° Electric motor : 7.5kW GM	1
J-7	Cement Silo	° Type: Concrete Construction ° Capacity : 300 tons ° Size : 12m dia x 26mH	6
J-8	Air Sliding Conveyor (complete et for silo)	° Type : open type ° Capacity : 200t/h ° Size : 250mmW x 90m (Total length) ° Accessory : Air control unit	6
J-9 - J-11	Forced Blower	° Capacity : 25m^3/min ° Pressure : 3000mmAq ° Electric motor: 22kW IM	3
J-12 - J-17	Air Sliding Conveyor	° Capacity : 200t/h ° Size : 400mmW x 8mL x 6° slope ° Accessory : Flow control gate	6
J-18- J-20	Forced Blower	° Capacity : 12m^3/min ° Pressure : 600mmAq ° Electric motor: 2.2kW IM	3
J-21 J-22	Dust Collector	° Type : Bag filter ° Capacity : 100m^3/min at 80°C ° Total area: 100m^2	2

(to be continued)

No.	Name of Equipment	Description	Q'ty
J-23 J-24	Induced Fan	° Capacity: 120m^3/min at 80°C ° Pressure: 200mmAq ° Electric motor: 7.5kW IM	2
J-25	Chain Conveyor	° Capacity: 200t/h ° Size: 500mmW x 55mL ° Electric motor: 37kW GM	1
J-26	Chain Conveyor	° Capacity: 200t/h ° Size: 500W x 50mL x 2.5mH ° Electric motor: 55kW GM ° Accessory: Motorized gate, two way chute	1

6-11-11 Packing & Loading Department

Table 6-11-11

No.	Name of Equipment	Description	Q'ty
K-1 K-2	Bucket Elevator	° Capacity: 200t/h ° Size: 750mmW x 25mH ° Electric motor: 30kW GM ° (Incl. modification of existing one)	1 + 1
K-3	Vibrating Screen	° Capacity: 200t/h ° Size: 1500mmW x 3000mmL ° Screen opening: 10mm ° Electric motor: 11kW IM	1
K-4	Chain Conveyor	° Capacity: 300t/h ° Size: 600mmW x 35mL ° Electric motor: 37kW GM	1
K-5 K-6	Packer Feed Bin	° Capacity: 20 tons ° Size: 3.5mW x 3.5mL x 5.5mH	2
K-7 K-8	Packer	° Type: 4 tube stationaly packer ° Capacity: 50t/h ° Electric motor: 30kW for main drive 2.2kW for rotary feeder	2
K-9	Over-flow Bin	° Capacity: 20 tons ° Size: 3.5mW x 3.5mL x 5.5mH ° Electric motor: 1.5kW for rotary feeder	1
K-10 K-11	Belt Conveyor	° Type: Flat reversible type ° Capacity: 50t/h ° Size: 750mmW x 6.5mL ° Electric motor: 15.kW GM	2

(to be continued)

No.	Name of Equipment	Description	Q'ty
K-12	Chain Conveyor	° Capacity: 60t/h ° Size: 350mmW x 39mL ° Electric motor: 7.5kW GM	1
K-13 K-14	Screw Conveyor	° Capacity: 10t/h ° Size: 250mmW x 6.5mL ° Electric motor: 2.2kW GM	2
K-15 K-16	Belt Conveyor	° Capacity: 50t/h ° Size: 750mmW x 5mL ° Electric motor: 1.5kW GM	2
K-17 - K-20	Belt Conveyor	° Capacity: 50t/h ° Size: 750mmW x 7mL ° Electric motor: 1.5kW GM (Incl. Modification of existing two)	2 + 2
K-21 - K-26	Retractable Belt Conveyor	° Capacity: 50t/h ° Size: 750mmW x 5mL ° Electric motor: 1.5kW GM (Incl. Modification of existing two)	4 + 2
K-27	Dust Collector	° Type : Bag filter ° Capacity: 360m^3/min at 80°C ° Area: Approx. 360m^2	1
K-28	Induced Fan	° Capacity: 400m^3/min x at 80°C ° Pressure: 350mmAq ° Electric motor: 45kW IM	1
	Hoist Rail	° Type: I-shaped steel ° Length: 20m (extension of existing one) ° Accessory: 1-Trolley wire, insulator, wire support, etc.	
	Bag Counter	° Type: Automatic counting device	

6-11-12 Foreshore Cement Loading Department

Table 6-11-12

No.	Name of Equipment	Description	Q'ty
L-1 - L-4	Stational Retractable Conveyor	° Capacity: 100t/h ° Size: 750mmW x 6mL and 3m regulation length ° Electric motor: 2.2kW GM	4
L-5 L-6	Reversible Belt Conveyor	° Capacity: 100t/h ° Size: 750mmW x 60mL	2

(to be continued)

No.	Name of Equipment	Description	Q'ty
		° Electric motor: 7.5kW for main drive 0.4kW for tripper ° Accessories: Roller	
L-7 - L-10	Reversible Belt Conveyor	° Capacity: 100t/h ° Size: 750mmW x 7mL ° Electric motor: 2.2kW GM ° Accessories: Roller chute	4
L-11	Belt Conveyor	° Capacity: 100t/h ° Size: 750mmW x 180mL ° Electric motor: 15kW GM	1
L-12	Hanging Belt Conveyor	° Capacity: 100t/h ° Size: 750mmW x 22mL ° Electric motor: 5.5kW GM	1
L-13	Hanging Support Column	° Type: Tower type ° Size: 14m High for main column 13m High for arm column ° Wire rope: 24mm dia x 200mL ° Accessory: Bag counter	1

6-11-13 Pontoon

Table 6-11-13

No.	Name of Equipment	Description	Q'ty
M-1 - M-3	Pontoon	° Complete set of steel plate ° Complete set of welding rod ° Complete set of deck house ° Complete set of mooring & towing ° Complete set of bilge pumping & sounding ° Complete set of lighting fixture ° Complete set of electric equipment ° Complete set of Anchoring equipment	3 3 3 3 3 3 3 3
M-4 M-5	Fork Lift	° Type: Mechanical lifting, diesel engine drive ° Service load: 2 tons ° Lifting height: 3m	2

6-11-14 All Necessary Fuel, Air, Water & Conduit Piping Chute and Supports

Table 6-11-14

No.	Name of Equipment	Description	Q'ty
N-1	Water Pump	° Capacity: 100t/h, 30mAq ° Electric motor: 19kW IM	5
N-2	Water Pump with Automatic Operation Device	° Capacity: 0.2m^3/h, 14mAq ° Electric motor: 1.5kW IM	12
N-3	Cooling Tower	° Capacity: 180t/h ° Hot water temperature: 38°C ° Cold water temperature: 30°C ° Wet bulb temperature: 27.2°C ° Electric motor: 22kW for fan	1
	Compressed Air Piping Material	Complete set	1
	Cooling & Process Water Piping Material	Complete set	1
	Slurry Piping Material	Complete set	1
	Natural Gas Piping Material	Complete set	1
	Chute, Duct and Support	Complete set	1

6-11-15 Water Supply System

Table 6-11-15

No.	Name of Equipment	Description	Q'ty
O-1	Source Water Pump	° Capacity: 100t/h, 15mAq ° Electric motor: 11kW IM	2
O-2	Water Pump	° Capacity: 100t/h, 10mAq ° Electric motors: 11kW IM	4
	Water Treatment Equipment	° Capacity: 200t/h	1
	Water Piping Material		1
	Treated Water Pump	° Capacity: 100t/h, 130mAq ° Electric motor: 75kW IM	2
	Gravity Piping Material		1

6-11-16 Electrical Equipment of Plant

Refer to Drawing No. E-01, Single-line Diagram.

(1) Incoming and transformer facilities

(i) Extra-high voltage switchgear

Existing facilities will be utilized.

(ii) Extra-high voltage transformer

Existing facilities will be utilized. However, it is desirable to install one set of transformer of the same specification as of the existing one as a stand-by.

Quantity: 1 set (Stand-by)

Type: Outdoor type, oil immersed self-cooling system

Main specification: Primary voltage 66kV
Secondary voltage 6.6kV
Impedance 7.91% at 75°C

Capacity: 9,000KVA

(iii) High voltage power distribution facilities (To be installed in main substation)

Quantity: 1 set

Type: Indoor, unit type metalclad switchboard

Main specification: Breaker to be used; small oil content type

Major use:
1 - Bus-tie panel between existing and extention bus-bar
1 - Substation service panel
2 - Transformer panel for low voltage power supply including 1,200KVA 6.6kV/400V transformer
1 - Feeder panel for foreshore
1 - Transformer panel for lighting
12 - High voltage motor panel

(iv) Control panel

Quantity: 1 set

Type: Indoor benchboard type panel

Accessories: 1 set of relay panel

(v) Emergency power supply facilities

Existing facilities will be utilized

(2) Power distribution facilities (To be installed in each local electric room)

Quantity and main equipment:

1 set - High voltage breaker panel (Only for limestone quarry and foreshore)

1 set - Power transformer (Same as above)

1 set - Lighting transformer (Same as above)

1 set - Motor control center

Main location:

- Limestone quarry electric room
- Secondary limestone crushing plant electric room
- Raw and finish grinding electric room
- Kiln dept. electric room
- Packing and shipping plant electric room
- Gypsum crushing plant electric room
- Foreshore electric room

(3) Power transmission facilities for limestone quarry

Quantity: 1 set

Type: High voltage overhead power transmission system

Electric system: AC6.6kV, 50Hz, 3 phase 3 wire syste, single line

The existing electric poles will be utilized. However electric wire is to be renewed for satisfying larger power demand.

(4) Power transmission facilities for Foreshore

The same specifications as that in par. (3) above will be applied.

(5) Electric motor

Quantity: 1 set

Main specifications:

Degrees of protection - In principle, motors shall be of totally-enclosed fan-cooled type. And also dust-proof type or explosion-proof type must be considered for hazardous location.

Voltage
- 6.6kV 110kW and over
- 400V Less than 109kW
- 230V Single phase small motor for controlling or other purposes.

Class of insulation - In principle, class-B (high voltage motor) and class-E (low voltage motor) shall be applied

Temperature rise - Special design must be made in consideration of the climate in the project area, although design ambient temperature is set to be 40°C.

Special electric motor - DC motor for kiln drive,
- Wound-rotor type induction motor for large capacity mill drive,
- Induction motor with eddy-current coupling for variable speed drive
- Geared motor for low speed motor

(6) Process control equipment (including instrumentation)

(i) Central control switchboard

Quantity: 1 set

Type: Indoor dust-proof, self-standing type including instrumentation panel and auxiliary panels

Use: - Kiln control room
- Raw grinding and finish grinding control room

Accessories: Local control switches

(ii) Local control panel

Quantity: 1 set

Type: Indoor dust-proof, self-standing type

Use: - Limestone quarry electric room
- Secondary limestone crushing plant electric room
- Packing and shipping room
- Gypsum crushing room

Accessories: Local control switches

(iii) General instrumentation

Quantity: 1 set

Type: Indoor for outdoor dust-proof type

(7) Lighting facilities

1 set - Lighting distribution board

1 set - Mercury-vapour lamp

1 set - Fluorescent lamp

1 set - Incandescent lamp for spot lighting

(8) Wiring and piping works

(i) Cable

Quantity and main specifications

High voltage cable - Cross-linked polyethylene insulated PVC sheathed cable, 6.6kV 3 core or 1 core, minimum cable size 22mm^2.

Low voltage power cable - Same as above
600V, 3 core or 1 core minimum cable size 2 mm^2

Control cable - PVC insulated and PVC sheathed cable

Earthing wire - PVC insulated cable

(ii) Outdoor line

Quantity: 1 set

Main specifications: Main line - cable trench
Branch - Underground concrete trough or directly buried conduit

(iii) Indoor line

Quantity: 1 set

Main specifications: Main line - cable rack or floor cable pit
Branch - conduit

(iv) Earthing circuit

Quantity: 1 set

6-12 Repair Shop and Spare Parts

6-12-1 Outline of the Existing Repair Shops

(1) Kyangine Cement Mill has a machine repair shop, vehicle maintenance shop and electric repair shop for repair and maintenance of the existing facilities. Since outside repairing services are not available, all the repairing work have to be accomplished in the plant. Any equipment which cannot be repaired in the mill must be sent to its manufacturer for repair.

These repair shops are indispensable for the smooth operation and management of the cement mill and it is most important to improve the capability of those repair shops.

It seems, however, that the function of existing repairing facilities is not fully demonstrated and certain facilities are left unused. This may be attributable to such facts that some of the existing facilities are not proper and technical level of the employees is somewhat low.

Under the present expansion plan, it is necessary to reinforce those repairing facilities and at the same time to train employees in order to improve the repair capacility in the plant. Generally, local fabrication of the parts or the whole of the machinery and equipment holds the

most important part of the repair works in a cement mill. Therefore, it is necessary to give employees technical training on such subjects as gas cutting, electric welding, operation of machining tools, repair of electric machines so that they will be fully competent in performing all types of repair work in a cement mill.
For this purpose, it is also necessary that the expected plant operators after the expansion cowork with CC employees during the period of construction or receive technical training in the country and abroad.

(2) Facilities of existing machine repair shop

Sawing machine
Lathe
Threading machine
Universal milling machine
Grinding machine
Shaping machine
Drilling machine
Squar shear
Roller plate bending machine
Acetylene gas generator
Electric furnace
Pneumatic hummer

(3) Machining tools to be additionally installed

Large Lathe
Medium Lathe
Grinding machine
Hydraulic press (50 tons)
Pillar drilling machine
Portable electric drill
Portable electric grinder
Others

(4) Electrical repairing facilities to be added

Complete set

(5) Vehicle repair facilities

Garage jack
Air compressor
Portable car washer
Others

(6) Review of additional repair facilities and tools

The scale of repair facilities to be added must be determined based on the analysis of actual records of part manufacturing and repair work down at the existing facilities and the estimated amount of repair work in the future. Technical training must be given to repair workmen to improve their technical ability in order to carry out general repair work safely and in short time, and sufficient number and kinds of repairing tools must be maintained.

6-12-2 Inventory of Spare Parts for 2 Year-operation

(1) General

Kyangin Cement Mill has an fairly abundant inventory of spare parts for its equipment covering 2 year operation. Spare parts other than consumables have not been used so much as the plant has not yet been in operation for a long time, but the necessity for such spare parts will be gradually increased in future as time goes by.

It takes a long time to aquire an accurate knowledge on the proper amount of inventory spare parts. The plant tends to have a relatively large amount of inventory of spare parts in prepartation for an emergency because of the fact that spare parts required at this mill must be procured from abroad, which will take a considerably long time for their delivery. Sometimes a machine becomes unusable before the spare parts for it are utilized.

Spare parts and items for those facilities to be additionally installed under this project may have to be stored in relatively large quantity in view of the above facts. However, considerable portion of such spare parts may be interchangeable if new facilities of the same type and capacity as those of existing ones are added.

Although machine suppliers would recommend complete set of spare parts for 2 years operation, a proper amount of inventory must be determined after reviewing the current inventory for the existing facilities.

(2) Spare parts of new facilities for 2 year operation

1) Complete set for Quarry and Heavy equipment
2) Complete set for Grinding mill (Raw & Finish)
3) Complete set for Rotary Kiln
4) Complete set for Air quenching cooler
5) Complete set for Refractory material of Rotary Kiln
6) Complete set for Conveying machines
7) Complete set for General machine
8) Complete set for Electrical equipment

Generally those spare parts listed above will be required, but final decision on spare parts should be made after checking the lists submitted by machine suppliers against the inventory.

CHAPTER 7 OUTLINE OF CIVIL WORK FOR MILL EXPANSION PROJECT

7-1 Premises

The following items of civil construction work including those existing buildings which will be utilized after the expansion of the Mill, auxiliary buildings which are under construction, and other facilities which will be decided upon consultation with Burmese party concerned at the site of construction are not to be included in this project.

(1) Accessory buildings of the cement production plant
- (a) General office
- (b) Laboratory
- (c) Guard room
- (d) Machine workshop
- (e) Machine repair shop
- (f) Vehicle repair shop
- (g) Warehouse
- (h) Employees' locker room
- (i) Outdoor toilet blocks
- (j) Dispensary
- (k) Locomotive and car repair shop

(2) Employees' accommodation facilities, guest house

(3) Welfare facilities; i.e. as swimming pool, tennis courts, etc.

(4) Paper bag plant and related facilities

(5) Repair of existing structures

7-2 Outline of Major Civil Work for Mill Expansion Project

7-2-1 Foundation and Building

Note: Symbol: RC: Reinforced concrete
S : Steel structure
BC: Belt conveyor

Table 7-2-1

Name	Construction	Dimensions(m)	Stories	Remarks
1. Primary crusher plant	RC, S	10W x 11L x 7.5H	3	Including discharge tunnel
2. BC bridge	S	150L		Bridge between primary crusher and ore bin

(to be continued)

Name	Construction	Dimensions(m)	Stories	Remarks
3. Screen chamber	S	6 x 7 x 14H	2	
4. Ore bin	RC, S	6W x 66L x 20H	2	Hopper RC Attached drawing (C-02)
5. Outdoor limestone stockyard BC bridge and supports	RC, S	405L		14 units of support in the storage Attached drawing (C-01)
6. Limestone receiving hopper	RC Hopper(S)	BC pit 6 x 60 x 5 Shelter 6 x 60 x 6	2	Including shelter and discharging BC pit Attached drawing (C-03)
7. BC bridge and transit tower	S	Transit tower 4 x 4 x 16H BC bridge 150L	–	To secondary crusher
8. Secondary crusher plant	RC	15.5 x 15 x 10.5 x 7.0	3	10.5m above ground 7.0m underground
9. Bridge and supports for BC to limestone storage	S	100L		
10. Limestone stockyard	RC, S	50 x 200 x 8 (Ridge height: 28)	1	Including BC bridge to the storage Attached drawing (C-04)
11. Bridge and transit towers for BC to raw material storage	S	No.1 40 No.2 55 No.3 50 Total 145L		
12. Expansion of raw material stockyard	RC, S	25 x 25 x 21.7	1	Including 8 units of hopper
13. Clay washing mill room	RC, S	4.4 x 5.9 x 3.4	1	
14. Expansion of wet-process raw grinding mill room	RC, S	24 x 31 x 7.9	2	Including mill foundation Attached drawing (C-05)
15. Slurry tank	RC	ø8 x 20H Units: 6		Attached drawing (C-06)
16. Slurry basin	RC	ø35 x 8H Unit : 1		4m above ground 4m underground Attached drawing (C-06)

(to be continued)

Name	Construction	Dimensions(m)	Stories	Remarks
17. Slurry pump room	RC, S	4.55 x 10.1 x 2.5	2	Basement floor level GL - 6,0m
18. Expansion of compressor room	RC, S	8 x 15 x 3.9	1	
19. Raw material feed chamber	RC, S	5 x 5 x 17.2 For 2 kilns	4	Attached drawing (C-07)
20. Foundation for kiln	RC	For 2 kilns		Attached drawing (C-07)
21. Kiln motor room	S	24 x 18 x 10.5	1	"
22. Kiln shed	S	24 x 61.5 x 10.5	1	"
23. Kiln inspection walkway	RC	120L		Each 1 bridge for each kiln
24. A.Q.C. room (Cooler room)	RC, S	24 x 21.5 x 20.1	5 (Underground 3 stories Above ground 2 stories)	Including clinker BE tower and control room Attached drawing (C-07)
25. Foundation for dust collector	RC	Units: 2		
26. Foundation for exhaust fan	RC	Units: 2		
27. Chimney for kiln	RC		1	Including foundation and chimeny shell up to 11m (ϕ3m)
28. Expansion of clinker stock-yard	RC, S	25 x 50 x 21.7	1	Including 4 hoppers
29. Expansion of cement mill room	RC, S	31 x 24 x 21.7	5	Attached drawing (C-05)
30. BC bridge to cement silo	S	160L		
31. Support of charging BE to cement silo	S	Unit: 1		
32. Chain conveyor bridge to cement silo	S	20L		
33. Cement silo	RC	ϕ12 x 29H Units: 6		Attached drawing (C-08)
34. BE pit and its shed for packing room (expansion)	RC	5 x 5 x 4.7 (pit)		Shed 5 x 5 x 2.55

(to be continued)

Name	Construction	Dimensions(m)	Stories	Remarks
35. Expansion of packing room	RC	24 x 20 x 14.65	4	Attached drawing (C-08)
36. Gypsum crusher room	RC, S	3 x 4 x 4	3	Including BE pit
37. Expansion of water pond	RC	40 x 40 x 5		
38. Pump room	S	4 x 8 x 3.5	1	
39. Main substation	RC, S	14 x 8 x 6.5	1	
40. Outdoor substation	RC	1 set		
41. Foreshore cement warehouse	RC, S	30 x 120 x 4.5	1	Attached drawing (C-09)
42. Cement shipping pier	RC	1 set		Pile foundation Attached drawing (C-09)

7-2-2 Sidetracks

Table 7-2-2

Name	Specification	Number	Remarks
1. From existing ore bin to new ore bin	Track	640 m	Attached drawing (Refer to C-12)
	Turnout	2	
	Bridge	1	8m(L) x 8m(W) x 3m(H)
2. Limestone receiving track	Track	820 m	Attached drawing (Refer to C-11)
	Turnout	3	
	Bridge	1	5m(L) x 6m(W) x 3m(H)
3. Cement loading track	Track	205 m	Attached drawing (Refer to C-11)
	Turnout	2	
4. Foreshore cement receiving track	Track	270 m	Attached drawing (Refer to C-11)
	Turnout	1	
Total	Track	1,935≒1,940m	
	Trunout	8	
	Bridge	2	

7-2-3 Land Preparation for Outdoor Limestone Stockyard

Table 7-2-3 Attached drawing C-12, C-13

Name	Specification	Quantity	Remarks
1. Cutting		≒ 34,000 m^3	Outdoor limestone stockyard 31,000 m^3 Side track 3,000 m^3
2. Banking		≒ 11,000 m^3	
3. Drain ditch		≒ 650 m^3	

7-2-4	Plant site road paving	Concrete (Thickness 20cm)	9,150 m^2	10m x 915L
7-2-5	Plant site drain ditch	RC and brick	1,830 m	915m x 2
7-2-6	Land preparation for cement warehouse	Banking	16,000 m^3	Foreshore

7-3 Specification for Design and Execution of Civil Work

Specification for design and execution of Civil Work should be basically the same as those of the existing plant facilities. However special attention should be paid to the following points:

(1) Construction type

(i) In principle the foundation and underground portion of building and structure shall be of reinforced concrete and portion above the ground shall be of reinforced concrete or steel structure.

(ii) The design will utilize locally made construction materials as much as possible in consideration of the promotion of local industries and trade balance.

(iii) Roof and external wall

In principle, the roof of new buildings will be of corrugated galvanized iron sheet, folded galvanized iron sheet or reinforced concrete.

External walls will be of brick with mortar finished or corrugated asbestos cement sheet.

Sashes and doors will be of steel.

(iv) Cement warehouse (Paper-bagged cement)

The height of floor shall be higher than the ground surface by more than 30 cm.

(2) Design load

(i) Wind pressure

Since Burmese architectural standard is not available at present, the Japanese standard is applied mutatis mutandis.

$$P = q \cdot c \cdot A \quad \ldots\ldots\ldots\ldots\ldots (1)$$

where P : Wind pressure (kg)

q : Velocity pressure ($kg \cdot m^2$)

c : Wind pressure coefficient

A : Face area (m^2)

(a) Velocity pressure (q)

$$q = \frac{1}{16} \cdot V^2 \sqrt[4]{\frac{h}{10}} \quad \ldots\ldots (2)$$

V : Design maximum velocity (m/sec)

The maximum recorded wind velocity in Burma; 32 m/sec

Maximum instantaneous wind velocity to be considered as V; $32 \times 1.5 = 48 \fallingdotseq 50$ m/sec

h : Height above the ground (m)

By substituting the above for formula (2)

$$q = \frac{1}{16} \times 50^2 \times \sqrt[4]{\frac{h}{10}} = 87.8 \sqrt[4]{h} \fallingdotseq 90 \sqrt[4]{h} \ (kg/m^2)$$

From the above result, we adopt the velocity pressure of $q = 90 \sqrt[4]{h}$

(Note) 1. The buildings and structures of the existing plant have been designed based on the following:

$$q = 37 \sqrt{h} \ (kg/m^2)$$

2. Comparison between the design values of the existing plant and our proposed values.

Table 7-3-1

h	20m	25m	30m	35m	40m
$q = 90\sqrt[5]{h}$ (kg/cm²)	190	201	210	219	226
$q_0 = 37\sqrt{h}$ (kg/cm²)	165	185	202	219	234

(b) Wind pressure coefficient (c)

The wind pressure coefficient shall be in accordance with the Japanese building standards.

(ii) Design lateral seismic coefficient

Since the Burmese building standards are not available, a lateral seismic coefficient will be determined with reference to the coefficient used for the desigh of the existing plant.

Standard lateral seismic coefficient K = 0.1

Importance coefficient $\alpha = 1.5$

Coefficient by the type of soil and foundation $\beta = (1.0 \sim 1.5)$

Adopted lateral seismic coefficient = $0.1 \times 1.5 \times \beta$

For high buildings and structures, it is desirable to make a lateral seismic coefficient larger than the above value. In the Japanese building standards, it is set forth that an additional value of 0.01 should be added for every 4m of height for the portion of a building higher than 16m above the ground.

Note: We have the record of an earthquake of grade 8 on Modified-Mercalli Intensity Scale (MM8) in Kyangin area on Aug. 24, 1858. It is said that the seismic acceleration of the soil corresponding to M.M. 8 is 94 - 202 gal (cm/sec²) and it corresponds to a lateral seismic coefficient of $K \fallingdotseq 0.09 - 0.20$.

In consideration of the fact that buildings and structures shall be constructed as economically as possible we have adopted a lateral seismic coefficient of K = 0.1 which was used for the existing plant based on the following policies.

(a) Buildings should withstand against an earthquake which may occur at a relatively high frequency i.e. once in 10 to 20 years without any damage.

(b) Buildings should be strudy enough to withstand against a severe earthquake which may occur seldom such as once in 50 to 100 years. They must not collapse or harm human lives though a slight damage may be caused.

However, the lateral seismic coefficient of chimneys, etc. will be more than K = 0.2.

(iii) Study allowable bearing power of soil

Based on the data of the following geological report given by the Burmese party at the site, we have reviewed the allowable bearing power of soil as follows:

Refer to the drawing showing the location of boring which was previously performed (C-16) and attached soil test data, Annex 7-3 Table A 7-3-1 to A 7-3-8.

- Report on Subsurface Exploration, Cement Mill at Ingauk Village, Kyaukgin.
  By Estimate & Research Section of Research & Testing Laboratory

(a) Calculation formula

In calculating allowable bearing power of soil, we made a review based on the unit volumetric weight and unconfined compression strength listed in the reports and the conditions below.

We used the calculation formula (Modified Terzaghi's Formula) provided in "AIJ STANDARD FOR STRUCTURAL DESIGN OF BUILDING FOUNDATIONS"

Note; AIJ: ARCHITECTURAL INSTITUTE OF JAPAN

1) Supposed conditions

It is assumed that soil is of silt and clay and its internal friction angle is $\phi = 0°$. Consequently, its cohesion will be as follows:

$C = qu/2$ where; C : Cohesion
qu: unconfined compression strnegth

It is assumed that the shape of foundation is square and the depth of base bottom level is GL - 3m.

2) Calculation formula

$$qa = 1/3\ (\alpha C N_c + \beta \gamma_1 B N_\gamma + \gamma_2 D_f N_q)$$

qa : Long term allowable bearing power (t/m^2)
C : Cohesion (t/m^2)
γ_1 : Soil unit volumetric weight (t/m^3)
(lower than base bottom level)
γ_2 : Soil unit volumetric weight (t/m^3)
(higher than base bottom level)
α, β: Coefficient of shape of foundation
square foundation $\alpha = 1.3, \beta = 0.4$

N_c, N_r, N_q : Bearing power coefficient

Internal friction angle $\phi = 0$, $N_c = 5.3$, $N_r = 0$, $N_q = 3.0$

D_f : Depth of base bottom level

(b) Estimation of soil bearing power

As shown in the attached drawing (C-16), the positions of boring for soil investigation previously performed are far away from those of the planned work sites under this project. Therefore, it is difficult to claculate allowable bearing power of soil at the positions of major building and structures from the data of the reports. In this review, we estimated allowable bearing power of soil at Boring point No.1, No.2 and No.8 in the vicinity of the foundation of the proposed kiln under this project from the available soil investigation data. In the estimation, we used an average value of wet density of soil from GL +0 to GL -2.85 as Y1 and an average value of unconfined compression strength, excluding the maximum and minimum, from GL -2.85 to GL -5.55 as C. However, the units of lb/ft^3 and lb/ft^2 used in the data were converted into the units of ton/m^3 and ton/m^2 respectively.

1) Allowable bearing power of Boring Point No. 1

Table 7-3-2 Soil test data

No.	Depth H(m)	Unit volumetric weight $\gamma(t/m^3)$	Unconfined compression strength $qu(t/m^2)$	Strain $\varepsilon(\%)$
1	0 ∿ 0.6	1.9	-	-
3	1.05 ∿ 1.5	2.2	-	-
4	1.5 ∿ 1.95	2.3	32.7	8.8
5	1.95 ∿ 2.4	2.1	17.5	11.3
6	2.4 ∿ 2.85	2.1	45.3	6.3
7	2.85 ∿ 3.3	2.2	-	-
8	3.3 ∿ 3.75	2.2	24.5	3.8
9	3.75 ∿ 4.2	2.2	18.5	5.0
10	4.2 ∿ 4.65	1.9	41.3	3.8
11	4.65 ∿ 5.1	1.9	41.9	9.0
12	5.1 ∿ 5.55	2.3	49.4	3.5

$\gamma = 2.1\ t/m^3$ ($\overline{\gamma}$ No.1∿6) $qu = 35.9\ t/m^2$ ($\overline{qu}$ No.8∿No.12)

(The maximum and minimum values excluded)

$C \fallingdotseq qu/2 \fallingdotseq 18\ t/m^2$

Allowable bearing power

$$qa = 1/3\ (1.3 \times 18 \times 5.3 + 2.1 \times 3.0 \times 3.0) \fallingdotseq 48\ t/m^2$$

2) Allowable bearing power of Boring Point No.2

Table 7-3-3 Soil test data

No.	H (m)	γ (t/m^3)	qu (t/m^2)	Δ (%)
4	1.5 ∿ 1.95	2.3	-	-
5	1.95 ∿ 2.4	2.2	-	-
6	2.4 ∿ 2.85	2.3	69.3	3.8
7	2.85 ∿ 3.3	2.2	37.7	3.8
8	3.3 ∿ 3.75	2.2	-	-
9	3.75 ∿ 4.2	2.2	28.7	2.5
10	4.2 ∿ 4.65	2.3	35.2	3.8
11	4.65 ∿ 5.1	2.3	35.4	2.5
12	5.1 ∿ 5.55	2.2	28.9	3.5

$\gamma = 2.3\ t/m^3$ ($\overline{\gamma}$ No.4 ∿6) $\quad \overline{qu} \fallingdotseq 33.2\ t/m^2$ ($\overline{qu}$ No.7 ∿12)

(The maximum and minimum values excluded)

Allowable bearing power $\quad C \fallingdotseq 17\ t/m^2$

$$q_a = 1/3\ (1.3 \times 17 \times 5.3 + 2.3 \times 3.0 \times 3.0) \fallingdotseq 46\ t/m^2$$

3) Allowable bearing power of Boring Point No. 8

Table 7-3-4 Soil test data

No.	H (m)	γ (t/m^3)	qu (t/m^2)	Δ (%)
1	0 ∿ 0.6	1.9	-	-
2	0.6 ∿ 1.05	2.2	49.6	3.8
3	1.05 ∿ 1.5	2.4	82.7	6.3
4	1.5 ∿ 1.95	2.2	49.5	3.8
5	1.95 ∿ 2.4	2.3	70.0	6.3
6	2.4 ∿ 2.85	2.3	41.2	6.3
7	2.85 ∿ 3.3	2.1	20.8	3.8
8	3.3 ∿ 3.75	2.1	34.2	5.0
9	3.75 ∿ 4.2	2.2	26.5	3.8
10	4.2 ∿ 4.65	2.2	21.6	2.5
11	4.65 ∿ 5.1	2.2	21.3	3.8
12	5.1 ∿ 5.55	2.3	31.4	2.5

$\gamma = 2.2\ t/m^3$ ($\overline{\gamma}$ No.1 ∿ 6) $\quad qu = 25.2\ t/m^2$ ($\overline{qu}$ No.7 ∿ 12)

(The maximum and minimum values excluded)

$C \fallingdotseq 13\ t/m^2$

Allowable bearing power

$q_a = 1/3\ (1.3 \times 13 \times 5.3 + 2.2 \times 3.0 \times 3.0) = 36\ t/m^2$

(iv) Soil investigation

The foundation of the existing buildings and structures is founded directly on the hard soil. (direct foundation)

Buildings to be constructed under this project should be constructed in the same way as that of existing plant. For this purpose, soil should be investigated at the following points as minimum requirements:

(a) Site alloted for a primary crusher plant ..... 2 points

(b) Site alloted for ore bin ..... 3 points

(c) Site for open limestone stockyard ..... 4 points

(d) Site for receiving hopper of limestone carried by wagons ..... 1 point

(e) Site for limestone stockyard ..... 6 points

(f) Site for cement shipping pier ..... 5 points

(g) Sites for major buildings and structures under this project which are away from previous boring positions ..... At least 1 point at each site

Items of soil survey

- Boring
- Standard penetration test (to be carried out at intervals of 1m)
- Location of ground water level
- Other necessary laboratory tests

(3) Paving of plant compound

In consideration of the durability for the traffic of heavy duty vehicles, the pavement of the new plant compound shall be of concrete same as the existing plant compound (thickness of more than 20cm).

(4) Drainage of plant compound

Where heavy vehicles are expected to pass very near, or cross over drain ditches, such drain ditches shall be of reinforced concrete for resisting the load and other ditches shall be of brick ditch.

(5) Railway siding

Sidetracks shall conform to Burmese rules for side track construction.

Gauge	3' - 3-3/8" (1,000 mm)
Rail	85 lbs (42.5 kg/m)
Sleeper	6' x 8" x 4-1/2"(1,828 x 203 x 114 mm)
Width of formation level	16' (4,877 mm)
Distance between center of track	12' - 6" (3,810 mm)
Grade	Less than 1/300 (within station premises)
Turnout	1 : 8-1/2
Minimum radius of curvature	338.27 ft (at turnout portion 103 m)
Slope of bank	1 : 2 (1 vertical to 2 horizontal)

ANNEX 7-3, Table A 7-3-1 NATURAL MOISTURE CONTENT, WET & DRY DENSITIES & UNCONFINED COMPRESSION TEST

JOB: CEMENT MILL, INGAUK VILLAGE. DRILL HOLE NO.1

SHELBY NO.	DEPTH Ft.	VISUAL CLASSIFICATION	MOISTURE content %	DENSITIES Lb/Cu. Ft. WET	DENSITIES Lb/Cu. Ft. DRY	UNCONFINED Strength Lb/Sq. Ft.	COMPRESSION Strain. %
1	0- 2	Brownish Grey SILT & CLAY, trace Sand, trace Gravel	14.5	111.0	97.0	-	-
2	2- 3 1/2	- do -	14.2	-	-	-	-
3	3 1/2- 5	- do -	15.4	131.2	113.8	9875	5.0
4	5- 6 1/2	- do -	10.6	134.9	121.9	6495	8.8
5	6 1/2- 8	- do -	22.9	123.9	101.2	3485	11.3
6	8- 9 1/2	- do -	20.5	124.6	103.3	9010	6.3
7	9 1/2-11	- do -	23.5	130.0	105.2	-	-
8	11-12 1/2	- do -	23.7	129.2	104.8	4865	3.8
9	12 1/2-14	Bluish Grey SILT & CLAY, trace Sand, trace Gravel	23.5	127.9	103.8	3685	5.0
10	14-15 1/2	- do -	21.2	111.1	134.9	8220	3.8
11	15 1/2-17	- do -	19.2	113.0	134.6	8330	9.0
12	17-18 1/2	- do -	20.9	134.5	111.2	9320	3.5
13	18 1/2-20	- do -	18.5	131.5	118.5	11440	6.0
14	20-21 1/2	- do -	17.7	130.4	110.9	-	-
15	25-26 1/2	- do -	17.5	136.1	116.0	9890	4.5
16	30-31	- do -	16.2	136.6	117.2	22810	6.5
17	35-36	- do -	16.3	138.2	118.9	6140	1.5
18	40-41	- do -	16.9	137.0	117.5	14070	7.0
19	45-46	- do -	17.0	139.1	119.1	11510	5.3
20	50-51	- do -	16.5	138.5	118.8	15740	3.5
21	55-56	- do -	11.9	138.9	124.2	19720	4.0
22	60-61	- do -	14.8	119.1	136.2	13210	5.0
23	65-66	- do -	16.8	116.3	135.5	13180	7.0
24	70-71	- do -	15.7	138.2	119.7	24440	4.0
25	75-76	- do -	16.6	135.0	115.7	-	-
26	80-81	- do -	17.8	138.4	117.9	25270	4.0
27	85-86	- do -	17.8	138.0	117.0	16220	4.0
28	90-91	- do -	17.8	142.3	121.0	20180	3.5
29	95-96	- do -	19.0	114.9	136.8	11720	5.0
30	100-101	- do -	20.1	115.2	138.2	9780	4.5
31	105-106	- do -	18.7	110.8	131.5	10170	7.5
32	110-111	- do -	17.8	139.7	118.5	10970	3.5
33	115-116	- do -	17.9	130.0	110.3	-	-

ANNEX 7-3, Table A 7-3-2 NATURAL MOISTURE CONTENT, WET & DRY DENSITIES & UNCONFINED COMPRESSION TEST

JOB: CEMENT MILL, INGAUK VILLAGE — DRILL HOLE NO.2

SHELBY NO.	DEPTH Ft.	VISUAL CLASSIFICATION	MOISTURE content %	DENSITIES Lb/Cu. Ft. WET	DENSITIES Lb/Cu. Ft. DRY	UNCONFINED Strength Lb/Sq. Ft.	COMPRESSION Strain %
1	0-2	Brownish Grey SILT & CLAY, trace Sand, trace Gravel	15.0	-	-	-	-
2	2-3 1/2	- do -	7.8	-	-	-	-
3	3 1/2-5	- do -	11.6	-	-	-	-
4	5-6 1/2	- do -	15.6	137.6	119.0	-	-
5	6 1/2-8	- do -	14.6	132.3	115.4	-	-
6	8-9 1/2	- do -	17.6	136.9	116.5	13780	3.8
7	9 1/2-11	- do -	20.8	129.6	107.3	7500	3.8
8	11-12 1/2	- do -	22.2	127.3	104.2	-	-
9	12 1/2-14	Bluish Grey SILT & CLAY, trace Sand, trace Gravel	18.4	127.6	107.7	5710	2.5
10	14-15 1/2	- do -	22.0	132.6	108.6	7000	3.8
11	15 1/2-17	- do -	19.5	132.0	110.4	7040	2.5
12	15-18 1/2	- do -	21.4	128.1	105.5	5750	3.5
13	18 1/2-20	- do -	20.6	133.5	110.6	7650	4.5
14	20-21 1/2	- do -	19.3	134.3	112.5	7890	5.0
15	23-26 1/2	- do -	20.7	136.2	112.8	12000	4.5
16	30-31 1/2	- do -	19.2	136.1	114.2	16150	5.3
17	35-36	- do -	18.0	131.9	111.9	7870	2.0
18	40-41	- do -	19.2	134.2	112.6	8850	4.5
19	45-46	- do -	18.9	133.8	112.5	12330	2.8
20	50-51	- do -	18.7	134.8	113.5	11780	5.0
21	55-56	- do -	18.6	134.3	113.2	16185	3.5
22	60-61	- do -	18.4	135.4	114.3	21485	3.5
23	65-66	- do -	17.2	136.0	116.0	12960	2.0
24	70-71	- do -	17.4	135.5	115.4	17380	2.8
25	75-76	- do -	16.3	134.4	115.5	14590	2.5
26	80-81	- do -	16.3	137.0	117.4	23330	4.0
27	85-86	- do -	16.6	133.5	114.5	11880	3.5
28	90-91	- do -	17.0	135.0	115.4	14180	4.5

ANNEX 7-3, Table A 7-3-3 NATURAL MOISTURE CONTENT, WET & DRY DENSITIES & UNCONFINED COMPRESSION TEST

JOB: CEMENT MILL, INGAUK VILLAGE DRILL HOLE NO.3

SHELBY NO.	DEPTH Ft.	VISUAL CLASSIFICATION	MOISTURE content %	DENSITIES Lb/Cu. Ft. WET	DENSITIES Lb/Cu. Ft. DRY	UNCONFINED Strength Lb/Sq. Ft.	COMPRESSION Strain %
1	0- 2	Brownish Grey SILT & CLAY, trace Sand, trace Gravel	10.8	-	-	-	-
2	2- 3 1/2	- do -	10.5	130.3	117.9	-	-
3	3 1/2- 5	- do -	10.4	134.2	121.5	14445	3.8
4	5- 6 1/2	- do -	15.0	138.5	120.4	18120	6.5
5	6 1/2- 8	- do -	21.3	129.3	106.5	8220	4.0
6	8- 9 1/2	- do -	13.7	137.4	120.8	13800	5.0
7	9 1/2-11	Bluish Grey SILT & CLAY, trace Sand, trace Gravel	18.4	132.3	111.7	13685	4.5
8	11-12 1/2	- do -	17.4	138.2	117.7	12845	5.3
9	12 1/2-14	- do -	18.1	131.8	111.6	11445	4.5
10	14-15 1/2	- do -	17.7	128.5	109.2	9220	7.8
11	15 1/2-17	- do -	16.6	134.7	115.5	13270	4.5
12	17-18 1/2	- do -	18.2	132.5	112.0	13705	5.0
13	18 1/2-20	- do -	17.8	134.3	114.0	11250	7.5
14	20-21 1/2	- do -	19.1	132.3	111.1	9080	5.0
15	25-26 1/2	- do -	16.4	133.6	114.7	14930	4.5
16	30-31 1/2	- do -	17.9	129.6	109.9	8485	6.5
17	35-36	- do -	14.8	127.2	110.8	-	-
18	40-41	- do -	18.8	133.9	112.7	-	-
19	45-46	- do -	15.4	131.8	114.2	-	-
20	50-51	- do -	15.3	139.4	120.8	19635	5.0
21	55-56	- do -	15.8	110.9	95.8	-	-
22	60-61	- do -	15.3	134.5	116.6	-	-
23	65-66	- do -	12.0	133.7	119.3	15130	7.8
24	70-71	- do -	14.4	132.8	116.0	-	-
25	75-76	- do -	14.3	-	-	-	-
26	80-81	- do -	16.1	130.6	112.4	-	-
27	85-86	- do -	17.4	137.3	116.9	13735	5.0
28	90-91	- do -	15.1	127.7	110.9	9190	6.5
29	95-96	- do -	15.1	132.4	115.1	-	-
30	100-101	- do -	15.3	125.2	108.5	6055	5.0

ANNEX 7-3, Table A 7-3-4 NATURAL MOISTURE CONTENT, WET & DRY DENSITIES & UNCONFINED COMPRESSION TEST

JOB: CEMENT MILL, INGAUK VILLAGE

DRILL HOLE NO.4

SHELBY NO.	DEPTH Ft.	VISUAL CLASSIFICATION	MOISTURE content %	DENSITIES Lb/Cu. Ft. WET	DENSITIES Lb/Cu. Ft. DRY	UNCONFINED Strength Lb/Sq. Ft.	COMPRESSION Strain %
1	0- 2	Brownish Grey SILT & CLAY, tract Sand, trace Gravel	21.0	120.0	99.2	-	-
2	2- 3 1/2	- do -	29.5	120.8	93.3	22060	12.5
3	3 1/2- 5	- do -	23.1	129.4	105.1	5970	10.0
4	5- 6 1/2	- do -	20.5	-	-	-	-
5	6 1/2- 8	- do -	20.4	122.8	102.0	5430	6.3
6	8- 9 1/2	- do -	21.2	131.6	108.6	4850	5.0
7	9 1/2-11	- do -	22.6	123.3	100.6	4645	8.8
8	11-12 1/2	- do -	21.9	129.0	105.8	3858	11.3
9	12 1/2-14	- do -	22.3	125.1	102.3	4052	10.0
10	14-15 1/2	- do -	22.0	131.4	107.7	3980	18.8
11	15 1/2-17	Bluish Grey SILT & CLAY, trace Sand, trace Gravel	22.9	130.0	105.7	4480	13.8
12	17-18 1/2	- do -	33.6	-	-	-	-
13	18 1/2-20	- do -	30.2	126.2	96.9	2905	12.5
14	20-21 1/2	- do -	29.7	127.1	98.0	2650	10.0
15	21 1/2-26 1/2	- do -	27.0	130.8	103.0	6265	3.8
16	30-31 1/2	- do -	24.0	129.4	100.7	3830	3.8
17	35-36 1/2	- do -	22.4	127.8	104.5	8095	2.5
18	40-41 1/2	- do -	26.7	126.2	99.6	7275	3.8
19	45-46 1/2	- do -	27.7	122.0	95.5	2110	3.8
20	50-51	- do -	21.7	132.3	108.7	-	-
21	55-56	- do -	17.2	133.1	113.5	16660	3.8
22	60-61	- do -	16.0	130.6	112.5	6310	2.5

ANNEX 7-3, Table A 7-3-5 NATURAL MOISTURE CONTENT, WET & DRY DENSITIES & UNCONFINED COMPRESSION TEST

JOB: CEMENT MILL, INGAUK VILLAGE

DRILL HOLE NO. 4A

SHELBY NO.	DEPTH Ft.	VISUAL CLASSIFICATION	MOISTURE content %	DENSITIES Lb/Cu. Ft. WET	DENSITIES Lb/Cu. Ft. DRY	UNCONFINED Strength Lb/Sq. Ft.	COMPRESSION Strain %
1	0- 2	Dark Brown SILT & CLAY, trace Sand, trace Gravel	39.7	123.8	88.6	850	13.8
2	2- 3 1/2	- do -	34.1	123.7	92.3	1715	11.3
3	3 1/2- 5	- do -	24.7	125.5	92.2	3950	18.8
4	5- 6 1/2	- do -	24.9	129.9	104.0	3765	18.8
5	6 1/2- 8	- do -	22.3	131.4	104.0	3760	20.0
6	8- 9 1/2	- do -	23.3	125.7	101.9	3095	15.0
7	9 1/2-11	- do -	24.4	124.2	99.8	2885	13.8
8	11-12 1/2	- do -	22.5	130.5	105.5	4675	20.0
9	12 1/2-14	Brownish Grey SILT & CLAY, trace Sand, trace Gravel	25.1	121.9	99.8	3575	20.0
10	14-15 1/2	- do -	24.5	126.0	101.2	3190	16.3
11	15 1/2-17	- do -	29.0	125.1	96.9	950	11.3
12	17-18 1/2	- do -	29.1	-	-	-	-
13	18 1/2-20	- do -	21.5	135.2	111.2	4905	18.8
14	20-21 1/2	- do -	25.8	127.5	101.4	2485	20.0
15	25-26 1/2	- do -	20.8	123.3	102.1	4720	11.3
16	30-31 1/2	- do -	22.5	131.3	107.2	3665	17.5
17	35-36 1/2	- do -	24.3	128.9	103.7	5595	5.0
18	40-41 1/2	Bluish Grey SILT and CLAY	22.0	130.8	107.0	7610	3.8
19	45-46	- do -	21.5	131.7	108.4	7715	2.5
20	50-51	- do -	20.7	135.9	112.5	11770	2.5
21	55-56	- do -	27.4	130.3	102.3	5330	4.0
22	60-61	- do -	21.3	130.2	107.3	8960	9.0

ANNEX 7-3, Table A 7-3-6 NATURAL MOISTURE CONTENT, WET & DRY DENSITIES & UNCONFINED COMPRESSION TEST

JOB: CEMENT MILL, INGAUK VILLAGE DRILL HOEL NO.5

SHELBY NO.	DEPTH Ft.	VISUAL CLASSIFICATION	MOISTURE content %	DENSITIES Lb/Cu. Ft. WET	DENSITIES Lb/Cu. Ft. DRY	UNCONFINED Strength Lb/Sq. Ft.	COMPRESSION Strain %
1	0- 2	Brownish Grey SILT & CLAY, trace Sand, trace Gravel	29.8	120.9	93.1	795	13.8
2	2- 3 1/2	- do -	25.7	128.4	102.1	1400	10.0
3	3 1/2- 5	- do -	20.1	122.6	102.0	3390	17.5
4	5- 6 1/2	- do -	15.4	135.3	117.2	9545	7.5
5	6 1/2- 8	- do -	18.0	134.1	113.6	6110	6.3
6	8- 9 1/2	- do -	28.0	124.7	97.4	4660	12.5
7	9 1/2-11	- do -	19.7	131.6	110.0	5285	8.8
8	11-12 1/2	- do -	20.9	131.4	110.8	4335	8.8
9	12 1/2-14	- do -	19.8	134.0	111.8	4490	10.0
10	14-15 1/2	- do -	23.0	125.3	101.8	3695	12.5
11	15 1/2-17	- do -	21.3	130.5	107.5	3450	13.8
12	17-18 1/2	- do -	23.6	131.4	106.3	2960	12.5
13	18 1/2-20	- do -	19.0	129.3	108.6	4075	20.0
14	20-21 1/2	- do -	19.2	129.0	108.2	4935	10.0
15	25-26 1/2	- do -	23.6	126.2	102.1	4400	8.8
16	30-31 1/2	- do -	21.2	129.4	106.7	2365	2.5
17	35-36	Bluish Grey SILT & CLAY, trace Sand, trace Gravel	24.8	135.6	108.5	2775	3.8
18	40-41	- do -	25.1	111.0	88.7	-	-
19	45-46	- do -	21.9	111.9	91.7	-	-
20	50-51	- do -	19.1	118.1	99.1	-	-
21	55-56	- do -	17.8	130.1	110.4	5990	2.5
22	60-61	- do -	25.2	105.9	84.5	-	-
23	65-66	- do -	19.2	137.9	115.6	7995	2.5
24	70-71	- do -	21.1	112.7	93.1	-	-
25	75-76	- do -	20.8	134.0	110.9	-	-
26	80-81 1/2	- do -	24.6	109.0	87.4	-	-

ANNEX 7-3, Table A 7-3-7 NATURAL MOISTURE CONTENT, WET & DRY DENSITIES & UNCONFINED COMPRESSION TEST

JOB: CEMENT MILL, INGAUK VILLAGE DRILL HOLE NO.6

SHELBY NO.	DEPTH Ft.	VISUAL CLASSIFICATION	MOISTURE content %	DENSITIES Lb/Cu. Ft. WET	DENSITIES Lb/Cu. Ft. DRY	UNCONFINED Strength Lb/Sq. Ft.	COMPRESSION Strain %
1	0- 2	Brownish Grey SILT & CLAY, trace Sand, trace Gravel	25.5	123.9	98.7	3590	11.3
2	2- 3 1/2	- do -	22.0	109.1	89.4	-	-
3	3 1/2- 5	- do -	17.6	127.3	108.3	4340	6.3
4	5- 6 1/2	- do -	14.6	135.4	118.2	14470	5.0
5	6 1/2- 8	- do -	15.4	133.2	115.4	-	-
6	8- 9 1/2	- do -	12.1	139.6	124.5	7675	7.5
7	9 1/2- 11	- do -	14.3	136.7	119.6	9065	7.5
8	11- 12 1/2	- do -	14.4	135.6	118.5	7760	6.3
9	12 1/2- 14	- do -	13.4	134.0	118.1	10640	3.8
10	14- 15 1/2	- do -	17.4	125.1	106.5	8260	10.0
11	15 1/2- 17	- do -	16.1	135.2	116.4	7470	5.0
12	17- 18 1/2	- do -	15.0	135.0	117.3	7865	6.3
13	18 1/2- 20	- do -	14.2	129.1	113.0	5645	6.3
14	20- 21 1/2	- do -	18.3	127.3	107.6	8640	5.0
15	25- 26 1/2	- do -	19.4	126.7	106.1	6050	3.8
16	30- 31 1/2	- do -	22.4	126.5	103.3	5010	2.5
17	35- 36 1/2	Bluish Grey to brown SILT & CLAY, trace Sand, trace Gravel	20.0	126.8	105.7	9660	6.3
18	40- 41	- do -	17.8	136.9	116.2	13480	3.8
19	45- 46	- do -	16.5	132.4	113.6	12220	5.0
20	50- 51	- do -	19.5	133.7	111.7	9680	5.0
21	55- 56	- do -	16.9	134.4	115.0	9355	5.0
22	60- 61	- do -	17.6	134.3	114.2	13850	6.3
23	65- 66	- do -	18.7	115.7	97.5	-	-
24	70- 71	- do -	18.3	130.6	110.3	13330	3.8
25	75- 76	- do -	21.8	131.7	108.1	9475	5.0
26	80- 81	- do -	19.8	134.1	111.9	12280	3.8
27	85- 86	- do -	19.7	129.5	108.1	7980	5.0
28	90- 91	- do -	19.1	129.9	109.1	11990	5.0
29	95- 96	- do -	17.0	130.6	111.6	7665	3.8
30	100-101	- do -	21.4	131.7	108.5	6930	5.0

ANNEX 7-3, Table A 7-3-8 NATURAL MOISTURE CONTENT, WET & DRY DENSITIES & UNCONFINED COMPRESSION TEST

JOB: CEMENT MILL, INGAUK VILLAGE DRILL HOLE NO.8

SHELBY NO.	DEPTH Ft.	VISUAL CLASSIFICATION	MOISTURE content %	DENSITIES Lb/Cu. Ft. WET	DENSITIES Lb/Cu. Ft. DRY	UNCONFINED Strength Lb/Sq. Ft.	COMPRESSION Strain. %
1	0- 2	Brownish Grey SILT & CLAY, trace Sand, trace Gravel	15.1	114.5	99.5	-	-
2	2- 3 1/2	- do -	14.9	132.0	115.1	9860	3.8
3	3 1/2- 5	- do -	13.9	111.1	123.2	16450	6.3
4	5- 6 1/2	- do -	14.2	131.2	115.0	9850	3.8
5	6 1/2- 8	- do -	13.4	133.2	117.5	13910	6.3
6	8- 9 1/2	- do -	16.2	132.5	114.0	8200	6.3
7	9 1/2-11	- do -	21.7	122.4	100.7	4130	3.8
8	11-12 1/2	- do -	19.6	126.2	105.6	6800	5.0
9	12 1/2-14	Bluish Grey SILT & CLAY, trace Sand trace Gravel	19.7	131.0	109.5	5275	3.8
10	14-15 1/2	- do -	19.0	127.9	107.5	4300	2.5
11	15 1/2-17	- do -	18.2	127.9	108.0	4230	3.8
12	17-18 1/2	- do -	19.4	138.1	115.5	6250	2.5
13	18 1/2-20	- do -	16.9	134.5	115.1	6410	1.3
14	20-21 1/2	- do -	19.6	132.5	110.8	8040	6.3
15	25-26 1/2	- do -	17.7	133.1	113.3	7500	2.5
16	30-31 1/2	- do -	17.4	134.0	114.0	13250	6.3
17	35-36 1/2	- do -	15.4	128.1	110.0	-	-
18	40-41 1/2	- do -	19.7	118.5	98.9	-	-
19	45-46 1/2	- do -	17.6	129.3	109.9	-	-
20	50-51 1/2	- do -	18.6	133.2	112.5	6600	3.8
21	55-56 1/2	- do -	16.9	128.6	110.0	-	-
22	60-61 1/2	- do -	15.8	134.8	115.4	-	-
23	65-66 1/2	- do -	16.5	139.3	119.5	8650	6.3
24	70-71 1/2	- do -	16.7	132.2	113.4	-	-
25	76-76 1/2	- do -	15.7	132.5	114.5	-	-
26	80-81 1/2	- do -	15.5	112.3	98.3	-	-

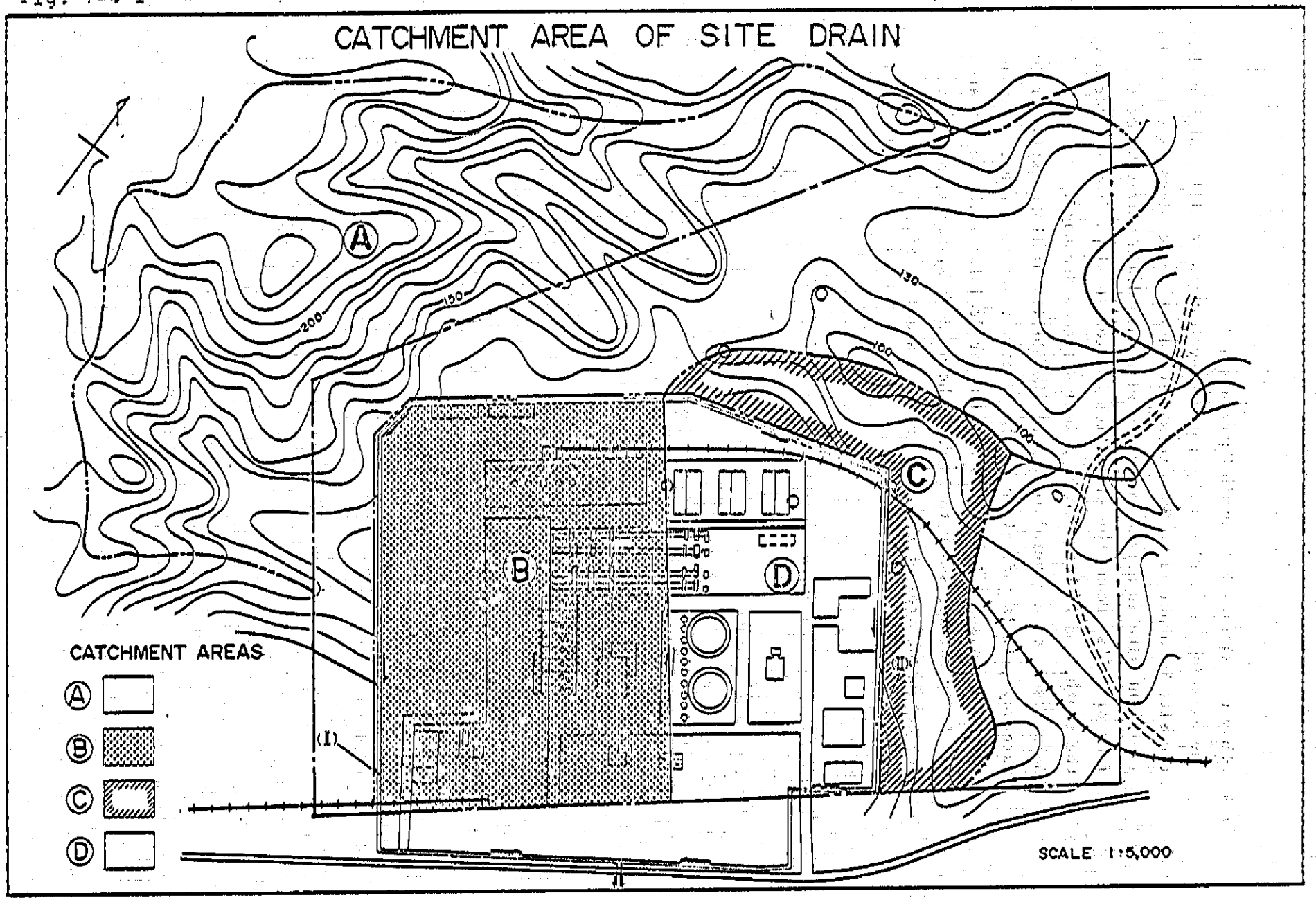
7-4 Study of Existing Main Drain Waterways

The existing plant site is surrounded by low gentle hills, higher than the site by about 15 to 30 meters, around its three sides except south. The plant site is already provided with main drain waterways at the foot of hills around the site which has gentle slope from the north to the south, and it seems to be a well designed drainage.

As a result of a general review of the ability of the existing drain waterways, it is made clear as shown below that the present drainage system has a sufficient cross-section for draining water in the area and it is not necessary to improve the present system at present.

The catchment area of the plant site is shown in Fig. 7-4-1.

Fig. 7-4-1


CATCHMENT AREA OF SITE DRAIN
A
B
C
D
200
150
130
100
100
CATCHMENT AREAS
A
B
C
D
(I)
(II)
SCALE 1:5,000

Calculation of run-off

(1) Conditions

Rainfall intensity i = 90 mm/h

Coefficient of roughness of waterway n = 0.014 (concrete)

Coefficient of run-off C = 0.8 (plant site)

C = 0.6 (Mountains and forests)

(2) Formula

(i) Maximum run-off

$Q = 1/360 . C.i.A.$

Q : Maximum run-off (m^3/sec)

C : Coefficient of run-off

i : Rainfall intensity (mm/h)

A : Catchment area (ha)

(ii) Manning's formula for average velocity of flow

$$V = \frac{1}{n} R^{2/3} I^{1/2}$$

V : Average velocity of flow (m/sec)

n : Coefficient of roughness

R : Hydraulic mean depth (m) (A/S)

A : Crosssectional area of stream (m^2)

S : Length of wetted perimeter (m)

I : Surface slope

(iii) Allowable run-off

$Q_a = V.A$

Q_a : Allowable run-off (m^3/sec)

V : Average velocity of flow (m/sec)

A : Crosssectional area of stream (m^2)

(iv) Factor of safety

$$F = \frac{Qa}{Q}$$

F : Factor of safety

(v) Maximum run-off

$$Q = \frac{1}{360} .C.i.A$$

Table 7-4-2

Catchment area code	C	I(mm/h)	A(ha)	Q(m^3/sec)	Qa(m^3/sec)	F
A	0.6	90	35.6	5.34	-	-
B	0.8	90	9.6	1.92	-	-
Total	(Drain waterway I)			7.26	8.65	1.19
C	0.6	90	5.7	0.85	-	-
D	0.8	90	7.5	1.50	-	-
Total	(Drain waterway II)			2.35	8.65	3.68

(vi) Allowable run-off of drain waterway

Crosssection of drain waterway

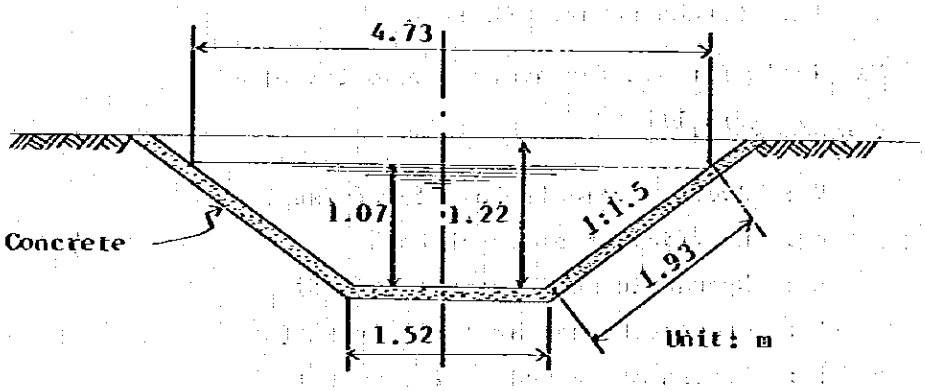


Fig. 7-4-3

$Qa = V.A$

$A = (4.73 + 1.52) \times 1/2 \times 1.07 = 3.34\ m^2$

$V = \frac{1}{n} R^{2/3} . I^{1/2}$

$= \frac{1}{0.014} \times (0.62)^{2/3} \times 0.0025^{1/2}$

$= 2.59$ m/sec

$Qa = 2.59 \times 3.34 = 8.65\ m^3/sec$

Where,

n = 0.014 (concrete)

$R = A/S$

$= \frac{3.34}{5.38} = 0.62$ m

I = 1/400 = 0.0025

(vii) Factor of safety

$F = \frac{Qa}{Q}$

Drain waterway (I) $F = \frac{8.65}{7.26} \fallingdotseq 1.19$

Drain waterway (II) $F = \frac{8.65}{2.35} \fallingdotseq 3.68$

7-5 Limestone Open Stockyard Drainage Plan

This drainage plan was roughly made by the survey team based on one-to-five-thousand topographical map obtained from Burma. However, in executing this project, the detailed survey should be made to decide the detailed plan.

Refer to the attached Fig. C-12 for the planned drainage and drain area. Because the formula for the claculation of the flow quantity is the same as that described in the paragraph, "7-4 Study of Existing Main Drain Waterways", it is omitted in this section.

(1) Maximum flow of rain water

$$Q = \frac{1}{360} C.i.A \ (m^3/sec)$$

Table 7-5-1

Drainage	Catchment area	C	i (mm/h)	A (ha)	Q (m^3/sec)
I	A	0.8	90	32.0	6.40
II	B	0.8	90	22.1	4.42

(2) Calculation of the section of drainage

(i) Drainage (I)

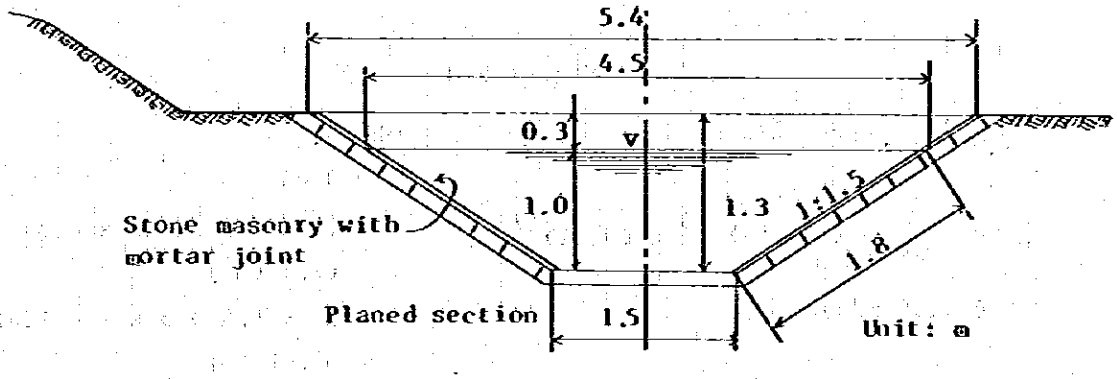


Fig. 7-5-2

$$Q_o = V.A$$

$$V = \frac{1}{n} \cdot R^{2/3} \cdot I^{1/2}$$

$$V = \frac{1}{0.03} \times (0.588)^{2/3} \times (0.01)^{1/2}$$

$$= 2.33 \ (m/sec)$$

$Q_0 = V.A = 2.33 \times 3.0 = 6.99\ (m^3/sec)$

$F = \frac{Q_0}{Q} = \frac{6.99}{6.40} \fallingdotseq 1.09$

where,

n = 0.03 (Stone masonry with mortar joints)

R = A/S

A = 3.0 (m^2)

S = 1.5 + (1.8 x 2) = 5.1 (m)

$R = \frac{3.0}{5.1} = 0.588\ (m)$

I = 0.01

(ii) Drainage (II)

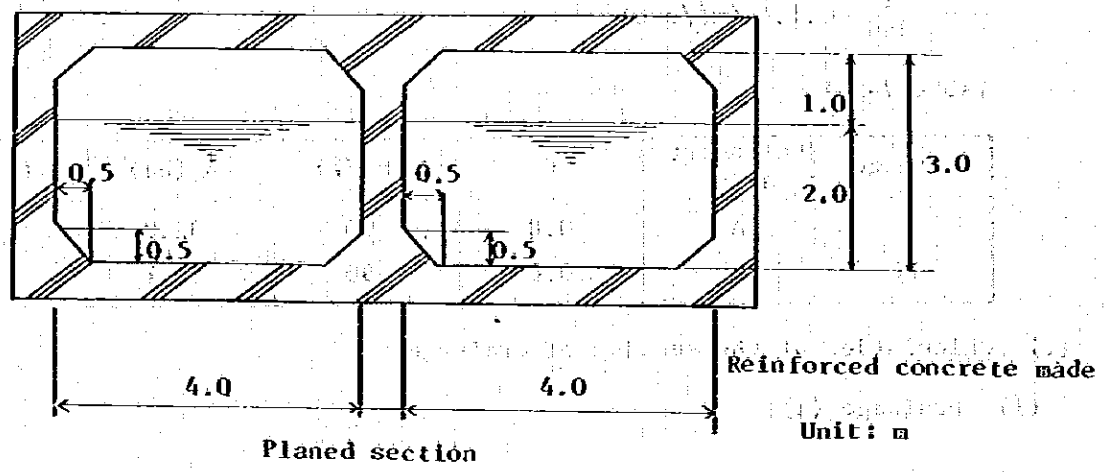


Fig. 7-5-3

$V = \frac{1}{n} \cdot R^{2/3} \cdot I^{1/2}$

$= \frac{1}{0.05} \times (0.58)^{2/3} \times (0.01)^{1/2}$

$\fallingdotseq 1.39$ m/sec

where,

n = 0.05

A = (4 x 2.0 - 0.5 x 0.5) x 2

= 15.5 (m^2)

S = (4 x 1.5 + 3 x 2 + 1.41) x 2

= 26.82 (m)

$Q_0 = V.A$

$= 1.39 \times 15.50 \fallingdotseq 21.54\ m^3/sec$

$R = \frac{A}{S} = \frac{15.50}{26.82} \fallingdotseq 0.58$

$F = \frac{Q_0}{Q} = \frac{21.54}{4.42} \fallingdotseq 4.8$

I = 0.01

7-6 Civil Construction Materials

7-6-1 Outline

The civil construction works will be undertaken by C.C. (Construction Corporation) in accordance with the drawings provided by the suppliers. All the materials with exception of cement, aggregate, lumber, bricks, asbestos cement boards and reinforced concrete pipes, etc., will be imported from the suppliers.

The quantities of the materials should include the quantity estimated from the drawings plus allowance.

The civil construction materials such as steel frames for buildings, stairs, etc., except steel bars for concrete structures, will be delivered in partially fabricated state and assmebled at the construction site.

Therefore, the actual sizes of steel frames and structures, etc., should be checked well at the designing and fabricating stages.

7-6-2 Materials to be imported

(1) 1-Lot of Reinforcing bar
(2) 1-Lot of prefabricated steel strucrure
(3) 1-Lot of Prefabricated steel door with accessories
(4) 1-Lot of corrugated galvanized iron sheets
(5) 1-Lot of corrugated translucent sheets
(6) 1-Lot of Paint for structural steel, steel doors, and steel windows
(7) 1-Lot of Vinyl tile and bond for control room
(8) 1-Lot of laboratory sink

CHAPTER 8 PLAN FOR CONSTRUCTION WORK

8-1 Outline

The porject is for an expansion of wet-process cement manufacturing plants which are of the type and capacity as those of the existing plants. As this is an additional construction, it may be estimated to be relatively easier than a totally new plant construction. However, if such problems as "transportation of raw materials", "excessive slurry water content", "inefficiency of cement packing and delivery", etc. are not solved, the same problems as those in the existing plant operation will be brought about, i.e. the poor production capacity and the extreme difficulty in operation in the rainy season.

In this expansion plan, sufficient considerations are to be given to the above problems. Unless they are carefully studied at the actual detailed designing, manufacturing and installation stages, the purposes cannot be achieved as initially planned.

Above all, transportation of sticky raw materials is the source of trouble in cement factories in every nation, and this problem should be carefully studied at the actual designing stage. The inadequate-sections in the existing plant should be improved at the detailed designing stage.

8-2 Administrative Organizations in Burma and Their Roles

This project will be executed by the following corporations under the control of the Ministry of No. 1 Industry. The Industrial Planning Department (I.P.D.) will be responsible for preparation and planning of the project. I.P.D. will undertake the determination of the scope of the project, planning of the implementation schedules for the project, feasibility studies, selection of plant site and negotiations for the contract. Additionally, the I.P.D. will also provide consulting services during the course of implementing the project and assist in coordinating with other governmental organizations to smoothly execute the project.

The supply contract will be signed between the Ceramic Industries Corporation (C.I.C.) and the successful supplier. The C.I.C. will undertake the implementation of the project.

In other words the project shall be within the scope of I.P.D.'s responsibility before the supply contract is signed, and shall be under responsibility of C.I.C. thereafter.

8-3 Method and System of Construction Work

(1) Procurement of construction materials and equipment

The construction materials which can be procured in Burma are limited to cement, aggregate, lumber, etc. while all the other civil construction materials such as steel bars, steel sheets, shape steel, doors, sashes, etc., must be imported.

All the machinery and equipment such as heavy machines for quarrying, vehicles, mechanical and electrical machinery and equipment, industrial instruments including other related equipment and electric cables must be imported.

Additionally, spare parts necessary for two years operation and maintenance must be also included.

As for construction consumables, electric welding rods (electrode) must be imported, while acetylene gas, oxygen, etc., can be supplied from Rangoon.

(2) Transportation of construction materials and equipment

Stationary crane with unloading capacity of 40 tons is available at the port of Rangoon. The construction materials and equipment are to be transferred to smaller ships by this crane, and carried through the River Irrawaddy. They will be landed at Kyangin located approximately 240 kilometers (= approx. 150 miles) north of Rangoon.

There are no harbor facilities at Kyangin. Therefore, the landing spot will be readjusted, if necessary, and the materials and equipment will be unloaded by truck cranes.

Among truck cranes which were used during the construction of the existing plant, two units might be available at present; one with 40-ton lifting capacity, and the other with 15-ton lifting capacity. However, their availability at the time of execution of this project is in question.

The supplier, therefore, must check the availability and provide necessary countermeasures.

Along the slope of the river bank, the cargoes will be pulled up by a bulldozer. The road to the factory is 5.5 meters wide, flat and paved (approx. 10 kilometers, or approx. 6.4 miles), and the bridges which

can withstand the supposed maximum load are available, and no other special obstacle to the transportation is foreseen.

The Burmese organization has confidence in land transportation from the experience of the construction work of the existing plant. However, should any accident occur during the transport, especially at landing, or should any equipment fall into the river, the damage will be fatal. The cargoes, therefore, should be adequately handled with special care. As no road exists between the plant and the limestone quarry, the construction materials must be carried by using the existing exclusive sidetrack.

(3) Erection

As for the machinery and equipment, C.I.C. will undertake the erection work under the supervision by the engineers of the supplier and using the erection equipments and tools to be provided by the supplier.

On the other hand, the Construction Corporation (C.C.) will execute the work, after C.C. entered into the contract with C.I.C., on the basis of drawings provided by the supplier. C.C. possesses the heavy machines necessary for civil construction work, cement mixing equipments (for field mixing), etc.

The following is the number of workers necessary for the Kyangin Cement Mill expansion project, which was shown in the feasibility study report prepared by C.I.C.

(a)	Professionals	16
(b)	Technicians	28
(c)	Skilled Labourers	209
(d)	Unskilled Labourers	72
	Total	325

However, the actually required number of the workers will be, of course, increased or decreased during the construction period, and the necessary number can be secured, according to the authority.

Although their actual skills are not clear, the number of workers can be increased or decreased as required, and highly skilled supervisors will be sent to guide the workers. Thus, the civil and erection work by C.I.C. and C.C. is judged practicable considering their experiences. The plant construction schedule has to be planned with due allowance, taking into consideration the fact that the work would be concentrated during the dry season.

There are no particular problems with electric power and water necessary for erection work inside the plant. However, when the quarry facilities and the loading facilities are increased, it should be checked beforehand whether sufficient electric power for the work will be available. Adequate measure must be taken, if it is short of requirement.
C.C. will be in charge of the quarry development and construction of the railroad facilities. However, new working faces in the quarry must be developed by C.I.C. Additionally, it is required to continue the operation of the existing plant as much as possible during the plant expansion.

8-4 Test Operation and Start-up of the New Production Lines

There will be no particular problems during the test operation after completing the installation because the skilled operators are working in the plant, which is different from the case of a new plant construction. However, the number of operators must be increased for the plant expansion, and the new personnel should be educated and trained in advance. The increase in the number of persons after starting test operation is as follows:

(a)	Professionals	30
(b)	Technicians	60
(c)	Skilled Labourers 419	
(d)	Unskilled Labourers 146	
	Total	655

The above figures are shown by C.I.C. in the feasibility study report on the Kyangin Cement Mill expansion project.
During the test operation period, the production should be set at 50% of the designed capacity for the purpose of adjusting inadequate parts to solve troubles which may occur in this period.
After the six-month test operation period, the production target will be set at 80% of the designed production capacity for the first one year, though it is of course desirable that, if there is no particular problem, attempts should be made continuously to increase the production to the designed capacity level and maintain it as long as possible.

8-5 Work Schedule of The Project

Table 8-5-1

No.	Particulars	1st year				2nd year				3rd year				4th year				5th year				6th year			
		1979				1980				1981				1982				1983				1984				1985	
		2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1
1	Tender Preparation and Invitation																								
2	Tender Vetting and Selection					Contract																			
3	Rehabilitation Works																								
4	Construction Works																								
5	Machineries Installation																								
6	Test Operation and Acceptance																								
7	Production																								

CHAPTER 9 INFRASTRUCTURE

9-1 Roads

The roads which would be required for this project were re-adjusted at the time of construction of the existing factory, hence no problem is expected.

However, there is no road from the factory to the limestone quarry. Means of transports for this section will be the exclusive sidetrack only, for the time being. Though the construction and operation can be done by using this exclusive sidetrack, it may lead to a low efficiency in quarrying. For this reason, construction of a new road over the said section in the future is considered very desirable.

9-2 Exclusive Sidetracks

(1) Present condition

(i) Sidetrack for transportation of limestone

The sidetrack approx. 5.34 miles (= approx. 8.6 km) long, extended from the factory to the ore loading bins in the quarry has been constructed.

On the way of the siderack, approx. 1.82 miles (= approx. 2.9 km) from the quarry, the shunting line to allow trains to go across has been provided.

Main bridges and bridges over ditches are shown in the attached drawing C-10. The bridges which are 40 feet (=12.19 m) or longer, are as follows.

L = 40' (12.19m) ..... 3 bridges
L = 60' (18.28m) ..... 1 bridge
L = 120' (36.57m) ..... 1 bridge
L = 220' (67.05m) ..... 1 bridge

The terminals at the ore bin yard and the unloading hopper yard are also shown in the attached Dwg. No. C-10.

(ii) Sidetrack for cement transportation

The sidetrack approx. 6 miles (approx. 9.6 km) in length, extended from the mill to the foreshore cement shipment base at the River Irrawaddy, has been constructed.

The terminals at the bagged cement shipment base at the mill and the foreshore cement shipment base are shown in the attached DWG. No. C-10.

The outline of the design which is common to the two sidetrack routes, is as follows:

a) Rail gauge ..... 3' - 3 3/8" (1,000 m)

b) Maximum gradient ..... 1/300 (3.3%) Almost flat.

c) Rail ..... Main 85 lbs/yard (42.5 kg/m)
Sub 60 lbs/yard (30 kg/m)
Most of them are used-rails made in the U.S.

d) Switch ..... 1 - 8 1/2
Most of the switch are spring switches.

e) Sleeper ..... 6'(L) x 8"(W) x 4.5"(T) (1,828 x 203 x 144 mm)
13 pieces per 33' (10 m)

f) Thickness of ballast 4.5" from the bottom of the sleeper

g) Roadbed ..... Average height of the bank; approx. 6 feet (= approx. 1.8 meters)
Black cotton soil
(Note; It is weathered black basaltic soil)
In the rainy season, rivers of various sizes near the railway line flood, and the support of the roadbed becomes aggravated by permeating water.

h) Present train travelling speed..... Dry season : 25 km/h
Rainy season : 20 km/h

Table 9-2-1

	Distance (km)	Travelling time (minutes) Dry season	Rainy season
Limestone transport	8.6	21	26
Cement transport	9.6	23	29

i) Formation and transport ..... Refer to 6-4 "Plan for the limestone transportation method" and 6-7 "Plan for the cement transportation method".

(2) Study of the existing sidetracks

(i) Rails

Used-rails were utilized when the existing sidetracks were laid. Wear must be checked well, and the right and left rails should be duely exchanged or replaced for new ones.

(ii) Sleepers

Sleepers made of soft wood are used.

Corruption, thrust of the rail, or cut and tear were observed partially. Spikes could not be replaced for some of them. If the sleepers are deteriorated, the support of the railway line would be aggravated. Accordingly, they should be checked, and the defective ones should be replaced with the new sleepers. Use of the sleepers made of hard wood are advisable.

(iii) Ballast

At present ballast is made of sand. It is laid approx. 4.5 inches (≒ 114mm) thick, and most of it is only at the bottom of sleepers. (It is unknown whether the sand between the top and bottom of the sleepers has been washed out by rain.)

The rails are remarkably bent over the entire track. It is considered that the track is being destroyed due to horizontal pressure which occurs as the train travels. The destructed track is serious problem in view of safe travelling as such destruction escalates very fast. The followings are considered as the causes of destruction.

1) Spikes are pushed out.
2) Spikes are pulled up.
3) In spite of the normal support of the rail, the sleepers are pushed out with the rail, and the wrap occurs rapidly.

Especially, the destruction often occurs at the spot where the roadbed is soft, or where the level of the right and left rails is bad, or where ballast is not sufficiently tamped down.

The main cause for the bent in the rail on the main track is assumed to be (3) above. The sand is provided under the sleepers only. This causes the absence of resistance at the end surface of the sleepers. It is desirable to lay ballast on top of the rail bed sand in thickness of 150 mm - 200 mm or more and upto the top end of the sleepers. The rail track to be additionally installed under this project should be executed in accordance with the above specification.

(iv) Roadbed

Due to flooding of large and small rivers in the rainy season, water permeates into the roadbed of the banks and weakens the banks. This is the cause of sinking.

As a countermeasure against this problem, the replacement of the material for the bank roadbed would be considered at this point. However, it will require high cost and difficult work. For this reason, another possible method is recommended to widen the bank width to minimize the affect of the permeated water as shown below.

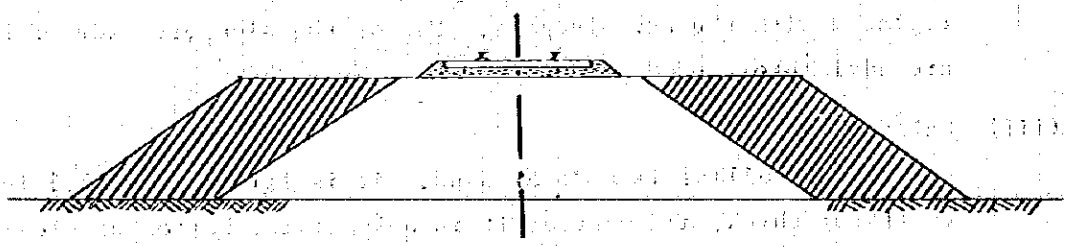


Fig. 9-2-2

(v) Travelling speed

The speed of the train depends on the capacity of the locomotive, However, it is also affected by the following conditions due to the structure of the sidetracks.

a) Stability of the roadbed
b) Supporting capacity of the ballast
c) Thickness of the ballast
d) Interval of the sleepers

The increase in the speed is possible if the above points are improved as described above.

The causes of the speed-down are the obsolete wagons which are provided with no brakes, and the pin-type coupler. The problem can be solved by replacing the wagons for new ones.

(vi) Signal system

Signal, signs and communication facilities are not available at present. As this is dangerous in the train operation, it is necessary to establish the communication facilities and the safety signs between respective terminals.

(3) Study of the capacity of the sidetrack after the expansion of the plant and the required works for expansion.

As was studied in Section 6-4: Plan for the limestone transportation method and Section 6-7: Plan for the cement transportation method, the sidetrack for the above transportation need not be made a double-track

even after the expansion of the mill. However, it is necessary to extend the existing sidetracks to respective terminal and improve them as shown in the attached drawings (C-10, C-11, C-12).

(i) Quarry site

Sidetrack is to be extended from the existing ore bins to the newly installed ore bins. (Extension approx. 640 m)

(ii) Plant site

a) The sidetrack for the unloading of the limestone is to be additionally laid. (Extension approx. 820 m)

b) Sidetrack for cement loading is to be newly laid. (Extension - approx. 205 m)

(iii) Foreshore

Sidetrack for the unloading of cement is to be installed. (Extension - approx. 270 m)

CHAPTER 10 CALCULATION OF COST AND PROFITABILITY

10-1 Costruction Cost

(1) Construction cost

Table 10-1-1 below shows the plant construction cost by different rates of loan interest, based on the study of the specifications of the machinery and equipment and the estimation of the erection cost for the expansion project (including the quarries).

Table 10-1-1 Plant Construction Cost

(in 10^3 KS)

			Foreign currency portion	Domestic currency portion	Total
Quarry road, etc.			-	1,700	1,700
Civil construction cost			34,000	116,600	150,600
Facilities cost			233,000	102,000	335,000
Detail: Machinery & equipment			(203,000)	(89,000)	(292,000)
Heavy machines			(30,000)	(13,000)	(43,000)
Erection cost			7,000	4,000	11,000
Construction expenses			-	1,700	1,700
Total			274,000	226,000	500,000
Interest for construction costs		Interest rate (7%/y)	-	57,540	57,540
		" (3%/y)	-	24,660	24,660
		" (2.75%/y)	-	22,605	22,605
Working capital			-	7,300	7,300
Grand Total	Construction interest	7%/y	274,000	290,840	564,840
		(10^3 US$)	≒42,810	≒45,440	≒88,250
		(10^3 Yen)	≒8,562,000	≒9,088,000	≒17,650,000
		3%/y	274,000	257,960	531,960
		(10^3 US$)	≒42,810	≒40,310	≒83,120
		(10^3 Yen)	≒8,562,000	≒8,062,000	≒16,624,000
		2.75%/y	274,000	255,905	529,905
		(10^3 US$)	≒42,810	≒39,990	≒82,800
		(10^3 Yen)	≒8,562,000	≒7,998,000	≒16,560,000

Note: Exchange rates 1 US$ = 6.4 KS

1 US$ = 200 yen

Note: 1. Construction interest was calculated on the basis that the interest on the loan during the construction period (3 years) is to be borne by the domestic currency portion.

2. For the quarry road construction cost and other cost, refer to 5-2-3.

3. For the details of the working capital, refer to Table A 10-1-1 in Annex 10-1.

4. The unit prices employed for computing the construction and erection cost are given in Table A 10-1-2 in Annex 10-1.

(2) Divisional construction cost

Table 10-1-2 shows the estimated construction cost for each division.

Table 10-1-2

x 10^3 KS

Division	Foreign currency portion	Domestic currency portion	Total
Quary	30,000	13,000	43,000
Primary crushing	31,500	32,500	64,000
Raw material receiving	17,500	20,500	38,000
Raw material grinding	28,000	20,500	48,500
Kiln cooler	51,500	40,000	91,500
Cement grinding	27,000	26,500	53,500
Packing and shipping	7,500	8,000	15,500
Foreshore shipping	13,500	14,500	28,000
Industrial water	12,500	10,000	22,500
Electricity	31,500	30,300	61,800
Laboratory equipment, etc.	3,000	1,300	4,300
Miscellaneous	4,000	1,700	5,700
Spare parts	16,500	7,200	23,700
Total	274,000	226,000	500,000

(3) Construction cost per ton of annual cement production

The construction cost per ton of annual cement production, which is one of the reference values in evaluation of the total construction cost, is given in Table 10-1-3.

Table 10-1-3 Construction Cost per Annual Tonnage

KS/t. cement

Operation rate (Cement basis)	80%	100%
Construction cost	2,490	1,993
Construction interest	123	98
Working capital	37	29
Total	2,650	2,120

Note: The above is for the 3% rate of annual interest on the loan.

10-2 Production Cost

The production cost was computed on the following conditions.

10-2-1 Rated production

(1) Plant capacity (at operation days per annum of 300 days)

Clinker	800 t/d	240,000 t/y
Cement	836 t/d	250,800 t/y

(2) Rated production (per annum)

Operation rate	80%
Clinker	192,000 t/y
Cement	200,640 t/y

10-2-2 Basic Computation of the Production Cost

(1) Direct cost

(i) Raw materials

Unit consumption (Dry basis)

Limestone	1.33	t/t.clinker
Clay	0.2	"
Laterite	0.03	"
Total	1.56	"
Gypsum	0.045	"

Unit prices (Dry basis)

For the details refer to Annex 10-2.

Limestone	7.59	KS/t	10.09	KS/t.clinker
Clay	0	"	0	"
Laterite	16.97	"	0.51	"
Ggypsum	190.77	"	8.58	"
Total			19.18	"

(ii)	a. Natural gas (for clinker production)		
	Heating value	8,015 Kcal/m^3	
	Unit consumption	1,650 x 10^3 Kcal/t.clinker	
		= 205.86 m^3/t.clinker	
	Unit price	0.037 KS/m^3	7.62 KS/t.clinker
	b. Diesel oil (for vehicles and rolling stock)		
	Unit consumption	7.94 l/t.clinker	
	Unit price	0.695 KS/l	5.52 KS/t.clinker
(iii)	Firebricks		
	Unit consumption	1.5 kg/t.clinker	
	Unit price	3.71 KS/kg	5.57 KS/t.clinker
(iv)	Grinding media		
	Unit consumption		
	Raw grinding mill	0.55 Kg/t.clinker	
	Cement mill	0.15 "	
	Total	0.70 "	
	Unit price	5.40 KS/kg	3.78 KS/t.clinker
(v)	Lubricants		
	Unit consumption		
	Lubricating oil	0.08 l/t.clinker	
	Grease	0.01 Kg/ "	
	Unit price		
	Lubricating oil	6.96 KS/l	0.56 KS/t.clinker
	Grease	34.66 KS/kg	0.35 "
	Total		0.91 "
(vi)	Electricity		
	Power consumption	130 kWh/t.clinker	
	Unit price	0.17 KS/kWh	22.10 KS/t.clinker
(vii)	Repair		
	Price per ton of clinker		5.08 KS/t.clinker
(viii)	Paper bag		
	Unit consumption	20 bags/t.cement	
	Unit price	3 KS/bag	60 KS/t.cement

(2) Fixed cost

(i) Labour cost (The mining labour cost is included in the limestone material cost.)

Number of workers after the plant expansion	435 persons
Average wages	220 KS/person.month
Annual labour expenses	1,148,400 KS/year

(ii) Depreciation

Residual value	10%	
Durable years		
Building and structure	40 years	2.5%/year
Machinery and Electrical equipment	20 years	5%/year
Heavy machines for quarry	5 years	20%/year

Annual depreciation

Building and structure	$150,600 \times 10^3 \times 0.9 \times 0.025 = 3.388 \times 10^3$ KS
Machinery and electrical equipment	$306,400 \times 10^3 \times 0.9 \times 0.05 = 13.788 \times 10^3$ KS
Heavy machine for quarry	$43,000 \times 10^3 \times 0.9 \times 0.2 = 7.740 \times 10^3$ KS
Total	24,916,000 KS/year

(iii) Interest

Annual rate of interest	7%	$274,000 \times 10^3 \times 0.07 = 19,180,000$ KS/year
"	3%	$274,000 \times 10^3 \times 0.03 = 8,220,000$ KS/year
"	2.75%	$274,000 \times 10^3 \times 0.0275 = 7,535,000$ KS/year

(iv) General expense

Unit price per ton of cement 8.49 KS/t.cement

10-2-3 Production cost

The production cost was computed in accordance with the above basic computation, and is shown in Table 10-2-1.

Table 10-2-1 Production cost

(Interest rate 3%/y)

	10^3 KS/year	KS/t.cement
Direct cost		
Raw materials	3,683	18.35
Natural gas	1,463	7.29
Diesel oil	1,060	5.28
Firebricks	1,069	5.33
Grinding media	726	3.62
Lubricants	175	0.87
Electricity	4,243	21.15
Repair cost	975	4.86
Paper bag	12,038	60.00
Total of direct cost	25,432	126.75
Fixed cost		
Labour cost	1,148	5.72
Depreciation	24,916	124.18
Interest	8,220	40.97
General expenses	1,705	8.49
Total of fixed cost	35,989	179.37
Total of production cost	61,421	306.12

For the different rates of interest, the main items of the production cost are given below.

For the annual interest rate of 7%,

Direct cost	25,432 x 10^3 KS/year	126.75 KS/t.cement
Fixed cost	46,949 x 10^3 "	234.0 "
Total	72,381 x 10^3 "	360.75 "

For the annual interest rate of 2.75%

Direct cost	25,432 x 10^3 KS/year	126.75 KS/t.cement
Fixed cost	35,304 x 10^3 "	175.96 "
Total	60,736 x 10^3 "	302.71 "

10-3 Profitability

For each case shown in Table 10-3-1, the break-even-point, and the discount cash flow (DCF) analysis were made.

Table 10-3-1

Case No.	Operation rate (%)	Ex-factory price	Loan condition
1	80	410 KS	Annual int. rate - 3% Grace period - 7y Payment period - 25y
2	80	450	- ditto -
3	80	370	- ditto -
4	90	410	- ditto -
5	80	410	Annual interest rate - 27.5% Grace period - 10y Payment period - 30y
6	80	450	- ditto -
7	80	370	- ditto -
8	80	410	Annual int. rate - 7% Grace period - 7y Payment period - 20y
9	80	450	- ditto -
10	90	410	- ditto -

10-3-1 Break-even-point

In this project, the production of the rated plant capacity (the operation rate to be 80%) is expected in the fourth year after the plant expansion, and the economic life is set to be 20 years. Therefore, the break-even-points were calculated for the 4th and 20th year in each case respectively.

(1) Calculation formula

The sum of sales revenue is equal to the sum of production cost (direct and fixed cost) at the break-even-point.

Accordingly;

$$X(\%) = \frac{\text{Fixed cost}}{\text{Sales}-(\text{Direct cost} + \text{Goods and services tax})}$$

Where, X(%) is the ratio of the break-even-point to the plant capacity (the operation rate to be 80% or 90%). The ratio of the break-even-point to the rated plant capacity (i.e. the operation rate to be 100%) was also computed.

As the depreciation is reserved internally, the computation is sometimes made by using the fixed cost excluding the depreciation expense, which is called the cash break-even-point.

Table 10-3-2 shows the results of the computation for both cases.

Table 10-3-2 Break-even-point (in %)

Case No.	Year	Break-even-point		Cash break-even-point	
		Operation rate 80%	Ratio to the rated plant capacity	Operation rate 80%	Ratio to the rated plant capacity
1	4	89.1	71.3	27.4	21.9
	20	71.0	56.8	9.3	7.5
2	4	76.9	61.5	23.7	18.9
	20	61.3	49.0	8.0	6.4
3	4	106.0	84.8	29.9	23.9
	20	84.5	67.6	11.1	8.9
4	4	79.2(90%)	71.3	24.4(90%)	22.0
	20	63.1(90%)	56.8	8.3(90%)	7.5
5	4	87.4	69.9	25.7	20.6
	20	75.3	60.2	13.6	10.9
6	4	75.4	60.3	22.2	17.8
	20	65.0	52.0	11.7	9.4
7	4	104.0	83.2	30.6	24.5
	20	89.5	71.6	16.2	12.9
8	4	116.9	93.4	55.1	44.1
	20	68.8	55.0	7.1	5.7
9	4	100.8	80.7	47.6	38.1
	20	59.3	47.5	6.1	4.9
10	4	103.9(90%)	93.5	49.0(90%)	44.1
	20	61.1(90%)	55.0	6.3(90%)	5.7

10-3-2 DCF Analysis

The discount cash flow (DCF) analysis was made in the following conditions.

(1) Conditions

(i) Construction cost

Refer to Table 10-1-1.

(ii) Cement production

1st year 50% x 0.5 year = 25%

2nd year 80%

3rd year 100%

The cement production is shown in Table 10-3-3.

Table 10-3-3 Cement Production t/year

Case No.	Operation rate (%)	1st year	2nd year	3rd year on
1,2,3 5,6,7 8,9	80	50,160	160,512	200,640
4,10	90	56,425	180,560	225,700

(iii) Cement ex-factory price and goods and services tax

Table 10-3-4 KS/t.cement

Case No.	Ex-factory price	Goods and services tax
1,4,5,8,10	410	82
2,6,9	450	90
3,7	370	74

(iv) Production cost

Refer to 10-2-3 (Table 10-2-1)

(v) Depreciation

Refer to 10-2-2 (2).

(vi) Financial source

See 1-1-5 (3).

(vii) Interest, the term of payment and grace period

See Table 10-3-5.

Table 10-3-5

Case No.	Interest rate (%/year)	Term of payment (years)	Grace period (years)
8,9,10	7	20	7
1,2,3,4	3	25	7
5,6,7	2.75	30	10

(2) Profit and loss statements

(i) Profit and loss calculation

The profit and loss statements were prepared to show the revenue, various types of cost, income, and cash flow, of the project. This is a series of profit and loss statment over 20 years, from which the economic index representing the profitability can be obtained.

Examples of the profit and loss statements for case 1 and case 4 are shown in Table 10-3-6 and Table 10-3-7 respectively.

(ii) Economic indexes

a) Average investment profit rate: Average net earning/Investment (Construction cost) (%)

b) Average sales profit rate: Average net earnings/Net sales revenue (%)

c) Payout: The period of time required to recover the investment (construction cost) by cumulative cash.

d) Internal rate of return (IRR): The present worth factor, or a coefficient of the present value which makes the present value of the investment equal to that of the cash flow. See Table 10-3-8.

Table 10-3-6 Profit and Loss Statement Case 1

x 1000 ks

Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Investment	531960																			
Sales volume (t)	50160	160512	200640	200640	200640	200640	200640	200640	200640	200640	200640	200640	200640	200640	200640	200640	200640	200640	200640	200640
Unit price (ks/t)	410	410	410	410	410	410	410	410	410	410	410	410	410	410	410	410	410	410	410	410
Sales revenue	20565	65809	82262	82262	82262	82262	82262	82262	82262	82262	82262	82262	82262	82262	82262	82262	82262	82262	82262	82262
G/S tax	4113	13161	16452	16452	16452	16452	16452	16452	16452	16452	16452	16452	16452	16452	16452	16452	16452	16452	16452	16452
Net sales revenue	16452	52648	65810	65810	65810	65810	65810	65810	65810	65810	65810	65810	65810	65810	65810	65810	65810	65810	65810	65810
Expenses																				
Direct cost	6354	20311	25432	25432	25432	25432	25432	25432	25432	25432	25432	25432	25432	25432	25432	25432	25432	25432	25432	25432
Fixed cost	2853	2853	2853	2853	2853	2853	2853	2853	2853	2853	2853	2853	2853	2853	2853	2853	2853	2853	2853	2853
Depreciation	24916	24916	24916	24916	24916	24916	24916	24916	24916	24916	24916	24916	24916	24916	24916	24916	24916	24916	24916	24916
Interest	8220	8220	8220	8220	7762	7305	6849	6392	5935	5479	5022	4566	4109	3652	3196	2737	2283	1826	1367	913
Total	42343	56333	61421	61421	60963	60506	60050	59593	59136	58680	58223	57767	57310	56853	56397	55940	55484	55027	54570	54114
Net earning	-25891	-3685	4389	4389	4847	5304	5760	6217	6674	7130	7587	8043	8500	8957	9413	9870	10326	10783	11240	11696
Net earning	-25891	-3685	4389	4389	4847	5304	5760	6217	6674	7130	7587	8043	8500	8957	9413	9870	10326	10783	11240	11696
Depreciation	24916	24916	24916	24916	24916	24916	24916	24916	24916	24916	24916	24916	24916	24916	24916	24916	24916	24916	24916	24916
Total	-975	21231	29305	29305	29763	30220	30676	31133	31590	32046	32503	32959	33416	33873	34329	34786	35242	35699	36156	36612
Loan payment					15220	15220	15220	15220	15220	15220	15220	15220	15220	15220	15220	15220	15220	15220	15220	15220
Cash flow (1)	-975	21231	29305	29305	14543	15000	15456	15913	16370	16826	17283	17739	18196	18653	19109	19566	20022	20479	20936	21392
Cumulative cash (1)	-975	20256	49561	78866	93409	108409	123865	139778	156148	172974	190257	207996	226192	244845	263954	283520	303542	324021	344957	366349
Cash flow (2)	7245	29451	37525	37525	37525	37525	37525	37525	37525	37525	37525	37525	37525	37525	37525	37525	37525	37525	37525	37525
Cumulative cash (2)	7245	36676	74221	111746	149271	186796	224321	261846	299371	336896	374421	411946	449471	486996	524521	562046	599571	637096	674621	712146

Table 10-3-7 Profit and Loss Statement Case 4

x 1000 ks

Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Investment	531960																			
Sales volume (t)	56425	180560	225700	225700	225700	225700	225700	225700	225700	225700	225700	225700	225700	225700	225700	225700	225700	225700	225700	225700
Unit price (ks/t)	410	410	410	410	410	410	410	410	410	410	410	410	410	410	410	410	410	410	410	410
Sales revenue	23134	74029	92536	92536	92536	92536	92536	92536	92536	92536	92536	92536	92536	92536	92536	92536	92536	92536	92536	92536
G/S tax	4626	14805	18507	18507	18507	18507	18507	18507	18507	18507	18507	18507	18507	18507	18507	18507	18507	18507	18507	18507
Net sales revenue	18505	59224	74029	74029	74029	74029	74029	74029	74029	74029	74029	74029	74029	74029	74029	74029	74029	74029	74029	74029
Expenses																				
Direct cost	7150	22884	28609	28609	28609	28609	28609	28609	28609	28609	28609	28609	28609	28609	28609	28609	28609	28609	28609	28609
Fixed cost	2853	2853	2853	2853	2853	2853	2853	2853	2853	2853	2853	2853	2853	2853	2853	2853	2853	2853	2853	2853
Depreciation	24916	24916	24916	24916	24916	24916	24916	24916	24916	24916	24916	24916	24916	24916	24916	24916	24916	24916	24916	24916
Interest	8220	8220	8220	8220	7762	7305	6849	6392	5935	5479	5022	4566	4109	3652	3196	2739	2283	1826	1369	913
Total	43139	58873	64598	64598	64140	63683	63227	62770	62313	61857	61400	60944	60487	60030	59574	59117	58661	58204	57747	57291
Net earning	-24631	351	9431	9431	9889	10346	10802	11259	11716	12172	12629	13085	13542	13999	14455	14912	15368	15825	16282	16738
Net earning	-24631	351	9431	9431	9889	10346	10802	11259	11716	12172	12629	13085	13542	13999	14455	14912	15368	15825	16282	16738
Depreciation	24916	24916	24916	24916	24916	24916	24916	24916	24916	24916	24916	24916	24916	24916	24916	24916	24916	24916	24916	24916
Total	285	25267	34347	34347	34805	35262	35718	36175	36632	37088	37545	38001	38458	38915	39371	39828	40284	40741	41198	41654
Loan payment					15220	15220	15220	15220	15220	15220	15220	15220	15220	15220	15220	15220	15220	15220	15220	15220
Cash flow (1)	285	25267	34347	34347	19585	20042	20498	20955	21412	21868	22325	22781	23238	23695	24151	24608	25064	25521	25978	26434
Cumulative cash (1)	285	25552	59899	94246	113831	133873	154371	175326	196738	218606	240931	263712	286950	310645	334796	359404	384468	409989	435967	462401
Cash flow (2)	8505	33487	42567	42567	42567	42567	42567	42567	42567	42567	42567	42567	42567	42567	42567	42567	42567	42567	42567	42567
Cumulative cash (2)	8505	41992	84559	127126	169693	212260	254827	297394	339961	382528	425095	467662	510229	552796	595363	637930	680497	723064	765631	808198

Table 10-3-8 Economic Indexes

Case No.	Average investment profit rate (a) (%)	Average sales profit rate (b) (%)	Payout (c) (Year)	IRR (d)	
				To Burmese investment (%)	To construction cost(%)
1	1.6	11.9	15.2	3.5	2.8
2	2.9	19.7	13.1	6.7	4.5
3	0.3	2.4	18.1	-	1.0
4	2.6	17.4	13.5	6.0	4.1
5	1.4	10.6	15.5	5.4	2.9
6	2.7	18.6	13.0	8.5	4.6
7	0.2	1.7	18.0	1.6	1.0
8	0.8	6.0	16.1	-	2.2
9	2.1	14.4	13.8	1.8	3.8
10	1.8	12.2	14.3	1.2	3.5

10-3-3 Profitability

The profitability of this project is described below by evaluating the economic indexes obtained from the break-even-points and the DCF analysis (and the profit-and-loss statements).

(1) A state-owned cement plant like this project does not have to be more profitable than necessary, of course, the plant must not be shown a deficit in terms of the national policy. From this point of view, the profitability is described as follows.

(2) The profitability will be deteriorated in case the loan interest rate is 7%/year, which is considered to be the general commercial base. If the lower rate of interest is applied, the profitability can be expected in all the cases except Case 3.

(3) The break-even-points are regarded as favorable in all the cases except the cases 3, 7, 8 and 10. They are lowered as reduction of interest due to the repayment of loan.

(4) The economic indexes are generally in favourable range in all the cases except the cases 3, 7, 8, 9 and 10.

(5) As observed in case 4 and case 10, the profitability can be improved by the improvement of the operation rate.

(6) From the above, it is quite necessary that the loan interest rate should be as low as possible and that the operation rate is improved.

ANNEX 10-1

Table A10-1-1 Working Capital

Item	Stock days	Stock volume (t)	Unit price (KS/t)	Total 10^3 KS
Raw materials				
Limestone (quarry site)	9	9,000	7.59	68
Limestone (open & roofed stockyard)	94	100,000	7.59	759
Clay	8	1,300	0	0
Laterite	72	1,700	16.97	29
Gypsum	33	1,200	190.77	229
Consumables				
Paper bag	7	89,600(Bags)	3	269
Materials in the process				
Raw meal	4	5,700(m^3)	17.04	97
Clinker	22	18,000	66.62	1,199
Product				
Non-packed cement	22	18,000	77.47	1,394
Packed cement	4	3,500	137.47	481
Net production cost	30	20,000	137.47	2,745
Cash				30
Total required working capital				7,300

ANNEX 10-1

Table A10-1-2 List of the Unit Price for the Plant Construction

	Item	Specifications	Unit	Current Unit price		Estimate unit price for the project		Remarks
				KS	Yen	KS	Yen	
Construction materials	Cement	Packed in 50kg bags	t	340	10,200	-	-	
	Concrete aggregate	Coarse aggregate (River gravel 40mm)	m^3	100	3,000	-	-	
	- ditto -	Coarse aggregate (River gravel 20mm)	m^3	140	4,200	-	-	
	- ditto -	Fine aggregate (River sand)	m^3	140	4,200	-	-	
	Bricks		1000 P.C.S.	430	12,900	-	-	
	Lumber	10cm x 10cm	m^3	1,400	42,000	-	-	
	"	30cm x 30cm	m^3	1,500	45,000	-	-	
	"	ø 30cm	m^3	1,400	42,000	-	-	
	"	Board materials 3cm - 5cm thick	m^3	700	21,000	-	-	
	Steel bar	For reinforced concrete	t	-		4,233	127,000	
	Steel materials	Shape steel (Angle, channel and H-type steel)	t	-		14,333	430,000	Processed, delivered to the plant site.
	Rails		t	-		-	-	
	Galvanized iron plate	Corrugated 7' x 3'	m^2	31	930	38	1,140	
	- ditto -	Flat 8' x 3'	m^2	29-30	870-900	35	1,050	
	Asbestos slate	Corrugated 7' x 3'	m^2	31	930	38	1,140	
	- ditto -	Flat 4' x 4' x 5/32"	m^2	17	510	21	630	

(to be continued)

	Item	Specifications	Unit	Current Unit Price		Estimate unit price for the project		Remarks
				KS	Yen	KS	Yen	
	Reinforced concrete pipe	Ø36" x 10'	Pipe (m)	770 (253)	23,100 (7,590)	-	-	
Civil construction cost	Excavation	Up to depth of 1m	m^3	5	150	6	180	
	- ditto -	Up to depth of 2m	m^3	7	210	9	270	
	- ditto -	Up to depth of 3m	m^3	9	270	11	330	
	- ditto -	Up to depth of 5m	m^3	15	450	18	540	
	Concrete work	Including materials (1:2:4)	m^3	500	15,000	533	16,000	
	Frame work	Including materials	m^2	135	4,050	150	4,500	
	Reinforced work	Construction, and spot transpot included	t	-	-	1,500	45,000	
	Steel frame work	Construction but heavy machines excluded	t	11,000	330,000	1,500	45,000	Including Painting
	Bricking work	Including materials 1:3 mortar	m^3	403	12,090	-	-	
	Plaster work	Cement mortar 3cm thick	m^2	17	510	-	-	
	Roof work	Including materials corrugated slate	m^2	66	1,980	-	-	
	- ditto -	Including materials corrugated galvanized iron plate	m^2	66	1,980	-	-	
	Wall work	Including materials corrugated slate	m^2	61	1,830	-	-	

(to be continued)

	Item	Specifications	Unit	Current unit price		Estimate unit price for the project		Remarks
				KS	Yen	KS	Yen	
Civil construction cost	Wall work	Including materials galvanized corrugated iron plate	m^2	61	1,830	-	-	
	Piling work	R.C.(1:1.5:3) 14"x14"x45"		23,000	690,000	23,000	690,000	Including materials
	Railway work	Gauge: 1,000mm Average height of the constructed bank: 2m	m	340	10,200	500	15,000	Single line including materials
	- ditto -	Turnout including materials		6,000	180,000	6,666	200,000	
	Bridges	20m span		552,700	16,581 x 10^3	-	-	
Labour cost	Labourer		Per Person per day	10-12	300 - 360	-	-	
	Concrete worker		"	20-25	600 - 750	-	-	
	Brick worker		"	20-25	600 - 750	-	-	
	Carpenter		"	20-25	600 - 750	-	-	
	Plaster		"	20-25	600 - 750	-	-	
	Fabricater or assembler		"	20-25	600 - 750	-	-	
	Painter		"	20-25	600 - 750	-	-	

(to be continued)

Others	Common temporary construction	15% of the direct construction cost
	General expenses	12% of the construction cost
	Investigation and design	5% of the direct construction
	Supervisers expense	According to the calculation

(Note)

(1) The exchange rate from the Burmese currency to Yen used in calculation is 1 KS = 30 Yen.

(2) The land cost was considered in calculation as free of charge

ANNEX 10-2 Raw Materials Cost

1) Limestone

Production (dry basis)	256,000 t/y
Direct cost	
Explosive	0.46 KS/t
Fuel and lubricants	1.16 KS/t
Total	1.62 KS/t
Fixed cost	
Repair cost	3.36 KS/t
Labour cost	2.27 KS/t
Electricity	0.34 KS/t
Total	5.97 KS/t
Grand Total	7.59 KS/t

Note: The interest and depreciation are not included in this cost, but entered to the fixed cost in the production cost.

2) Clay

Production (dry basis) 38,400t

Since clay will be obtained directly from the deposit on the hill near the mill which is owned by the mill itself, the direct expense, fixed expense, interest, and depreciation are included in the production cost.

0 KS/t

3) Laterite (ferrous material)

Production (dry basis) 5,760 t

Purchase unit price = 16.97 KS/t

4) Gypsum

Production (dry basis) 8,640 t

Purchase unit price = 190.77 KS/t

5) Cost of fuel (natural gas)

Heating value 900 BTU/cft = 8,015 kcal/m^3

Purchase unit price 1.05 KS/1,000 cft

= 0.037 KS/m^3

6) Cost of fuel (Diesel oil)

Purchase unit price 3.16 KS/gallon

= 0.695 KS/l

CHAPTER 11 ECONOMIC EVALUATION

The economic evaluation on this project should be made from two aspects. One is the effect of this project on external economy, that is, the evaluation in terms of national economy or regional economy. The other is in terms of payability and profitability of this project.
As the latter was described in details in CHAPTER 10, the evaluation on the former is stated hereinafter.

(1) Saving of foreign currency

Assuming that all the cement to be produced in this project would be provided by import, total amount is approximately 65,000 x 10^3 KS per year as computed below. Even in case of taking account of the expenses for the spare parts imported after the completion of the project, foreign currency worth of approximately 46,500 x 10^3 KS can be saved annually.

Cement import unit price	324 KS/t (CIF)
Cement import amount	200,640t
Payment of foreign currency	65,000 x 10^3 KS
Foreign currency for the purchase of spare parts	-18,500 x 10^3 KS
Saved foreign currency	46,500 x 10^3 KS

(2) Domestic supply of development materials

As one of the development materials, cement, is domestically supplied, the supply to the Construction Corporation, and to other consumers, will be ensured and this will contribute directly to the development of the infrastructure.

(3) Promotion of employment

The execution of this project offers the opportunity of employment to approximately 655 persons, which is equivalent to about 2,600 persons in total numbers of persons in families of the above candidates. Additionally, there will be other employment opportunities indirectly provided in the related fields of industries.

(4) Regional development

In Burma, the eastern region, around the River Irrawady, has been developed in the past. It is considered that the execution of this project will contribute to the development of the western region.

(5) Improvement of industrial techniques

The improvement of the level of industrial techniques can be very much hoped for through the promotion of the project.

(6) Effective utilization of underground resources

Underground resources in Htone Daung quarry, and near the plant, can be utilized effectively.

(7) Contribution to national economy

The profit, wages and goods and services tax obtained through the execution of the project contribute to national economy in the annual amount of 22,000 x 10^3 KS.