4.3 Construction Project of New Abis Compost Plant

4.3.1 General

The Abis Compost Plant with a capacity of 160 t/d began operating on a trial basis in Alexandria in October 1984. Full-scale operation was inaugurated in January 1985, and the plant has now been operative for just over one year.

Evaluations carried out on various facts of the plant's operation are described in detail in Section 2.6 of this report. They provide data and information.

Plans for a new Abis Compost Plant with a capacity of 300 t/d -- the target project of this Feasibility Study -- are based on this data and information. The plans are proposed so as to prevent repeated occurrence of problems incurred at the existing plant.

The major problems are as follows:

(1) Waste storage capacity in the tipping hall

The waste storage capacity of the tipping hall in the existing plant corresponds to only one day's worth of plant treatment capacity. For this reason, as the operating record of the plant demonstrates, the plant is sometimes unable to operate because there is no waste ready for treatment.

In order to rectify this problem, the waste storage capacity of the tipping hall in the new plant has been increased by 50% to 1.5 days.

(2) Feeding hopper

The feeding hopper in the existing plant is designed at a height of approx. 2.5 m from the apron stage. As a result, the front-end loader must raise the waste to this height in order to throw it into the hopper.

In the new plant, the feeding hopper is placed at the same height as the apron stage, in order to yield the following benefits:

- The collection vehicle can directly unload waste into the feeding hopper.

- Feeding by shovel loader can be reduced.

(3) Constant and continuous feeding of waste by feeder conveyor.

Because the waste feeding conveyor in the existing plant has a gentle slope and is not equipped with a leveller, lumpy waste is fed as is to the hand-sorting line, thereby causing various problems.

In the new plant, the following measures have been taken in order to ensure that lumpy waste is not fed to the hand-sorting line. Specifically, an apron conveyor with a steep slope is employed as the feeder conveyor so that large lumps of waste will fall downward by force of gravity and gradually become loose while being carried out by the apron conveyor.

In addition, a rotating leveller is provided with the apron conveyor to ensure constant feeding to the picking line.

(4) Hand-sorting line

In the existing plant, the width and length of the belt conveyor used on the hand-sorting line are inadequate. Owing to a fast operating speed of 20 m/min, the recovery rate of reusable materials is extremely small compared with the target amount. For the same reason, it is impossible to sufficiently remove foreign material which may cause malfunctioning of the homogeneous drum.

In designing the new plant, the recovery rate of reusable materials and foreign material removal have both been improved through the following measures:

- Adoption of constant and continuous feeding.

- Belt speed is set at 10 m/min instead of 20 m/min, in order to form a suitable thin layer of waste.

- The belt width is also increased to 1.6 m.

- Total length of the picking line is designed to be twice that of the existing plant.

- Additional picking line with the same length is provided after the pulverizing and classifying system.

(5) Tire puncture problems

The following countermeasures are to be taken against easy tire puncture:

- The shovel loader is to be provided with cut resistance tires (CR tires) of sufficient thickness. CR tires are highly effective in minimizing punctures by nails, glass, iron fragments, etc.

- Use of rubber tire chains is also to be considered as a means of avoiding slippage caused by scattered waste.

(6) Hourly waste treatment capacity of the plant

The existing plant has a waste treatment capacity of 10 t/hr. Based on a 16-hour operating per day, the plant thus has a planned daily capacity of 160 tons.

In actual practice, however, it is impossible to ensure operation of a full 16 hours per day, owing to time required for plant start-up preparations, as well as clean-up and daily maintenance after operation is completed for the day.

The hourly treatment capacity of the new plant is therefore being achieved as follows:

Hourly treatment capacity (t/hr)

- Working time per day : 16 hours (8 hr/shift x 2 shifts)
- Actual waste treatment time : 14 hr/day

- Hourly plant capacity (normal) : 21.43 t/hr
  (300 t/day + 14 hr)
- Hourly plant capacity (maximum): 23.57 t/hr
  (21.43 t/hr x (1+)

where = allowance for load fluctuation (10%)

4.3.2 Selection of Equipment

(1) Reception facility

System of waste reception into the composting plant is largely classified to receiving stage/front end loader combined system and pit & crane system.

These two systems were examined and decided to employ the "receiving stage + front end loader system" with cheaper construction costs and operating costs in the New Abis Plant.

Features of these two systems are as shown in the Tab. 4-3-1

Tab. 4-3-1 COMPARISON TABLE OF EACH RECEPTION SYSTEM

	Receiving Stage and Front End Loader System	Pit & Crane system
Area of stock yard	Height of waste heap is limited to 2 to 3 m, so the area becomes wider	The pit can be planned at the depth of 10 m, so flat area of the pit can be minimized.
House	The construction of building can be simplified because no load is applied to the building.	Weight of the crane is loaded to the construction of building, and at the same time space for for movement of the crane is required at the top of the deposit block, so a high and sturdy construction of building is required. As buoyancy is loaded to the pit at higher water level, scale of the civil engineering becomes larger.
Maintenance	Only maintenance of the front end loader is required so the maintenance is easier as compared to that for the crane. The maintenance can be executed by even an engineer who can execute maintenance of cars.	A specialist engineer is required for maintenance of the crane. Maintenance of wirerope machines and electric system is difficult.
Working environment	Because the work is done in the waste deposit room, the working environment is worse.	The working environment is better, because of remote control from the control room.
Construction cost	Cheap	Expensive
Operating and maintenance/ management cost	Cheap	High

Tab. 4-3-2 SPECIFICATION AND CONSTRUCTION COST OF EACH RECEPTION SYSTEM

	Receiving Stage and Front End Loader System	Pit & Crane system
Deposit rate	1,800 m^3 for 1.5 days	1,800 m^3 for 1.5 days
Number of required units	Front end loader x 2 units	Crane : 1 unit Bucket: 6.3 m^3
Number of operators	2 people x 2 shifts = 4 people	1 man x 2 shifts = 2 people
Required quantity of fuel	80 l /day x 300 days/year = 24,000 l/year	-
Consumption rate of electric powe	-	280 Kwh/day x 300 days/year = 84,000 Kwh/year
Facility cost	770,000 LE	1,320,000 LE

US$1 = LE1.33

Tab. 4-3-3 OPERATING AND MAINTENANCE COST FOR EACH RECEPTION SYSTEM

	Receiving Stage and Front End Loader System	Pit & Crane system
Depreciation cost	65,300 LE/year	57,200 LE/year
Maintenance and Management cost	9,800 LE/year	8,600 LE/year
Labour cost	9,600 LE/year	4,800 LE/year
Fuel cost	3,600 LE/year	-

	Receiving Stage and Front End Loader System	Pit & Crane system
Charge for electricity	-	29,400 LE/year
Total	88,300 LE/year	100,000 LE/year

Note: - Exchange rate

US$1.00 = 1.33 LE

- Fuel

Diesel oil: 0.15 LE/liter

- Electricity

0.35 LE/Kwh

- Labour cost

Operator : 200 LE/month

Other : 150 LE/month

- Depreciation period

Building and civil structure: 30 years

Machinary and equipment : 15 years

Front end loader : 5 years

- Maintenance cost

15% of depreciation cost

(2) Hand sorting

1) System without hand sorting

(From a view point of engineer)

In case of no requirement for salvaging reusable materials, the hand sorting line can be omitted from the proposed process flow, and two lines of pre-treatment process can be integrated into one process line by construction cost reducing.

In this case, the following items should be examined.

a. If glass content in the waste is high, also glass content in the product compost becomes high.
b. As reusable materials are not recovered, amount of rejects to be disposed of increases by about 30 tons.
c. Social needs of resource recycling will be lost.

(3) Comparison between truck system and distributed conveyor system for raw compost handling

The system of compostable material feeding to the fermentation yard is classified to truck system and distributed conveyor system, and specification of each system is shown in the Tab. 4-3-4

As compared to the distributed conveyor system, truck system has the following features.

1) Operating cost and maintenance/management cost are low as shown in Tab.

2) It is not necessary to stop operation of the whole plant due to failure of an equipment.

If the distributed conveyors are stopped due to failure or for maintenance or service, all equipment of the plant are stopped in the distributed conveyor system, but in the truck system no affect is generated by arranging a spare truck.

3) High mobility

Mobility in the truck system is very high, which enables efficient use of the yard space. In the truck system, transportation of compostable material to the fermentation yard and supply of matured compost to the refining system can be executed as a cycle shown in Fig. 4-3-1

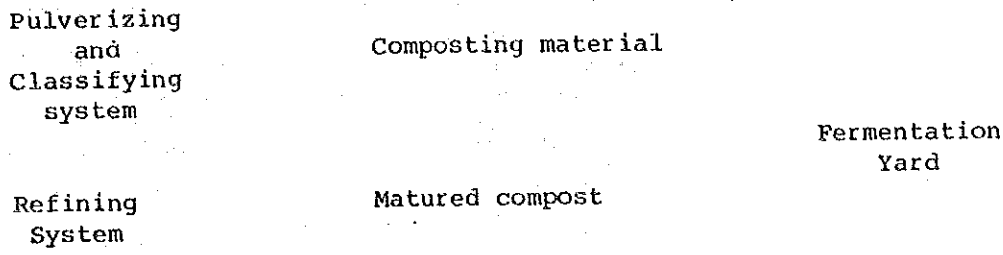


Fig. 4-3-1 CYCLE MOBILITY OF TRUCK SYSTEM

Tab. 4-3-4 COMPARISON BETWEEN COMPOST MATERIAL TRANSPORT METHODS

	Distributed Conveyor System	Truck System
Quantity	1 set, Belt width: 900 mm	3 units (including a spare one)
Operator	1 person/shift x 2 shifts = 2 people	2 people/shift x 2 shifts = 4 people
Fuel consumption rate	-	40 l/day x 300 days/ year = 12,000 l/year
Electricity consumption rate	500 Kwh/day x 300 days/ year = 150,000 Kwh/year	-
Equipment cost	LE 944,000	LE 57,000

Tab. 4-3-5 OPERATING COST AND MAINTENANCE/MANAGEMENT COST

	Distributed Conveyor System	Truck System
Depreciation cost	63,000 LE/year	10,260 LE/year
Maintenance/ Management cost	9,450 LE/year	1,539 LE/year

	Distributed Conveyor System	Truck System
Labour cost	3,600 LE/year	9,600 LE/year
Fuel cost	-	1,800 LE/year
Change for electricity	52,500 LE/year	-
Total	128,550 LE/year	23,199 LE/year

(4) Handling system of raw compost and method to pile up on the fermentation yard

The raw compost is pre-treated and classified in the pre-treated/sorting facility and transported by the conveyor to carry-out yard.

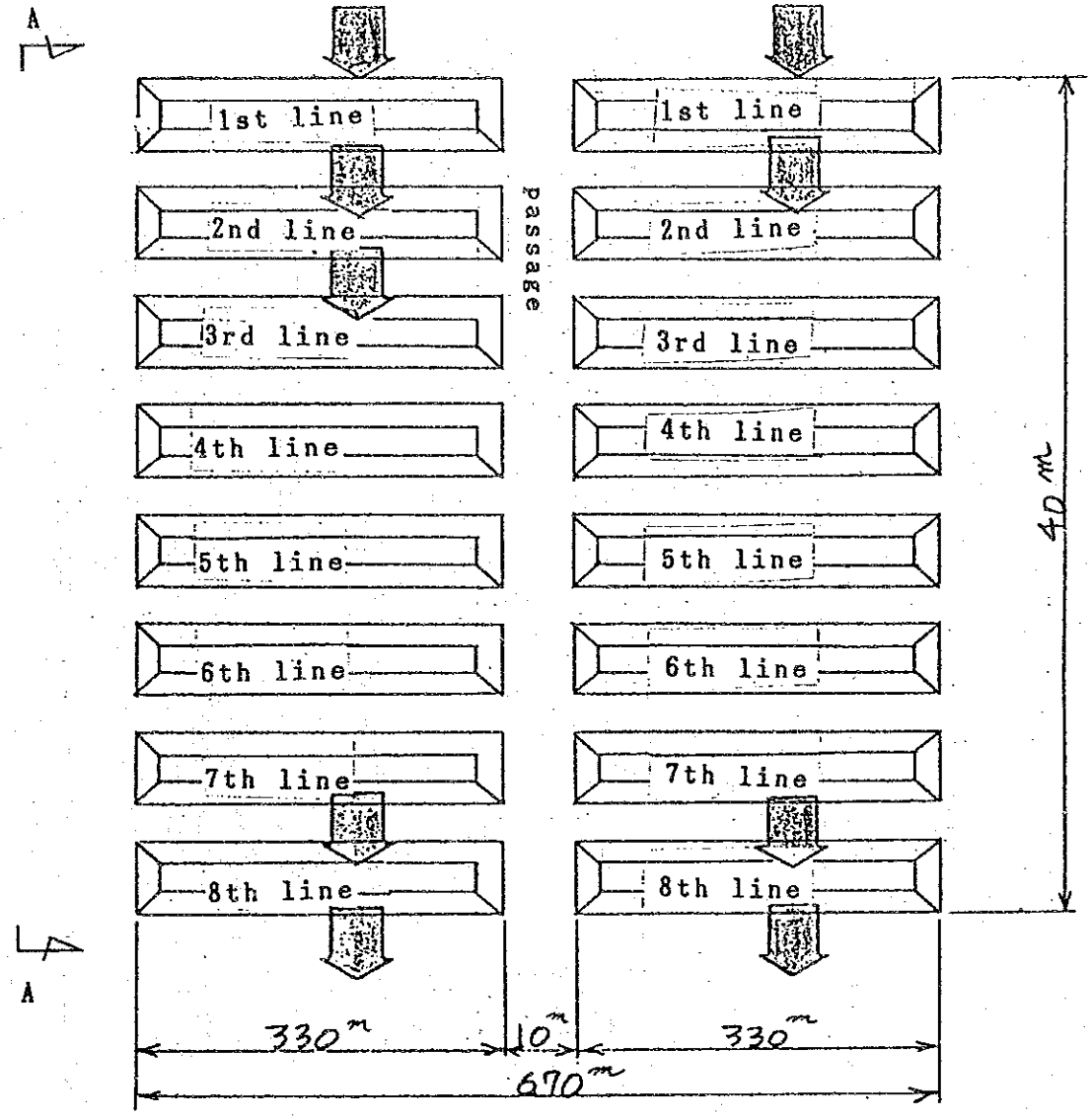
The raw compost is loaded on 2 trucks alternately by arranging a conveyor based on reversible operating system in the raw compost carry-out space. Three-directional rotating dump trucks to enable loading off to three directions are employed for transportation of raw compost.

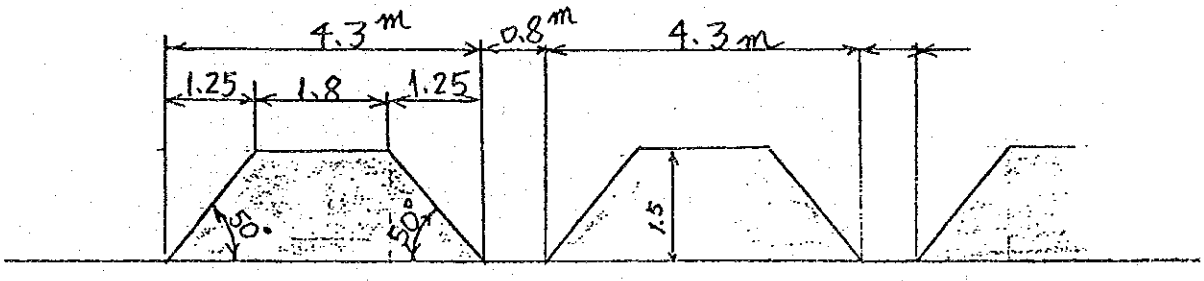
Raw compost loaded on a truck is transported to the first line in the fermentation yard and loaded off there. (Fig. 4-3-2)

Fig. 3 shows schedule of the trucks.

As fermentation proceeds, the raw compost in the fermentation yard is transferred from the first line to the final one by the turning machine, being agitated.

Matured compost at the final line (8th line) is loaded on a truck by the front end loader, and transported to the receiving hopper in the refining facility.





View A - A

Fig. 4-3-2 FORMATION IN FERMENTATION YARD

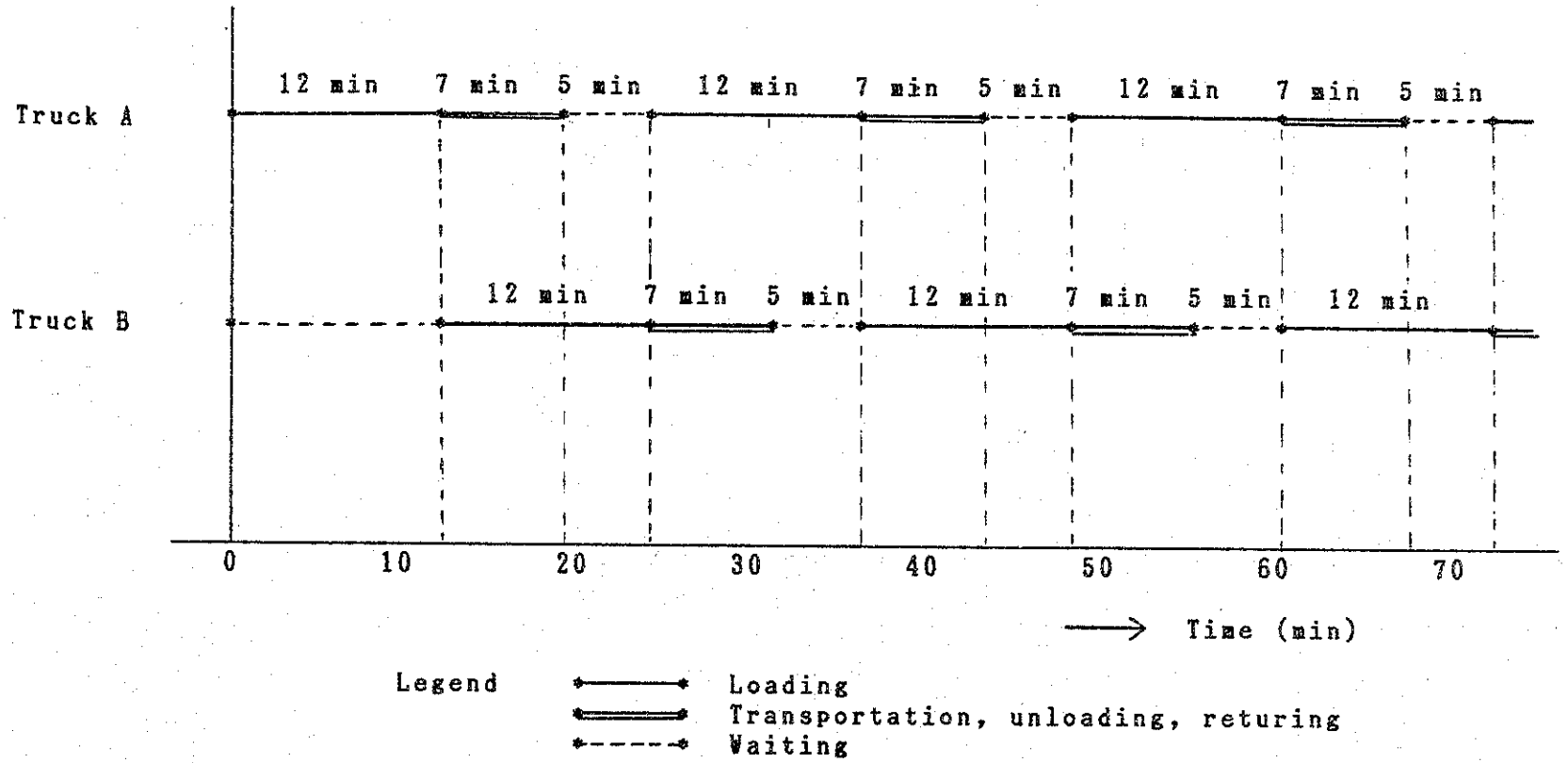


Fig. 4-3-3 SCHEDULE OF TRANSPORT TRUCK FOR COMPOSTABLE MATERIAL

4.3.3 List of Main Equipment

Main equipments for the 300 t/d compost plant are listed as follows;

ITEM NO.	NAME	Q'TY	DESCRIPTION	CAPACITY	DIMENSION (m)	WEIGHT UNIT(TON)	FITTINGS
[Reception facility]							
	Truck Scale	1	Pendulum indication type	30 t	Loading stage		
	Feeding conveyor	2	Apron conveyor Belt width 1.00 m	10.7 t/h	13 L x 7.5 H		Hopper
	Leveller	2	Rotating blade type	10.7 t/h	ø1.4 x 0.7 W		
	Shovel loader	2		1.5 m^3			
	Selective pulverizing classifier	2	Two separation type (SPC2)	10.7 t/h	9.7 L x 7.7 w x 3.5 H		
	Magnetic separator (1)	1	Over band type	19.1 t/h	2.8 L x 1.1 W x 0.6 H		
	Conveyor (1)	2	Belt conveyor (for feeding to Classifier) Belt width 0.8 m	10.1 t/h	20 L		
	Conveyor (2)	2	Belt conveyor (for compostable materials) Belt width 0.5 m	9.6 t/h	9 L		
	Conveyor (3)	1	Belt conveyor (for compostable materials) Belt width 0.8 m	19.1 t/h	24 L		
	Conveyor (4)	1	Belt conveyor (for compostable materials) Belt width 0.8 m	18.9 t/h	23 L		
	Conveyor (5)	1	Belt conveyor (for compostable materials) Belt width 0.8 m	18.9 t/h	5 L		
	Conveyor (6)	2	Belt conveyor (for non-compostable materials) Belt width 0.6 m	3.5 t/h	22 L		
[Sorting facility]							
	Hand sorting conveyor (1)	2	Belt conveyor (for 1st hand-sorting line) Belt width 1.6 m	10.7 t/h	22 L		
	Hand sorting conveyor (2)	2	Belt conveyor, flat type (for 2nd hand-sorting line) Belt width 1 m	3.5 t/h	17 L		
	Magnetic separator (2)	1	Over band type	6.2 t/h	2.2 L x 1.3 W x 0.9 H		

ITEM NO.	NAME	Q'TY	DESCRIPTION	CAPACITY	DIMENSION (m)	WEIGHT UNIT (TON)	FITTINGS
	Baler for ferrous metals	1	Press type	0.8 t/h	3.6 L x 0.9 W x 1.7 H		
	Baler for paper and textile	2	Band packing type	0.8 t/h	1.1 L x 0.7 W x 0.7 H		
	Conveyor (7)	1	Belt conveyor (for reject) Belt width 0.6 m)	5.4 t/h	38 L		
[Fermentation facility]							
	Dump truck	4		4 t			
	Turning machine	1	Automatic type	2,000 m^3/h			
[Reception facility]							
	Feeding conveyor	1	Belt conveyor (for feeding to vibrating screen) Belt width 0.6 m	6.9 t/h	16 L		Hopper
	Vibrating screen	1	Flip-flow type	6.9 t/h	5.2 L x 2.3 W x 0.5 H		
	Conveyor		Belt conveyor (for reject) Belt width 0.35 m	1.7 t/h	3 L		
	Shovel loader	1		1.5 m^3			
[Disposal facility]							
	Shovel loader	1		1.5 m^3			
	Dump truck	5		8 t			

4.3.4 Project Cost

(1) Proconditions of calculation

The project cost divides into two parts: construction of the compost plant and its attendant facilities, and purchase of vehicles and other capital equipment.

The order placement system, which is one of the preconditions for calculating the project cost, will be international bidding, for the following two reasons:

1) International bidding was applied in the case of both the construction of the existing Abis Compost Plant and the purchase of its vehicles.

2) Local firms are technically incapable of satisfying the project's needs.

For the sake of efficiency, when international bidding is taken as a precondition for facilities construction, the bulk of such construction will be mechanical construction.

(2) Calculation method

The capital equipment purchasing cost has been calculated based on the CIF price of machinery including transport fees and customs duties, plus inland transportation fees.

As in the case of conventional construction projects, the facilities construction cost was calculated by determining the labor cost, construction equipment cost and material cost. For these direct construction costs, the common temporary facilites cost, on-site management cost and general management cost were calculated for each related category to yield a unit cost for each category.

The engineering fee was calculated separately and a contingency was added to derive the cumulative project cost.

(3) Facilities construction cost

The construction cost was divided into civil engineering/building work and machine facilities work. The results for each work category are: civil engineering/building work LE 3,423,846 ; machine facilities work LE 7,410,000 as shown in Tab. 4-3-9.

Tab. 4-3-6 CONSTRUCTION COST FOR CIVIL AND BUILDING STRUCTURE

(LE)

Items	Unit	Q'ty	Unit Price	Construction Cost		
				Total	Foreign	Local
Embankment	m^3	76,320.0	10.3	786,096	122,112	663,984
Pavement	m^3	4,440.0	60.0	266,400	26,640	239,760
Base course	m^3	8,880.0	30.0	266,400	26,640	239,760
Floor concrete	m^2	3,000.0	8.5	25,500	4,800	20,700
R.C. pile	m	450.0	60.0	27,000	13,770	13,230
R.C. foundation	m^3	880.0	280.0	246,4000	138,160	108,240
Fence	m	1,910.0	25.0	47,750	0	47,750
Control center	m^2	240.0	500.0	120,000	0	120,000
Guard house	m^2	20.0	400.0	8,000	0	8,000
Plant building	m^2	2,550.0	460.0	1,173,000	586,500	586,500
Storage house	m^2	204.0	300.0	61,200	30,600	30,600
Generator house	m^2	120.0	400.0	48,000	0	48,000
Loading house	m^2	56.0	300.0	16,800	8,400	8,400
Workshop	m^2	300.0	400.0	120,000	60,000	60,000
Refining building	m^2	180.0	400.0	72,000	0	72,000
Road construction						
- Embankment	m^3	7,000.0	10.3	72,100	11,200	60,900
- pavement	m^2	5,600.0	6.0	33,600	3,360	30,240
- Base course	m^2	5,600.0	6.0	33,600	3,360	30,240
Total				3,423,846	1,035,542	2,388,304

Tab. 4-3-7 MANUFACTURING AND INSTALLING COST

(LE)

Items	Unit	Q'ty	Unit Price	Construction Cost		
				Total	Foreign	Local
Reception/pre-treatment						
- Equipment	lump sum	1	2,760,000	2,760,000	2,760,000	0
- Erection	"	1	820,000	820,000	328,000	492,000
Fermenting						
- Equipment	"	1	980,000	980,000	980,000	0
- Erection	"	1	550,000	550,000	220,000	330,000
Water supply						
- Equipment	"	1	20,000	20,000	20,000	0
- Erection	"	1	10,000	10,000	4,000	6,000
Emergency generator						
- Generator	"	1	400,000	400,000	400,000	0
- Erection	"	1	30,000	30,000	12,000	18,000
Electricity	"	1	520,000	520,000	416,000	104,000
Trial operation	"	1	490,000	490,000	392,000	98,000
Freight	"	1	610,000	610,000	610,000	0
Spare part	"	1	220,000	220,000	220,000	0
Total				10,833,846	7,397,542	3,436,304

(4) Equipment purchasing cost

Purchasing cost of equipments required for plant operation is summarized on Tab. 4-3-8

Tab. 4-3-8 PURCHASING COST OF EQUIPMENT

(LE)

Items	Specification	Q'ty	Unit Price	Purchasing Cost		
				Total	Foreign	Local
Shovel loader	2 m^3	4 sets	61,000	244,000	244,000	-
Dump truck	4 t	4 sets	24,000	96,000	96,000	-
Dump truck	8 t	5 sets	42,000	210,000	210,000	-
Turning machine	w=4.3 m	1 set	265,000	265,000	265,000	-
Sub-total			815,000	815,000	815,000	-
Spare parts		lump sum	-	81,500	81,500	-
Total				896,500	896,500	-

(5) Project cost

In addition to the facility construction cost and equipment puchasing cost, considering other necessary engineering fee and contingency, the project cost of 300 t/d compost plant mounts to 14,050,000 LE as shown in Tab. 4-3-9

Tab. 4-3-9 PROJECT COST

(LE)

Items	Foreign	Local	Total
1. Facility			
Civil and building	1,035,542	2,388,304	3,423,846
Plant machinery	6,142,000	1,048,000	7,190,000
Spare parts	220,000	0	220,000
Sub-total	7,397,542	3,436,304	10,833,846
Eng. service	739,754	343,630	1,083,384
Total	8,137,296	4,779,934	11,917,232
2. Equipment purchasing cost			
Equipment	815,000	-	815,000
Spare parts	81,500	-	81,500
Sub-total	896,500	-	896,500
Eng. service	35,860	8,965	44,825
Total	932,366	8,965	941,325
Contingency	813,729	377,993	1,191,722
Grand total	9,883,391	4,166,892	14,050,277

(6) Maintenance and operation cost including personnel cost for 105 persons amounts to 1,474,287 LE per year or 583,472 LE per year except depreciation cost as shown in Tab. 4-3-10

Total waste treatment cost is calculated as follow:

$$\frac{\text{yearly O/M cost}}{\text{yearly waste treatment amount}} = \frac{1{,}474{,}287 \text{ LE/y}}{300 \text{ t/d} \times 300 \text{ d/y}} = 16.4 \text{ LE/t}$$

In case of without depreciation cost:

$$= \frac{583{,}472 \text{ LE/y}}{300 \text{ t/d} \times 300 \text{ d/y}} = 6.5 \text{ LE/t}$$

Tab. 4-3-10 OPERATION AND MAINTENANCE COST PER YEAR

(LE)

Item	Amount	Remarks
Depreciation		
Civil and Building	138,095	
Machinery	597,740	
Vehicles	154,980	
Sub-total	890,815	
Maintenance		
Machinery	143,800	
Vehicles	65,200	
Sub-total	209,000	
Fuel, oils and Lubricants		
for Vehicles	65,376	
for Machinery	45,000	
Sub-total	110,376	
Water and Power		
Water	5,400	
Power	80,976	
Sub-total	86,376	
Personnel Cost	177,720	
Grand Total	1,474,287 LE/year (583,472 LE/year)	16.4 LE/ton (6.5 LE/ton)

Note: ( ) excluding depreciation cost.

4.3.5 Electrical and Instrument Specification

(1) High-voltage incoming panel

a. Type

Metal enclosed switchgear, indoor use, self standing type			1 panel

b. Main components

Main switch	:	circuit breaker 12 kV	1 unit
Instrument current transformer	:	CT mold type	3 units
Overcurrent relay	:	OCR induction type	3 units
Ground relay	:	OCG	1 unit
Ammeter and changeover switch, watt-hour meter			1 set
Voltmeter and changeover switch			1 set
Other indicators, terminal blocks, wiring materials, etc.			1 set

(2) Power transformer

a. Type

Indoor oil-immersed self-cooling type — 1 unit

b. Specification

Rating : Primary 11 kV
Secondary 380 V

Capacity : 750 kVA

Phase : 3 phase-3 wire type

(3) Lighting transformer

a. Type

Indoor oil-immersed self-cooling type — 1 unit

b. Specification

Rating : Primary 380 V
Secondary 220 V - 110 V

Capacity : 50 kVA

Phase : 1 phase-3 wire type

(4) Generator control panel

a. Type — 1 panel

Metal enclosed indoor use type

b. Main components

Circuit breaker	: ACB 380 V, 1,200 A	1 uint
Instrument current transformer	: Mold type	3 units
Watt meter, watt-hour meter, power factor meter		1 set
Ammerter and changeover switch		1 set
Voltmeter and changeover switch		1 set

(5) Low voltage switchgear

a. Type

Metal enclosed, indoor use, self standing type	1 panel

b. Main incoming supply and standby incoming supply

Circuit breaker	: 1,200 A, ACB	2 units
Voltmeter and changeover switch		2 units
Ammeter and changeover switch		1 unit

c. Motor starters (Figures below represent quantities per unit.)

Control push-buttons (ON/OFF)		1 set
Main circuit breaker	: 380 V., AC various currents	1 unit

Magnetic starter including th Ry.		1 unit
Instrument transformer	: CT mold type	1 unit
Other pilot lamps, terminal blocks, wiring material, etc.		1 set

(6) Distribution board for small power and lighting

a. Type

Metal enclosed, indoor use, wall mounted type		1 panel

b. Main components

Main circuit breaker	: Molded case circuit breaker 380 V, 225 A	1 unit
Others	: Miniature circuit breaker	1 set
Pilot lamp and terminal blocks, wiring material, etc.		1 set

4.3.6 Building, Fermentation Yard etc.

(1) Building

Administration office building	240 m^2
Gate house	20
Storage and sorting building	2,700
Reusable material storage	204
Generator house	120
Row compost loading house	56
Workshop and restroom	300
Refining room	180

(2) Yard

Fermentation yard	36,300 m^2

(3) Total site area

900 m x 55 m = 49,500 m^2

4.3.7 Maintenance Part List

Spare and consumable parts lists are shown in Tab. 4-3-11. Purchasing cost of these spare and consumable parts is included in the plant construction cost.

Tab. 4-3-11 SPARE PARTS LIST

No.	NAME	PART NAME	PARTS Q'TY
1.	FEEDING CONVEYOR	Steel-Velt	25%
		Driving chain	25%
		Bearing	25%
2.	LEVELLER	Driving chain	25%
		Bearing	25%
3.	SELECTIVE PULVERIZING CLASSIFIER (SPC 2)	V-belt for scraper	100%
		V-belt for drum	100%
		Chain for drum revolution detector	50%
		Spray nozzle	10%
		Bearing	50%
		Shear-pin relay	100%
		Rotary joint	100%
4.	MAGNETIC SEPARATOR	Roller chain	50%
		Bearing	25%
5.	BALING MACHINE	Solenoid Valve	100%
6.	BELT CONVEYOR	Carrier roller	5%
		Return roller	5%
		Bearing	25%
		Driving chain	25%
7.	FAN	Bearing	25%
		V-belt	100%
8.	PUMP	Bearing	25%
9.	VIBRATING SCREEN	Vibrating motor	100%
		Bearing	100%
		Screen	50%
		Spring	100%
10.	TURNING MACHINE	Tire	100%
		Drum	100%
		Conveyor belt	100%
		Carrier roller	5%
		Return roller	5%
11.	FRONT END LOADER	Tire	100%
		Chain for tire	100%
		Fan belt	100%
12.	DUMP TRUCK	Tire	100%
		Fan belt	100%
13.	ELECTRICAL EQUIPMENT	Lump	50%
		Fuse	50%
14.	GENERATOR AND ENGINE	Piston ring	20%
		Suction valve	10%
		Exhaust valve	10%
		Spring	5%
		Filter	100%
		Stem seal	5%
		Gasket for Cylinder head	10%

Tab. 4-3-12 CONSUMABLE PARTS LIST (FOR ONE YEAR)

No.	NAME	PART NAME	PARTS Q'TY
1.	WEIGH BRIDGE	Card	100%
		Ribbon for printer	100%
2.	SELECTIVE PULVERIZING CLASSIFIER (SPC 2)	Driving chain for durm	50%
		Inlet seal block	200%
		Projection	100%
		Drum screen	25%
		Scraper	10%
3.	BALING MACHINE	Oil filter	100%
4.	BELT CONVEYOR	Belt cleaner element	100%
5.	FAN	Packing	100%
		Gasket	100%
6.	PUMP	Coupling rubber	50%
		Packing	100%
		Gasket	100%
7.	TURNING MACHINE	O-ring	100%
		Oil seal	100%
		Oil filter	100%
		Lump	100%
		Fuse	100%
		Air cleaner	100%
		Fan belt	100%
8.	DUMP TRUCK	O-ring	100%
		Oil seal	100%
		Oil filter	100%
		Lump	100%
		Fuse	100%
		Air cleaner	100%
		Fan belt	100%

No.	NAME	PART NAME	PARTS Q'TY
9.	FRONT END LOADER	O-ring	100%
		Oil seal	100%
		Oil filter	100%
		Lump	100%
		Fuse	100%
		Air cleaner	100%
		Fan belt	100%

4.3.8 Processing System

(1) Process flow

1) General

This plant is intended to produce good compost of stable quality, highly effective as a fertilizer, by disposing of municipal refuse for the restoration of farmland. At the same time, it is also intended to recover valuables included in municipal refuse.

The Plant consists of three (3) major facilities in accordance with its function, that is

a. Reception and Classifying Facility
b. Fermentation Facility
   (Including curing yard)
c. Refining Facility

The strucutre of the Plant is as follows:

Municipal refuse

Reception

Classifying Facility	Plastics
	Paper
Fermentation Facility	Ferrous metal
	Textile
Refining Facility	Glass

Compost

2) Reception and classifying facility

Municipal refuse transported by vehicles is dumped directly into the hopper of a conveyor, or dumped onto the reception floor and then fed to a conveyor by a front-end loader.

The refuse fed to the conveyor is taken constantly at a specific volume rate by a combination of conveyor and Leveller, and is then supplied to hand-sorting line and then the a Classifier (SPC2).

At hand-sorting line, valuables, i.e. papers and glass are recovered by hand-sorting.

The refuse is classified into A and B groups by one process of the SPC2. In A group, compostable materials which consist mainly of putrescibles, fragile paper, and glassy materials are selectively classified.

Compostable materials classified are pulverized coarsely to such grade that aeration resistance is not too large in the fermentation process and grain size of most foreign glassy materials is appropriate for removal by refining facilities.

In addition, dry cell batteries contained in the refuse can be rejected by a combination of SPC2 and a magnetic separator without being destroyed. Heavy metal contamination coming from dry cell batteries in produced compost can be avoided.

A group material is delivered to the fermenter after removal of dry cell batteries, small iron chips, bottle caps, etc., by a magnetic separator. Removed ferrous metal from A group material is stored in a yard.

In B group material, most of the non-compostable substances, e.g., metals, fibers, plastics, corrugated cardboard boxes, etc., are selected and classified.

B group material is conveyed to a hand-sorting line and valuables, i.e. plastic, textile are recovered by hand-sorting. Ferrous metal is recovered by a magnetic separator. Recovered materials and rejects are stored in yards.

3) Fermentation

The compostable material is transported by truck to the fermentation yard in a particular location.

The compostable material is stirred and conveyed to next line by a self-propelled turning machine to obtain the compost after a fermentation (including curing) period of about 60 days.

Maturing is possible even without turning the compostable material over by installing a separate maturing yard. However, the operation of the maturing yard does not take simply four weeks for composting but requires the daily discharge of the material after it has been composted for four weeks. That is, the material has to be discharged in the fourth week of composting for daily input as the starting material for the maturing yard.

Thus, rather than the fermentation conditions, it is the material handling aspect that has led us to adopt the above method of stirring and transportation using the turning machine without splitting the process into a fermentation and curing stage.

In addition, a water faucet will be provided at a convention point in the fermentation yard so that water can be sprinkled as and when required to maintain the appropriate moisture level required for the fermentation process.

The fermentation yard is located outdoors and has a concrete floor.

4) Refining Facility

The cured compost delivered from the storage yard, which is stabilized, is conveyed to a vibrating screen. The vibrating screen effectively removes foreign matter like flaky plastics, glass, ceramics, etc.

High quality compost which has little foreign matter and appropriate particle size is recovered.

Foreign matter can be removed to such extent that the refined compost can be safely used for agriculture.

(2) Selective pulverizing classifier of two separation type (SPC2)

1) Main features of the SPC2

a. The SPC2 has a separation function i.e. it can classify municipal refuse into two groups; compostable material and non-compostable materal.

b. The SPC2 functions as a crusher, i.e. it can crush compostable materials in municipal refuse into sezes suitable for aerobic fermentation.

Excessive crushing is avoided, because it not only wastes power, but also ruptures dry batteries which cause heavy metal contamination in the compot.

c. The SPC 2 is trouble free, even when bulky refuse such as metal appliances are charged.

d. The SPC 2 has a bag-break function. Consequently, it can cope with refuse collected in bags or boxes.

e. SPC2's maintenance is easy and frequency of such maintenance is low.

2) Outline of the SPC2

It utilizes the differences in the resistance to destruction of different material, and both pulverization and classification by screening are incorporated in one machine.

Refuse is classified into compostable materials (garbage with paper) and others by the classifier which applies the technology of the selective pulverizing system developed under a national project sponsored by AIST, MITI.

As shown in Fig. 1., and SPC2 consists of a rotating drum screen and a scraper rotating at a different speed inside the screen.

As the refuse is fed continuously into the rotation drum, almost all of the garbage (food waste) and brittle materials such as dirt, glass and ceramics, and part of the flimsy paper are pulverized into particles or flakes and pass through the screen (A Group). The remaining residue consisting of plastics, metals and textiles etc., are discharged through the open end of the drum (B group).

1 Such maintenance control as that of a troublesome crusher is not required.

2 Even when metal lumps are introduced, they will be automatically removed so that it is not necessary to stop operation to remove them.

3 Maintenance is extremely easy with little wear on scratch plate or protection.

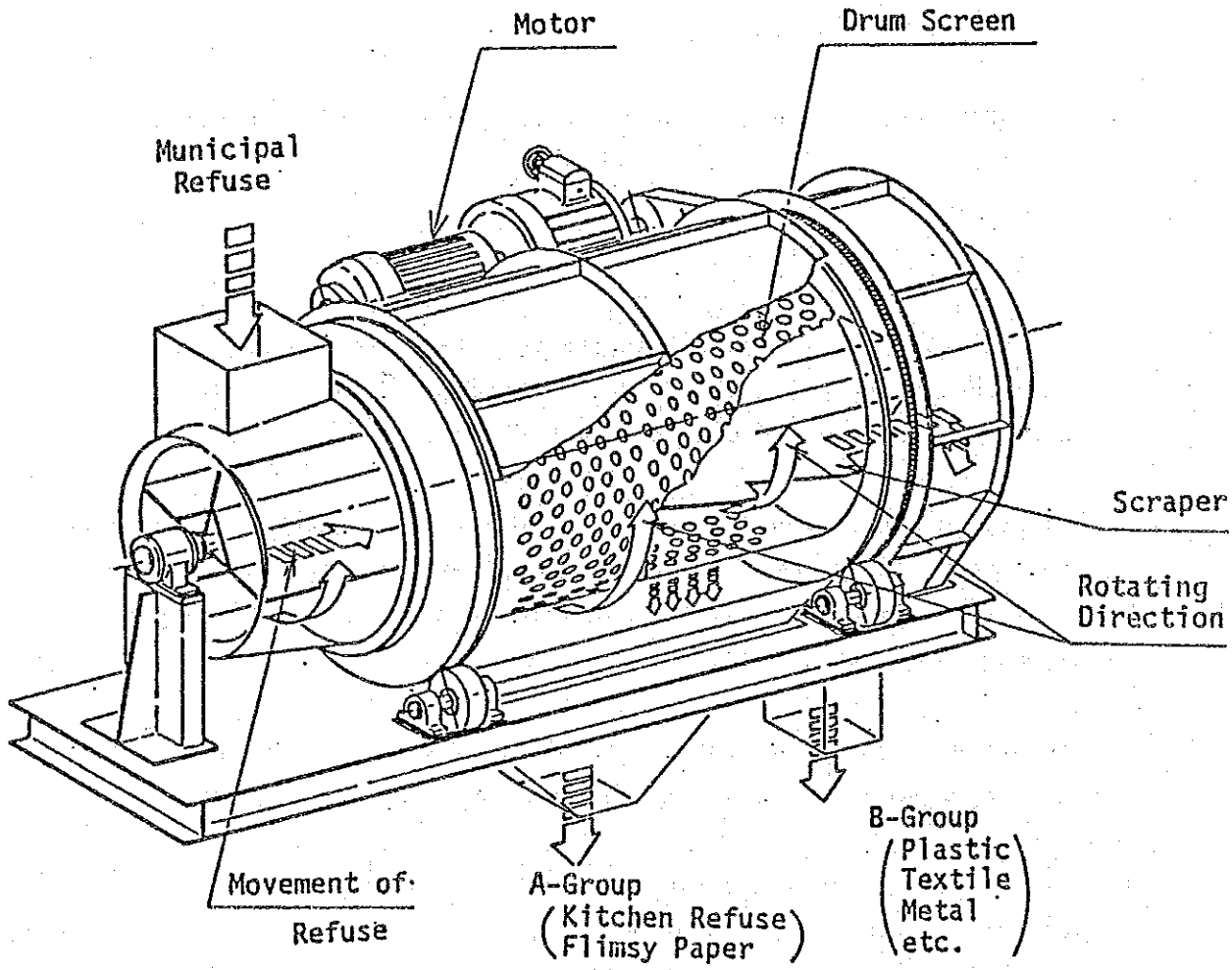


Fig. 4-3-4 SELECTIVE PULVERIZING CLASSIFIER (SPC2)

Unlike a conventional shredder which completely shreds all refuse, this classifier discharges B Group material from the drum end following selective pulverization, and this refuse remains close to its original size. It has been found that almost all of the dry batteries contained in the refuse maintain their original shape and remain sealed.

Small batteries are discharged into A Group without crushing, and are removed by the magnetic separator.

Size of glass and ceramic particles discharged into A Group is extremely large in comparison with those produced by conventional shredding, and such particles can be easily removed after fermentation.

Maintenance characteristics of this classifier can be summarised as follows:

a. Entanglement of long strings around the rotary shaft, a major problem with conventional shredders, is eliminated by the wrap prevention device specifically developed for this machine. This makes manual removal of strings unnecessary and greatly reduces maintenance time.

b. Because of its very low speed, this classifier causes far less wear, noise and vibration than conventional highspeed shredders.

c. By decreasing or synchronizing the relative speeds of the drum and scraper in case of an overload, the cause of the overload (metal mass, etc.) can be easily eliminated.

4.3.9 Guidance for Plant Operation

(1) Utility consumption

Expected utility consumption are as follows:

a. Power

Composting: 1,680,000 Kwh per year

b. Water

Composting: 36,000 m^3 per year

c. Oil (for front-end loaders)

Composting: 360 m^3 per year

(2) Operation personnel

Recommendable operating personnels required to this plant are as follows:

No.	Name	No. of Personnel per shift	No. of shift	Total
1	Plant manager	1	1	1
2	Operation director	1	1	1
3	Operation worker			
	Shift chief	1	2	2
	Operator (Mech)	1	2	2
	Operator (Elec)	1	2	2
	Driver	8	2	16
	Inspector	1	2	2
	Worker (Baler)	3	2	6
	(Sorting)	14	2	28
	(Assist)	5	2	10
	(Clean)	2	2	4
	(Guard)	2	2	4
	Total			78

(3) Operation method

Comprehensive precautions are incorporated to make full use of the proposed Plant capability for operation and control.

a. Safety of facilities

In case that the plant stops, upstream equipment on the line stops automatically according to the design concept, thus preventing piling or bridging in the equipment.

b. Emergency electric power failure

Feeding conveyor for municipal refuse and compost is provided with a break device. Accordingly, the conveyor will never revolve in reverse even during emergency power supply failure.

The composting plant for municipal refuse will never be subject to such trouble as explosions, equipment damage, etc., even if emergency stop takes place by power supply failure.

For emergency electric power off, 625 kVA stand-by generator is provided.

(4) Outline of maintenance

a. For each piece of equipment and each unit, inspection space and inspection walkway will be provided.

b. Generally, each piece of equipment will be solidly constructed and free of trouble, thus long periods for inspection times before or after operation are not necessary.

CHAPTER 5. PROJECT EVALUATION OF THE NEW ABIS COMPOST PLANT

5. Project Evaluation of the New Abis Compost Plant

In this ection, assumptions and procedures of calculation for the project evaluation such as benefit, revenue and cost are described.

5.1 Economic evaluation

The benefits of conversion of municipal waste into compost were estimated as mentioned below.

a. Increased productivity of crops
b. Amount of chemical fertilizer
c. Saved amount of water supply
d. Benefit from reusable materials
e. Benefit from saved transportation cost
f. Benefit from decrease of landfill area needed

Major benefits generated from the application of compost to the cultivated lands, namely a, b, c, listed above, are described with the method of benefit calculation in the Supporting Report 2.8.

1) Benefit from reusable materials

About reusable materials, the recovery rate changes from 5.39% in 1990 to 6.92% in 2000.

According to the change of the recovery rate, the benefit also changes from 1.55 LE/(solid waste ton) to 1.87 LE/(solid waste ton).

2) Benefit from saved cost for transportation

Because of the composting, the volume of solid waste to be transported decreases to one-third of the original volume and the required number of vehicles, drivers, fuels and etc. decreases subsequently.

These costs calculated in Tab. 5-1-1 are regarded as benefit from the saved cost of waste transportation.

3) Benefit from decreased landfill area needed

The composting also decreases the landfill area needed for the solid waste disposal. Saving cost of the final disposal changes in proportion to the composting volume.

Because of the composting, the landfill area needed for the compost-rejects is calculated as shown below.

General solid waste	300 ton =	375 m^3/day
Compost-reject	100 ton =	167 m^3/day
Saved volume by composting		208 m^3/day

The benefit from decreased landfill area needed is calculated from the saved volume multiplied by the cost of final disposal in each year as shown in Tab. 5-1-2.

Meantime, the following costs were estimated separately.

a. Cost of construction
b. Cost of operation and maintenance
c. Cost of transportation of compost products

According to the cost indicated in the Supporting Report 3.4, transportation cost of compost products was not included in the abovementioned cost.

4) Transportation cost of compost products

The cost for transportation of compost products consists of purchase cost and operation and maintenance cost.

Conditions for calculation of purchase cost are presented as follows:

a. Capacity of transportation vehicle: 4 ton
b. Life of vehicle : 5 year
c. Average trip per day : times
d. Average price of vehicle : 20,000 LE

From the calculations, required number of vehicles are estimated with 5 or the purchast cost at 120,000 LE.

Conditions and calculation means of operation and maintenance costs are indicated in Tab. 5-1-3.

5.2 Financial Evaluation

(1) Method for Financial Evaluation

The Financial Evaluation was carried out with three steps.

- Financial evaluation for Middle District
- Financial evaluation for the project
- Financial evaluation for the Authority

The differences of the three steps are indicated in Tab. 5-2-1.

Estimated construction and operation cost other than the project; collection and sweeping service in other districts, the present Abis compost and final disposal at other disposal sites, was estimated in proportion to the volume of solid waste referring to the Alternative-2 in the Master Plan and shown in Tab. 5-2-2.

Tab. 5-1-1 BENEFIT FROM SAVED TRANSPORTATION COST

Supposition &	with compost	without compost: Direct hauling	without compost: With transfer station
a. Distance of landfill site	6 km	35 km	6 km for T/s 30 km for DS
b. Average speed	18 km/h	25 km/h	18 km/h for T/S 40 km/h for D/S
c. Average fuel consumption	3 km/l	5 km/l	3 km/l for T/S 5 km/l for DS
d. Average collection time	80 min	80 min	80 min
e. Load & unloading time	5 min	5 min	5 min 30 min for DS
f. Hauling time incl. collection f = 2x60x(a/b)+d+e	125 min	253 min	125 min
g. Hauling time for 1 houling g = 2x60x(a/b+e)			150 min
h. Average trip per day h = 480/f *1	3.8 trip	1.9 trip	3.8 trip for T/S 2 trip for DS
i. Necessary collection vehicles h = 300 ton/(hx3.5ton)	23	45	23
j. Necessary hauling vehicles *1			5
k. Necessary drivers *1	23	45	23 5
l. Necessary assistants *1	46	90	46 5
Annual cost (LE 1,000)			
Depreciation cost			
Collection vehicle	199	389	199
Hauling vehicle			131
Personnel expenses			
Driver	55	108	67
Assistant	66	130	73
Maintenance & other	24	48	40
Total	344	675	510
Benefit		510 - 344 = 166	

*1 was calculated in proportion to the solid waste treated in T/S
DS represents Dumpsite
T/S represents Transfer Station

5-1-2 ESTIMATED BENEFIT FROM DECREASE OF LANDFILL AREA NEEDED

(UNIT 1,000 LE)

	MBSDS						QUARRY DISPOSAL SITE									
	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
CAPITAL INVESTMENT																
Construction Cost of Disposal Site	-	-	2,893	-	-	335	-	-	335	-	-	335	-	-	335	-
Procurement cost of Landfill Equipment	-	-	1,182	-	-	-	-	1,182	-	-	-	-	1,182	-	-	-
Total	-	-	4,075	-	-	335	-	1,182	335	-	-	335	1,182	-	335	-
ORDINARY EXPENDITURE																
Depreciation of Facilities	-	-	-	1,021	1,021	867	101	101	101	107	108	108	119	121	121	122
Depreciation of Landfill Equipment	118	118	118	205	205	205	205	205	205	205	205	205	205	205	205	205
Personnel Expense	81	81	81	55	55	55	55	55	55	55	55	55	55	55	55	55
Maintenance Cost	53	53	53	83	83	83	83	83	83	83	83	83	83	83	83	83
Fuel Cost	25	25	25	47	47	47	47	47	47	47	47	47	47	47	47	47
Power & Water	-	-	-	3	3	3	3	3	3	3	3	3	3	3	3	3
Total	277	277	277	1,414	1,414	1,260	494	494	494	500	501	501	512	514	514	515
Cost per M^3 (LE/m)	1.03	0.99	0.97	4.85	4.73	4.62	1.97	1.92	1.84	1.81	1.75	1.70	1.68	1.64	1.59	1.54
Benefit							123	120	115	113	109	106	105	102	99	96 *1

*1 After 2000 year, the benefit was considered as same as the cost in 2000.

Tab. 5-1-3 ESTIMATED TRANSPORTATION COST OF COMPOST PRODUCTS

Item	Value
a. Amount of compost produced	75 ton/day
b. Average distance from the plant to farm	15 km
c. Average speed of vehicles	20 km/h
d. Average fuel consumption	4 km/l
e. Loading & unloading time	60 min
f. Operation time per trip	
f = 2(b/c)x60+e	150 min
g. Average trip per day	
g = 480/f	3.2 trip/day
h. Necessary vehicles	
h = a/(4g)	6 units
i. Necessary drivers	
i = 1.2h	7 persons
j. Necessary assistants	
j = 2i	14
k. Unit price of vehicle	20,000 LE/vehicle
l. Average price of fuel	0.15 LE/l
m. Average wage of driver	200 LE/month
n. Average wage of assistant	120 LE/month
Transportation cost of compost products (LE)	
Personnel expense	37.0
Operation & maintenance cost	14.4 (6x20,000 LE x 0.6/5)
Fuel cost	9.9
Total	61.3

Tab. 5-2-1 ASSUMPTION OF REVENUE AND COST FOR FINANCIAL EVALUATION

Item/Stage	for Middle	for Project	for Authority
Revenue			
Resident	from Middle	from Middle	from Alexandria
Company	from Middle	from Middle	from Alexandria
Cleansing Fund	for Middle	for Middle	for Alexandria
Chapter 3	for Middle	for Middle & MBDS & Compost	for Project & Out-of-project *1
Wage from C/G	Calculated in proportion to solid waste	for project member	for Authority member
Compost	Calculated in proportion to solid waste	New Abis	New Abis & Present Abis
Reusable Material	Calculated in proportion to solid waste	New Abis	New Abis & Present Abis
Plastic Bags	-	-	for Alexandria
Cost	Calculated in proportion to solid waste from Project cost	for Project	for Authority adding cost for Administrative person and office etc.
Investment	Calculated in proportion to solid waste from Project Investment	for Project	for Project & Out-of-project

5-2-2 ESTIMATED CONSTRUCTION & OPERATION COST OTHER THAN THE PROJECT

(UNIT LE 1,000)

	MBSDS						QUARRY DISPOSAL SITE										
	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	Total
Construction & Purchase																	
Collection & Sweeping	1,606	1,637	1,540	1,540	1,580	2,116	2,116	2,028	2,028	1,971	2,477	2,372	2,372	2,372	2,462	3,045	33,220
Transfer Station																	
Compost					641					641					4,111		5,393
Final Disposal				6,056					2,103		1,837			2,233			10,392
Total	1,606	1,637	1,540	7,605	,2221	2,116	2,116	2,028	4,131	2,612	4,314	2,372	2,372	4,605	6,513	3,045	49,005
Operation & Management																	
Personnel Expense	(1,826)	(1,923)	(2,020)	(2,116)	(2,133)	(2,217)	(2,339)	(2,461)	(2,584)	(2,717)	(2,839)	(3,027)	(3,214)	(3,402)	(3,592)	(3,780)	(42,190)
Collection & Sweeping	1,552	1,645	1,737	1,829	1,922	2,014	2,136	2,258	2,381	2,503	2,625	2,813	3,000	3,188	3,375	3,563	38,541
Transfer Station	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Compost	118	118	112	118	118	110	110	110	110	110	110	110	110	110	110	110	1,800
Final Disposal	156	160	165	169	93	93	93	93	93	104	104	104	104	104	107	107	1,849
Maintenance	(716)	(731)	(737)	(766)	(820)	(859)	(891)	(930)	(961)	(1,008)	(1,090)	(1,104)	(1,153)	(1,141)	(1,183)	(1,190)	(15,280)
Collection & Sweeping	513	525	528	554	575	614	646	586	716	743	825	839	888	876	906	913	11,346
Transfer Station	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Compost	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	1,632
Final Disposal	101	104	107	110	143	143	143	143	143	163	163	163	163	163	175	175	2,302
Fuels	(214)	(220)	(227)	(233)	(264)	(269)	(280)	(292)	(303)	(330)	(341)	(539)	(378)	(396)	(421)	(439)	(4,966)
Collection & Sweeping	100	105	110	115	120	125	136	148	159	171	182	200	219	237	256	274	2,657
Transfer Station	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Compost	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	1,056
Final Disposal	48	49	51	52	78	78	78	78	78	93	93	93	93	93	99	99	1,253
Others	(43)	(43)	(43)	(43)	(54)	(54)	(54)	(54)	(54)	(56)	(56)	(56)	(56)	(56)	(56)	(56)	(834)
Collection & Sweeping	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Transfer Station	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Compost	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	688
Final Disposal	-	-	-	-	11	11	11	11	11	13	13	13	13	13	13	13	146
Sub-total																	
Collection & Sweeping	2,165	2,275	2,375	2,498	2,617	2,753	2,918	3,091	3,256	3,417	3,632	3,852	4,107	5,301	4,537	4,750	52,544
Transfer Station	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Compost	329	329	329	329	329	321	321	321	321	321	321	321	321	321	321	321	5,176
Final Disposal	305	313	323	331	325	325	325	325	325	373	373	373	373	373	394	394	5,550
Total	2,799	2,917	3,025	3,158	3,271	3,399	3,564	3,737	3,902	4,111	4,326	4,546	4,801	4,995	5,252	5,465	63,270
Grand Total	4,405	4,554	4,576	10,763	5,492	5,515	5,680	5,765	8,033	6,723	6,803	6,918	7,173	9,600	11,765	8,510	112,275

5.3 Evaluation of Alternative Compost Plant

5.3.1 Economic evaluation

In this section, economic evaluation of alternative plant proposed in Clause 6.6 is studied.

1) Evaluation conditions

Evaluation conditions are same as Clause 6.4.

2) Calculation of benefits and costs

Comparison with benefits of plant proposed in Clause 5.3 and plant proposed in Clause 6.6 (Alternative plan) are shown below.

S.R. Table 5-3-1 COMPARISON OF BENEFIT

	Plant Proposed in Clause 5.3	Plant Proposed in Clause 6.6 (Alternative Plan)
Increase harvest of crop	1,395,000 LE/y	same as left
Reduction in use of chemical fertilizer	273,000 LE/y	same as left
Reduction in volume of irrigation water	. 207,000 LE in reduced reduced construction cost. 102,000 LE in 3rd year 105,000 LE in 4th year . 6,000 LE/y in reduced maintenance cost.	same as left
Salvage of reusable materials	. 140,000 LE/y at the first year . 168,000 LE/y in 2000	. 169,200 LE/y at the first year . 208,100 LE/y in 2000
Haulage costs saving through disposal amount reducing	166,000 LE/y	174,000 LE/y
Landfilling costs saving at landfill sites through disposal amount reducing	. 123,000 LE/y at first year . 96,000 LE/y in 2000	

Comparison with costs of plant proposed in Clause 5.3 and plant proposed in Clause 6.6 (Alternative plan) are shown as follows.

S.R. Table 5-3-2 COMPARISON OF COST

	Plant proposed in Clause 5.3	Plant proposed in Clause 6.6 (Alternative plan)
Construction costs	13,108,000 LE with 2 years construction period	9,245,000 LE with 2 years construction period
Vehicle purchase costs	941,000 LE	716,000 LE
Cost of purchasing vehicles to haul the compost	120,000 LE	120,000 LE
Plant O/M costs	582,000 LE/y	450,230 LE/y
Product (compost) haulage cost	61,000 LE/y	71,200 LE/y

5.3.2 Comparison of the Alternative Compost Plant

Comparison of the plant conditions, specification and cost are shown in Table 5-3-3, 5-3-4 and 5-3-5.

S.R. Table 5-3-3 COMPARISON OF CONDITION

	PLANT 1	PLANT 2 ALTERNATIVE	PLANT 2 ALTERNATIVE Conditions: Same as PLANT 3	PLANT 3
Composition of MSW				
Paper	23 %			17.5 %
Garbage	51			67.2
Textile	6			2.7
Plastics	9			1
Metals	6	same as left	same as right	1.8
Glass	4			2.1
Bone	-			0.5
Miscellaneous	1			7.2
Total	100			100
Salvaging rate by handsorting				
Paper	10 %			40 %
Textile	5			60
Plastics	5	same as left	same as right	50
Metals	70			85
Glass	25			30
Bone	-			30
	Above figure to be determined from the actual data of existing Abis Compost Plant.			
Price of reusable materials				
Coarse compost	7 LE/ton	8 LE/ton		11 LE/ton
Fine compost	9	10		15
Paper	40	40		25
Glass	20	12	same as right	29.5
Bone	-	50		33
Textile	20	20		22
Metal	9	16		16
Plastics	120	120		120
Exchange rate	US$1=LE1.33	US$1=LE1.33	US$1=LE0.82	US$1=LE0.82 * (* Expected)
Unit price of Utilities				
Electricity	0.0482 LE/kwH			0.02 LE/kwH
Water	0.12 LE/m^3			0.029 LE/m^3
Fuel	203 LE/kl	same as left	same as right	25 LE/Kl
Lubricant	203 LE/kl			1500 LE/Kl
Depreciation period	Vehicle: 5 years with aresidual value of 10% Equipment: 15 years Civil works and buildings: 30 years	same as left	same as right	Installed Stationary and mobil equipment: 12 years Civil works and buildings: 30 years
Operational personnels	105 No. of personnel is determined on the survey of existing base of Abis Compost Plant.	101	55	55
Date of report submitted	April, 1986	April, 1986	April, 1986	January, 1985

S.R. Table 5-3-3 CONPARISON OF CONDITION

	PLANT 1	PLANT 2 ALTERNATIVE	PLANT 2 ALTERNATIVE Conditions: Same as PLANT 3	PLANT 3
Staff and labour unit cost	High rank general manager 2,000 LE/Year-p 1st class 1,600 2nd class 1,400 3rd class 1,100 4th class 800 5th class 700 6th class 600	same as left	same as right	Managing director 3,000 LE/year-p Plant manager (Mechanical engineer) 2,400 Accountant/Secretary 1,800 Maintenance/Mechanic 1,800 Electrician 1,800 Laboratory assistant 1,800 Turning machine operator 1,800 Shovel loader operator 1,800 Weigh bridge operator 1,440 Pickers 1,200 Unskilled labour 1,080 Plant cleaning personnel 900 Subproduct baling operator 1,080 Watchman 1,080

S.R. Table 5-3-4 COMPARISON OF SPECIFICATION

* expected from the data of existing Abis Compost Plant

	PLANT 1	PLANT 2 ALTERNATIVE	PLANT 2 ALTERNATIVE Conditions: Same as PLANT 3	PLANT 3	
Capacity	300 t/d 21 t/h	same as left "	same as left "	19 t/h	
Operation hours	16 hrs/d Net 14 hrs/d	" "	" "	16 hrs/d	
Operation days	300 d/y	"	"	300 d/y	
Fermentation period Fermentation Maturing Total	 30 days 30 days 60 days	 " " "	 " " "	 Five weeks (35 days*) Four weeks (28 days*) 63 days*	
Guarantee	Whole system Guarantee	"	"	Equipment Guarantee	
Feature of the plant					
1. Pretreatment system					
1) Storage capacity for refuse	for 1.5 day	for one day	for one day	for one day	
2) Feelding Conveyor	Steep apron conveyor with leveller x 2 lines x 11 ton/h-line (22 ton/h)	same as left	same as left	Short horizontal apron conveyor without leveller x 2 lines x 9.5 tons/h-line (19 ton/h)	*
3) Handsorting conveyor before SPC2	Belt conveyor (width 1.6 m speed 10 m/min x 2 lines x 11 ton/h-line (22 ton/h)	same as left	same as left	Belt conveyor (width 1.0 m speed 20 m/min x 2 lines x 9.5 tons/h-line (19 t/h)	*
4) Pulvesizer and Classifier	Selective pulverizing classifier (SPC2) x 2 lines x 11 ton/h-line (22 ton/h)	Salective pulverizing classifier (SPC2) x 1 line x 22 ton/h-line	same as left	homogenizing drum x 2 lines x 9.5 t/h (19 t/h)	*
5) Hondsorting conveyor after SPC2	Belt conveyor (width 1 m speed 10 m/min x 2 lines x 3.6 ton/h-line (7.3 ton/h)	Belt conveyor (width 1.6 m speed 10 m/min x 1 line x 7.3 t/h	same as left	-	
2. Fermentation and Maturing					
1) Distributing method to yard	Truck	Distrubuting conveyor	same as left	Distributing conveyor	
2) Fermentation	Turning by turning machine	same as left	same as left	same as left	
3) Maturing	Turning by turbine machine	Static pile without turning	same as left	same as left	
4) Area Fermentation) Maturing	36,300 m^2	28,000 m^2	same as left	20,000 m^2	*
3. Refining System 1) Refining screen	Vibration screen x 1 line x 6.9 ton/h	same as left	same as left	Vibration screen or Rotating drum x 1 line	*
4. Generator	625 KVA x 1 unit	same as left	same as left	750 KVA x 2 units	

S.R. Table 5-3-4 COMPARISON OF SPECIFICATION

* expected from the data of existing Abis Compost Plant

	PLANT 1	PLANT 2 ALTERNATIVE	PLANT 2 ALTERNATIVE Conditions: Same as PLANT 3	PLANT 3	
5. Civil Works and Building					
1) Site preparation	5 ha	3.5 ha	same as left	2.5 ha	*
2) Fence and gate	1910 m	1370 m	"	1,020 m	
3) Administration Office	240 m^2	240 m^2	"	no mention	
4) Main building	2700 m^2	1030 m^2	"	1,300 m^2	*
5) Reusable material storage	204 m^2	-	-	no mention	
6) Raw compost loading house	56 m^2	-	-	-	
7) Generator house	120 m^2	100 m^2	"	120 m^2	*
8) Workshop and rest room	300 m^2	200 m^2	"	no mention	
9) Refining room	180 m^2	-	-	-	
10) Guard house (Gate house)	20 m^2	-	"	20 m^2	*
11) Kiosk for weighbridge	-	-	-	20 m^2	*

S.R. Table 5-3-5 COMPARISON OF PLANT COST

* expected from the data of existing Abis Compost Plant

	PLANT 1	PLANT 2 ALTERNATIVE	PLANT 2 ALTERNATIVE Conditions: Same as PLANT 3	PLANT 3
Construction Cost	US$1 = LE 1.33	US$1 = LE 1.33	US$1 = LE 0.82	US$1 = LE 0.82
Equipment	LE 9,047,500	LE 7,128,000	LE 4,674,285	LE 4,300,000
Civil works and Building	3,766,231	2,358,730	2,087,382	2,000,000
Design and Supervision	1,236,548	474,100	340,433	150,000
Total	14,050,270	9,960,830	7,102,100	6,450,000
Operation Cost				
Depreciation	890,815 LE/y	676,932 LE/y	461,548 LE/y	425,000 LE/y
Maintenance	209,000	163,780	106,058	86,000
Electricity etc.	196,752	115,130	33,544	30,349.5
Personel cost	177,720	171,320	75,600	75,600
Total	1,474,287	1,127,162	676,750	616,949.5
Total (Excluding Depreciation)	583,472	450,230	215,202	191,949.5
Revenue	Reusable materials 1990 - 140,000 LE/y 2000 - 168,000 Compost 1990 - 207,360 LE/y 2000 - 196,830 LE/y	Reusable materials 1990 - 144,540 LE/y 2000 - 208,080 Compost 1990 - 236,160 LE/y 2000 - 228,540	same as right	Reusable materials 282,700 LE/y Compost 424,320 LE/y

CHAPTER 6. DRAWINGS

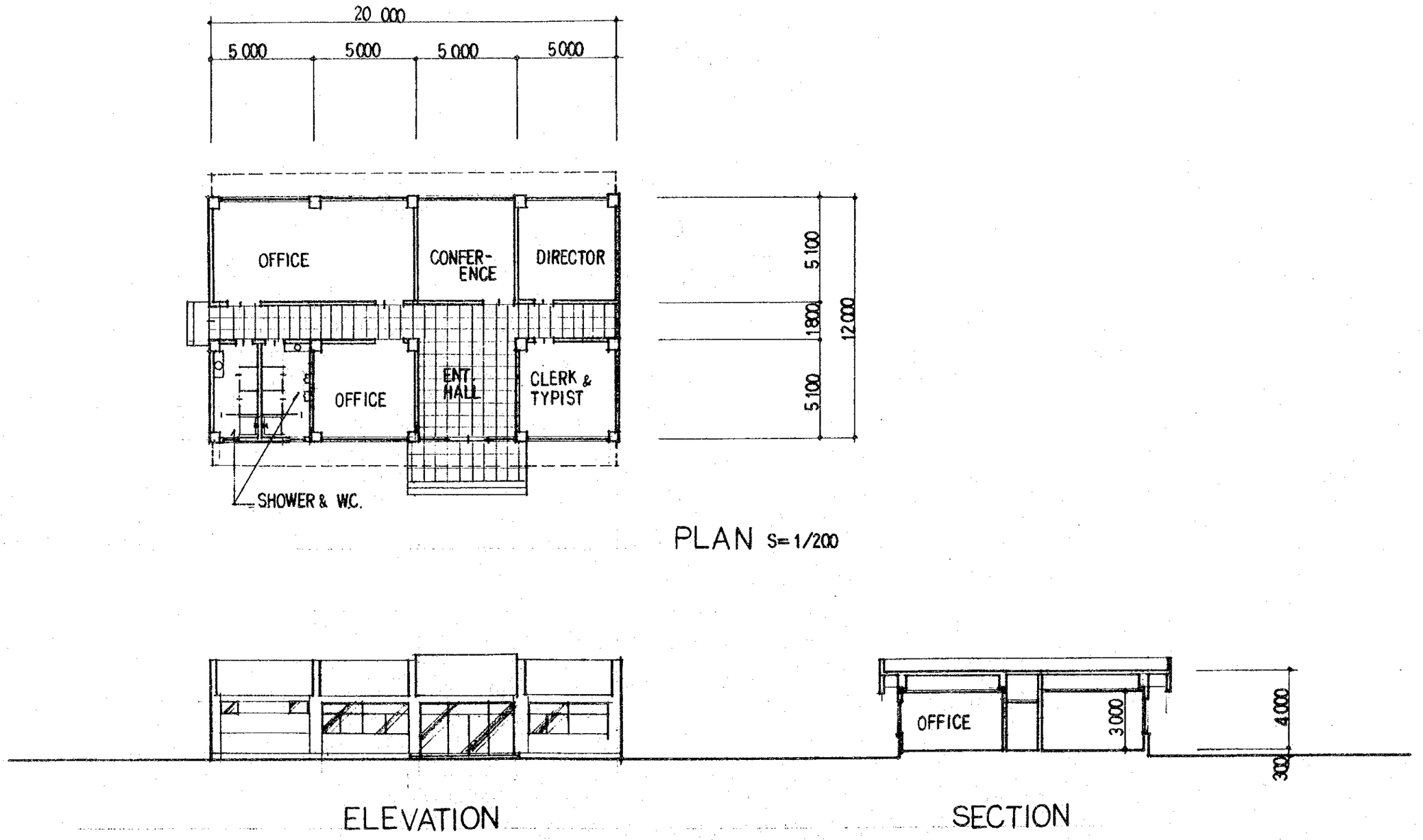
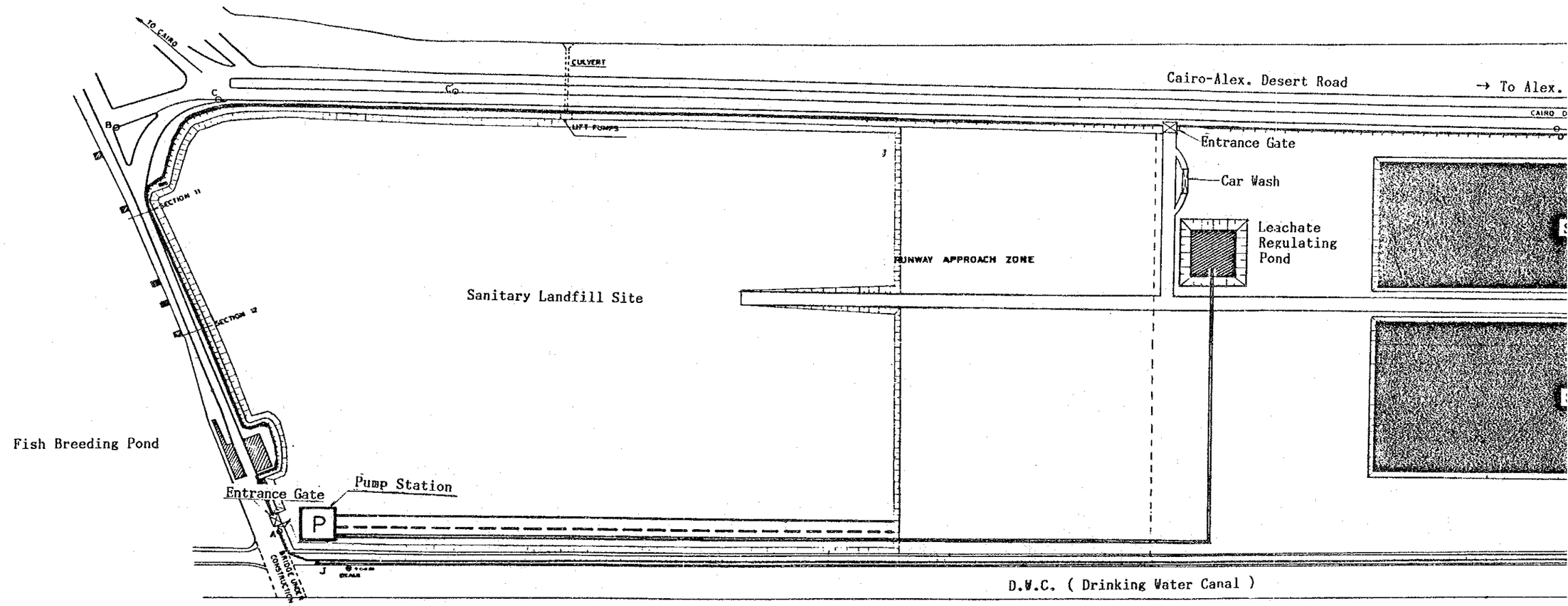


Fig. 6-1-1 ADMINISTRATION BUILDING OF THE TRANSFER STATION

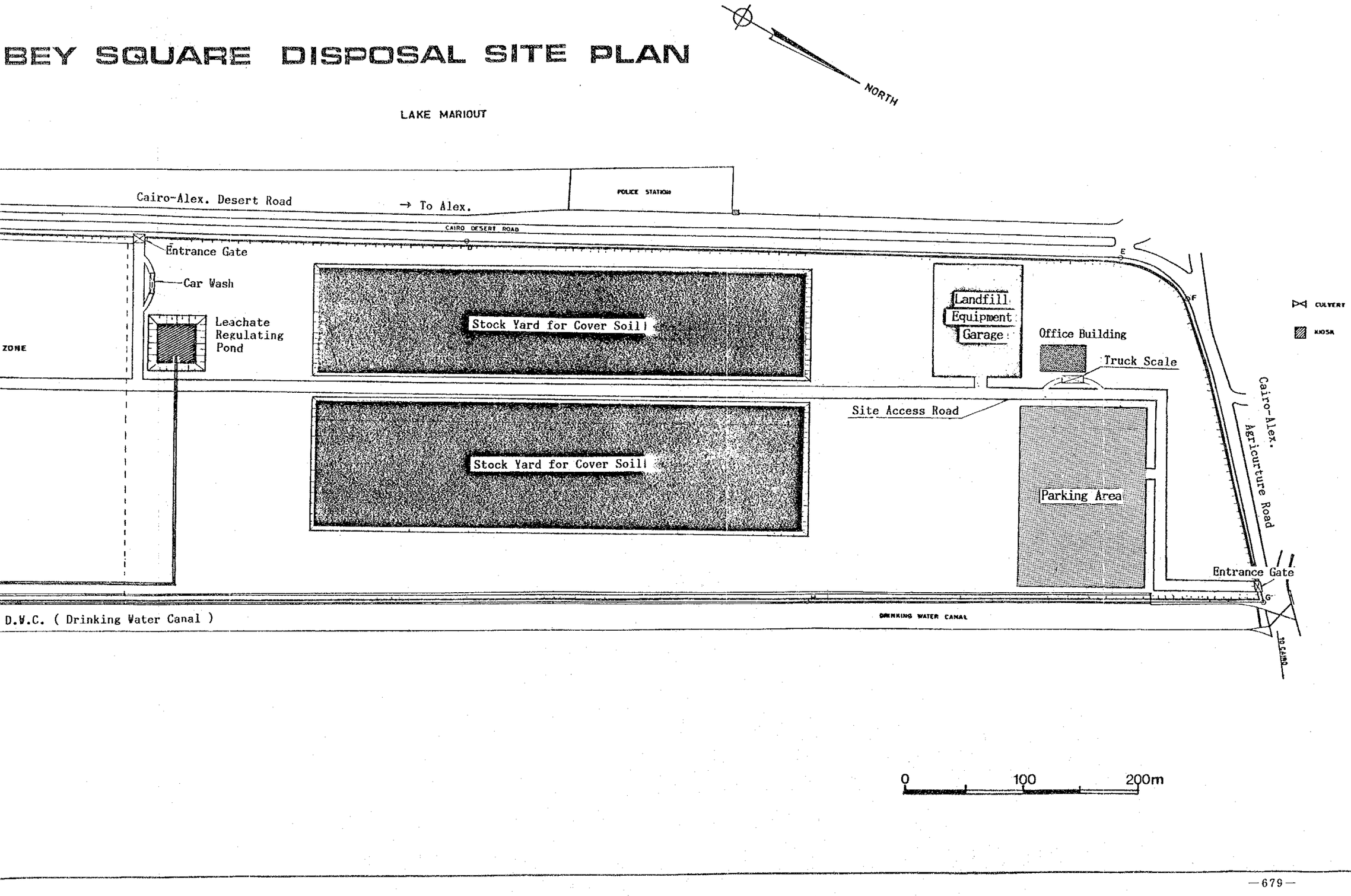
ADMININISTRATION BUILDING

S.R. FIG. 6-2-1 MOHARAM BEY SQUARE DISPOSAL



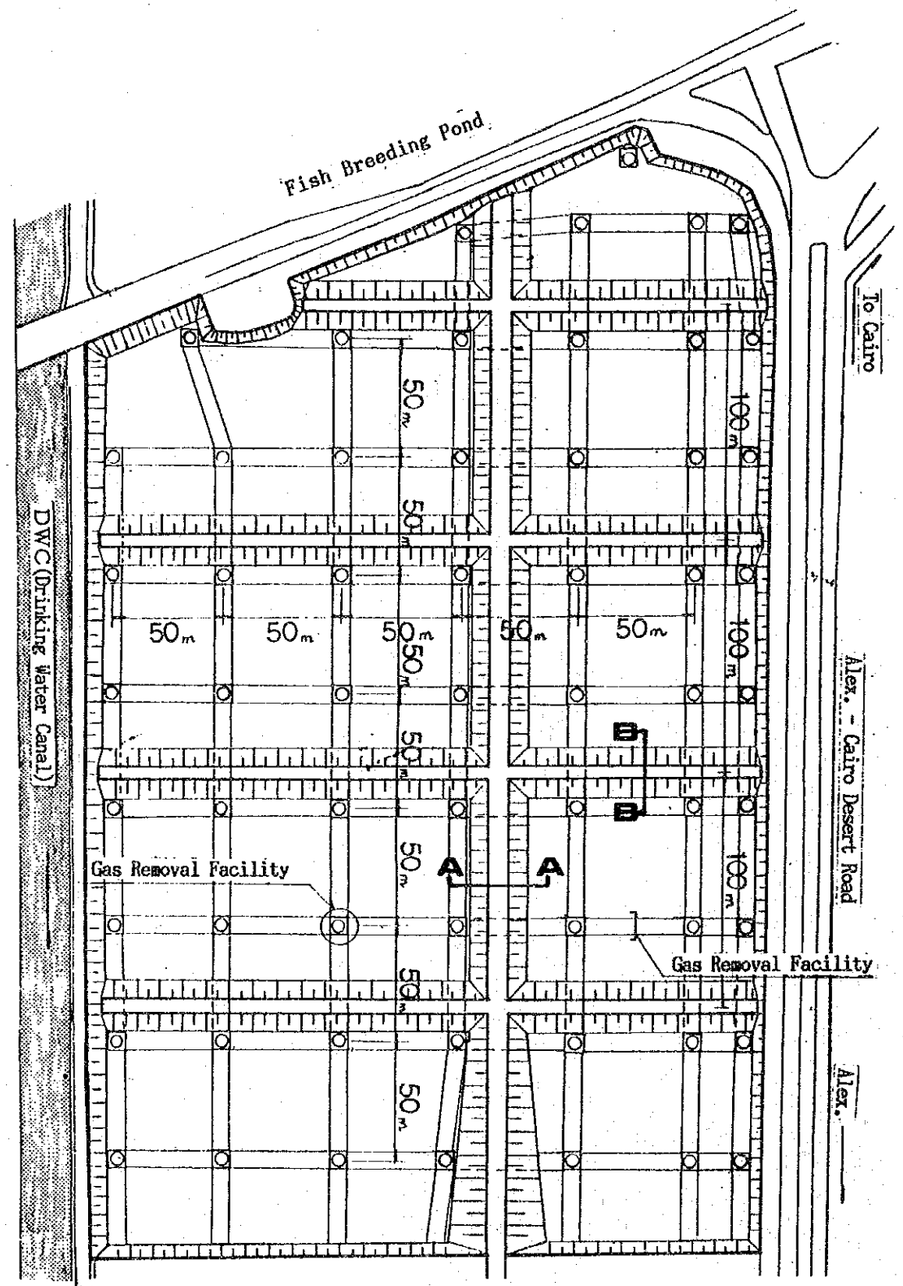
L E G E N D	
Fence	
Leachate Pipe	
Filter	
Leachate Collection Pipe	
Gate	

BEY SQUARE DISPOSAL SITE PLAN

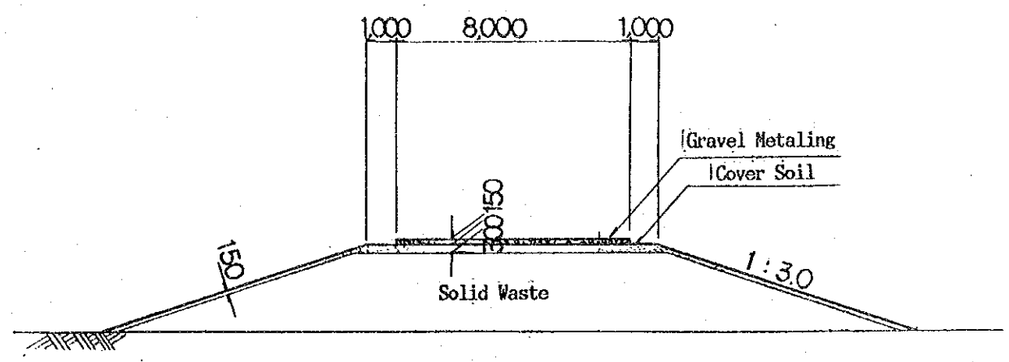


S.R. FIG. 6-2-2 LANDFILL PLAN

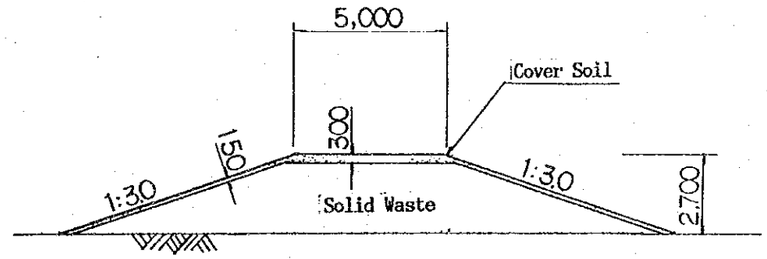
P L A N



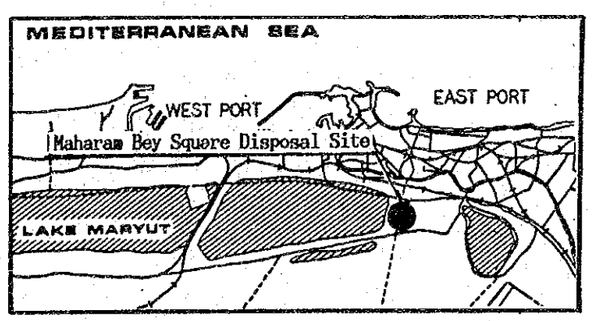
SITE ACCESS ROAD
(A-A CROSS SECTION)



APPROACH ROAD
(B-B CROSS SECTION)

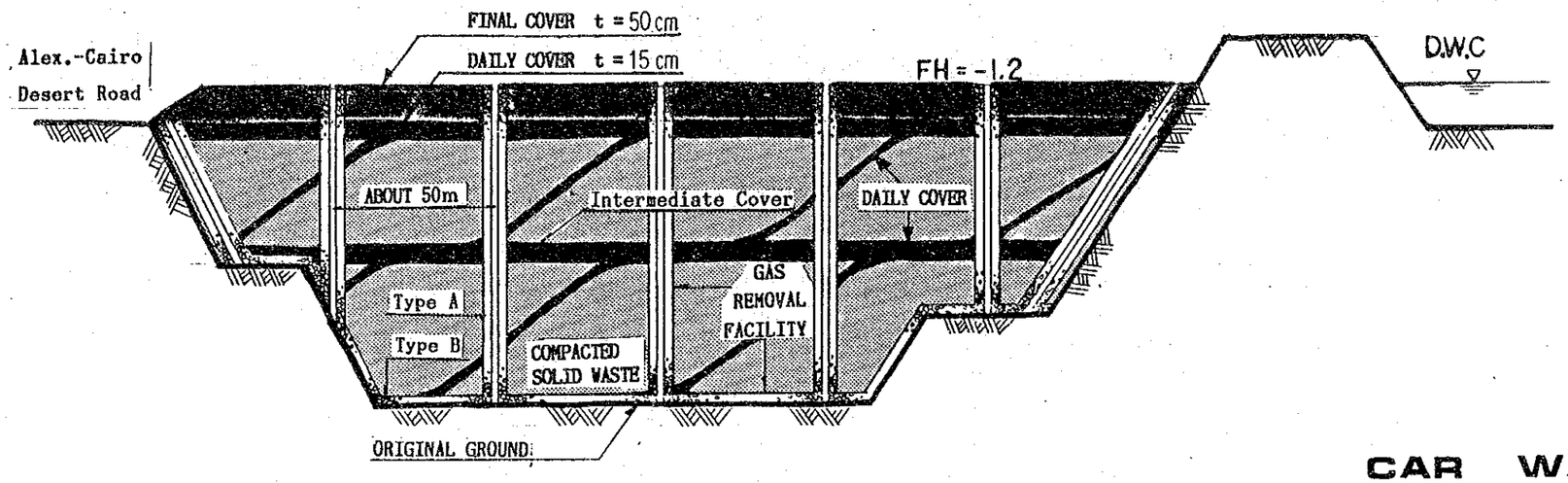


LOCATION MAP



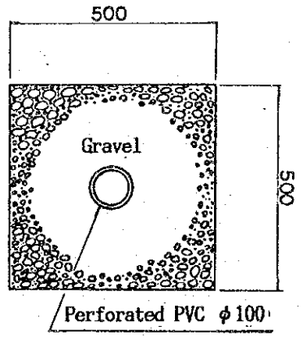
S.R. FIG. 6-2-3 FACILITY PLAN

CROSS SECTION OF LANDFILL SITE

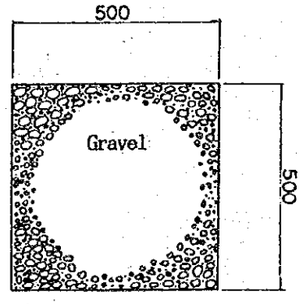


GAS REMOVAL FACILITY

TYPE A (VERTICAL)

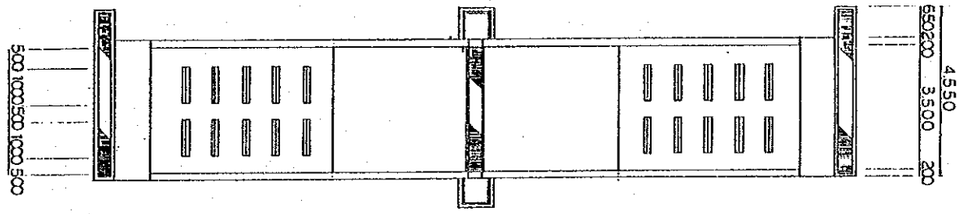


TYPE B (HORIZONTAL)

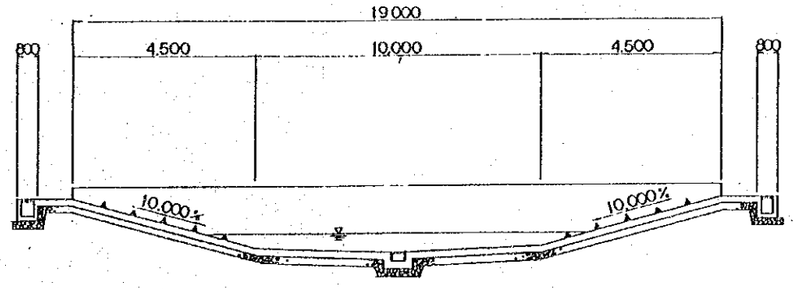


CAR WASH

PLAN

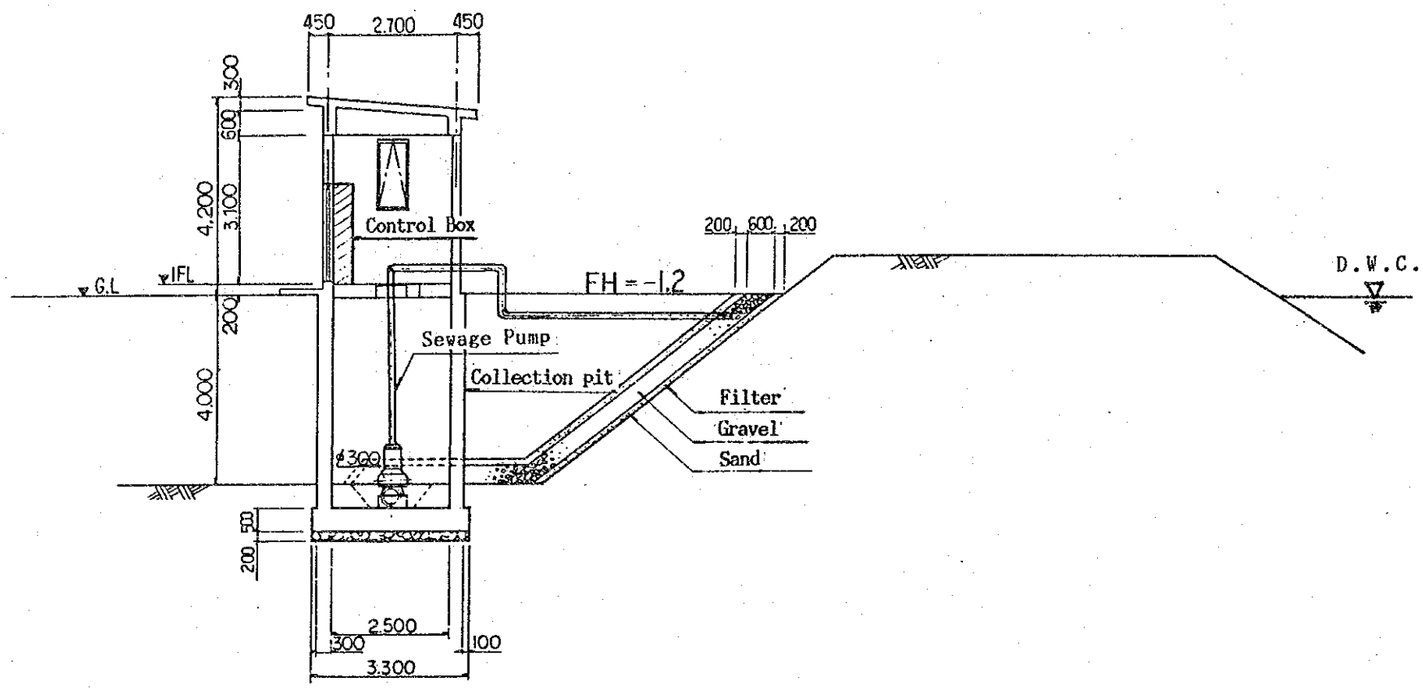


CROSS SECTION

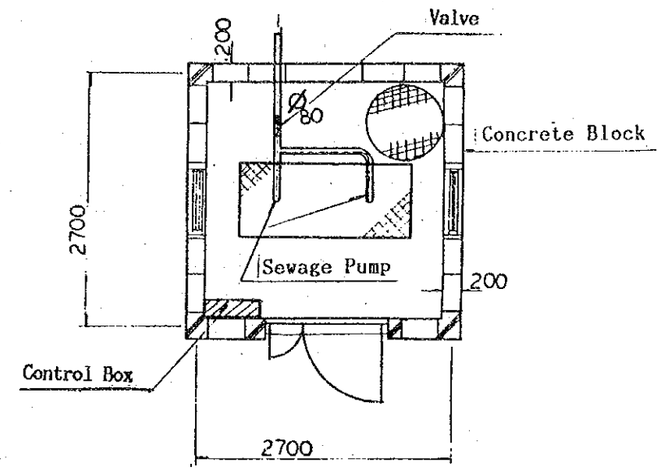


S.R. FIG. 6-2-4 LEACHATE CONTROL FACILITY PLAN

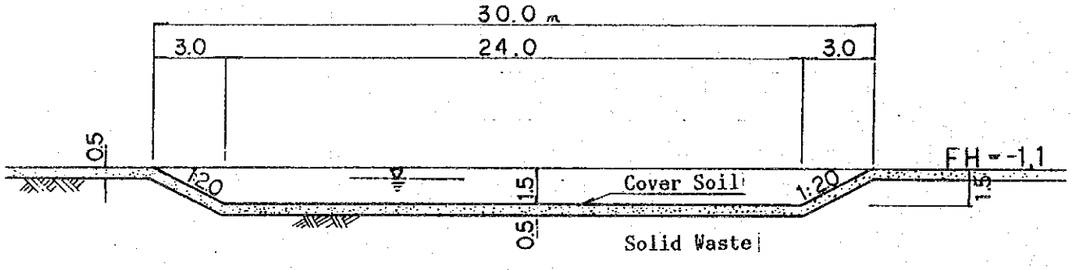
PUMP STATION



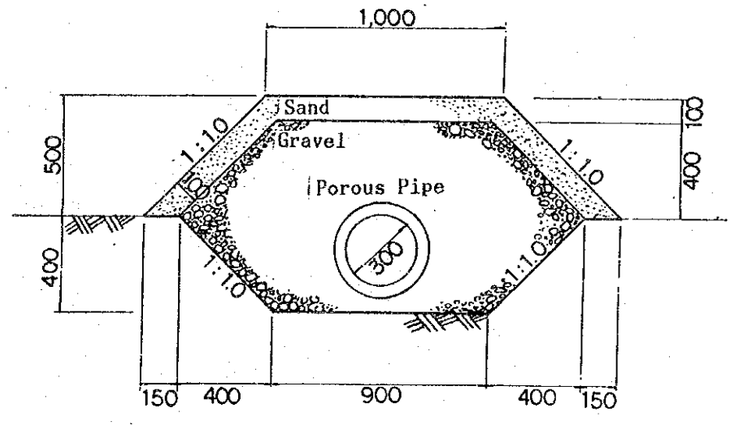
PLAN OF PUMP STATION



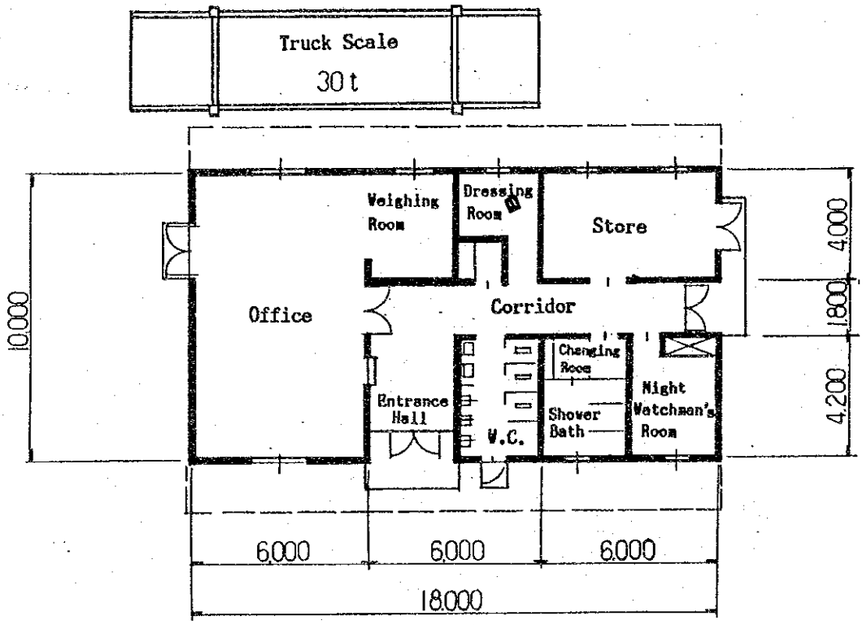
LEACHATE REGULATING POND



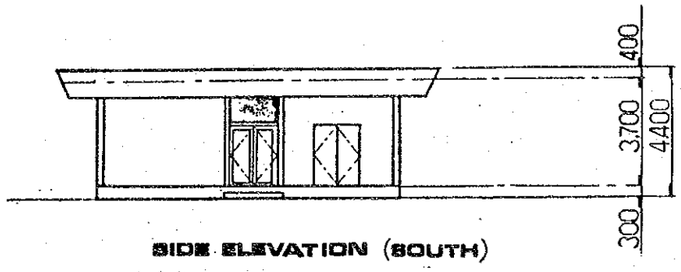
LEACHATE COLLECTION PIPE



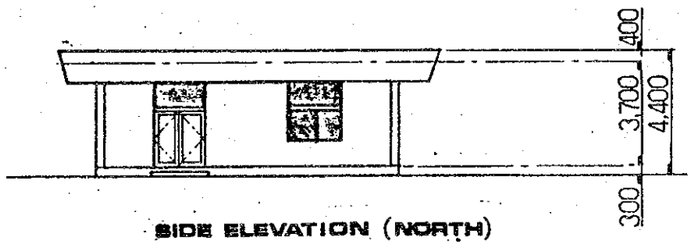
S.R. FIG. 6-2-5 OFFICE BUILDING PLAN IN MBSDS



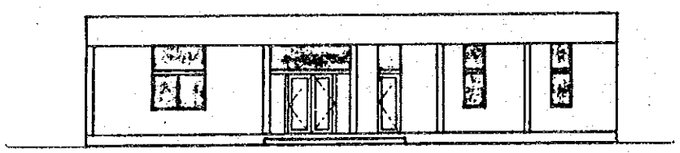
FLOOR PLAN



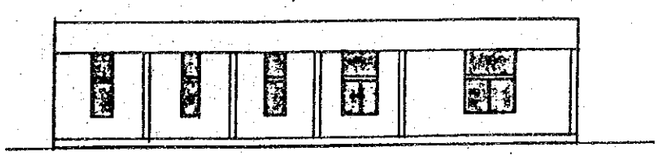
SIDE ELEVATION (SOUTH)



SIDE ELEVATION (NORTH)



FRONT ELEVATION (WEST)



FRONT ELEVATION (EAST)

SCALE

0 5 10m

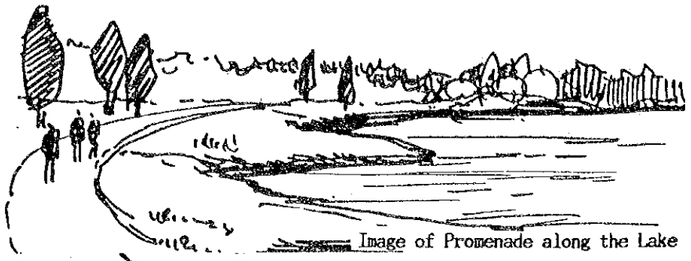


Image of Promenade along the Lake

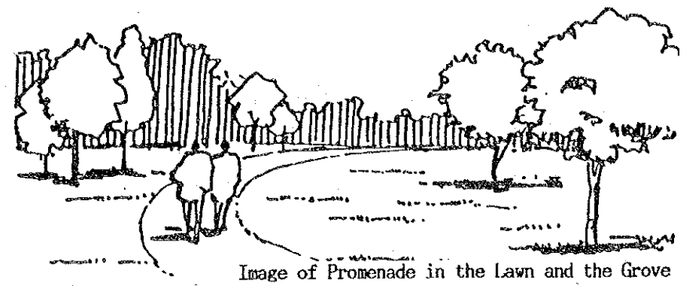
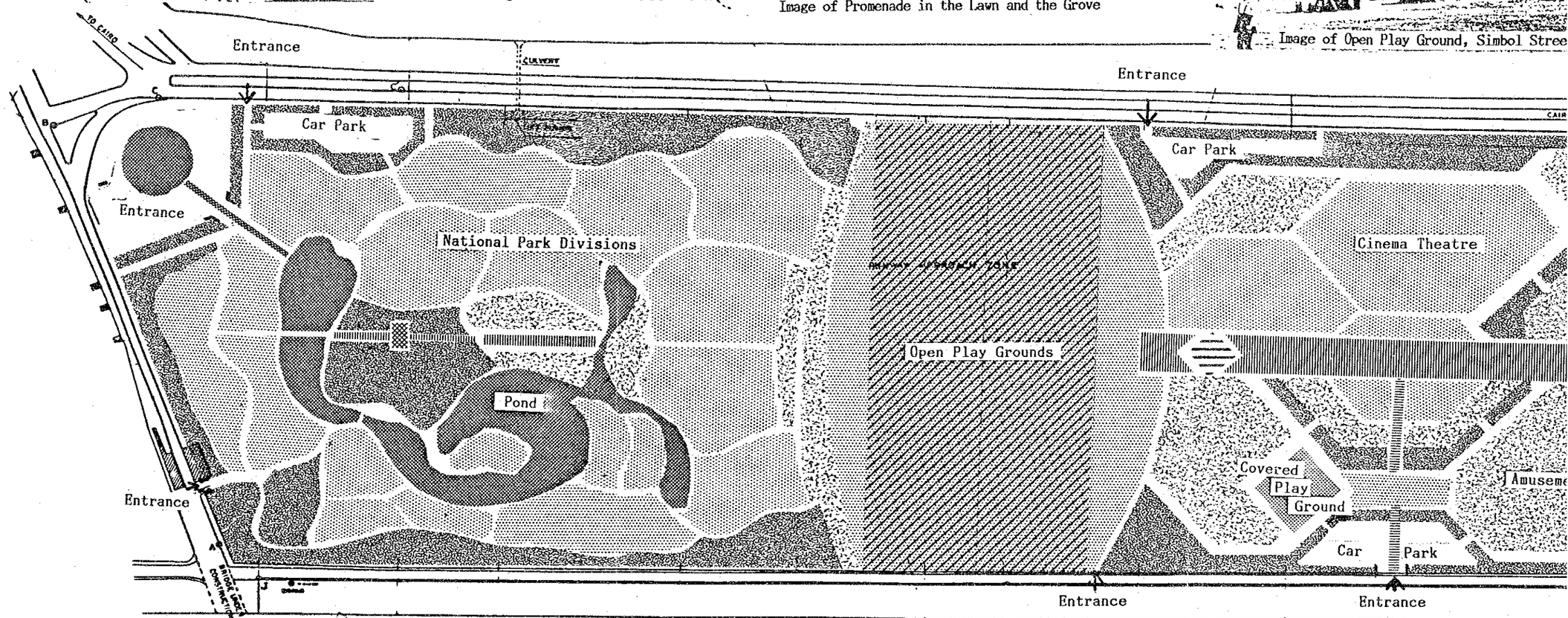


Image of Promenade in the Lawn and the Grove

Image of Open Play Ground, Simbol Stree



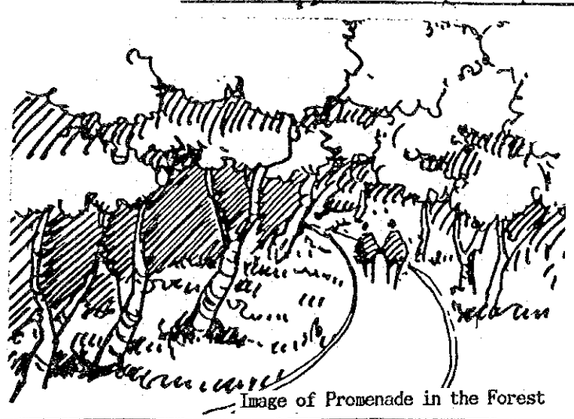


Image of Promenade in the Forest

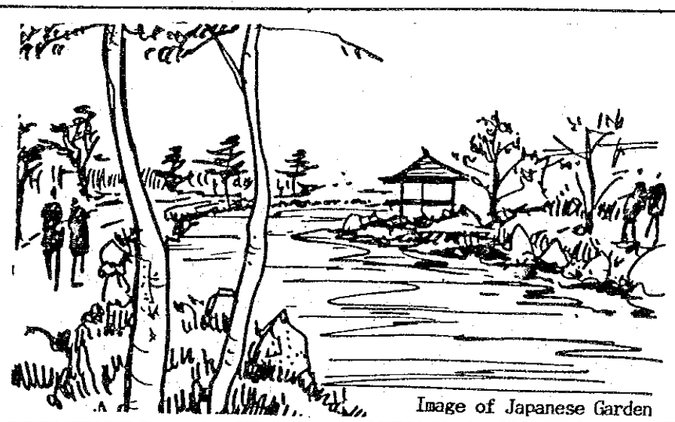


Image of Japanese Garden

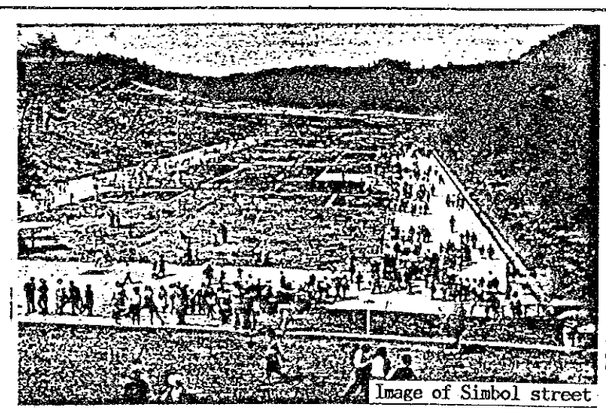


Image of Simbol street

S.R. FIG. 6-2-6

ULTIMATE USE OF COMPLETED MBSDS

Lawn and the Grove

Image of Open Play Ground, Simbol Street, Handicap Garden and so on

NORTH

Entrance

POLICE STATION

CAIRO DESERT ROAD

Car Park

Handicap Garden

Cinema Theatre

Restaurant

Car Park

Coffee Shop

Flower Exhibition

Entrance Simbol

ay Grounds

Simbol Street

Main Entrance

Children Park

Covered Play Ground

Amusement Park

Car Park

Car Park

Administration

Car Park

(Housing Complex for New Couples)

CULVERT

RIVER

Entrance

Entrance

Entrance

DRINKING WATER CANAL

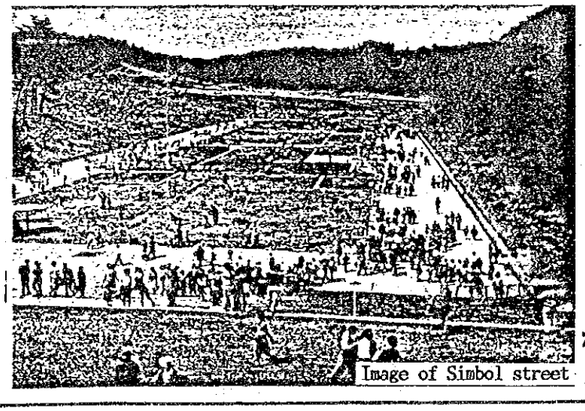


Image of Simbol street

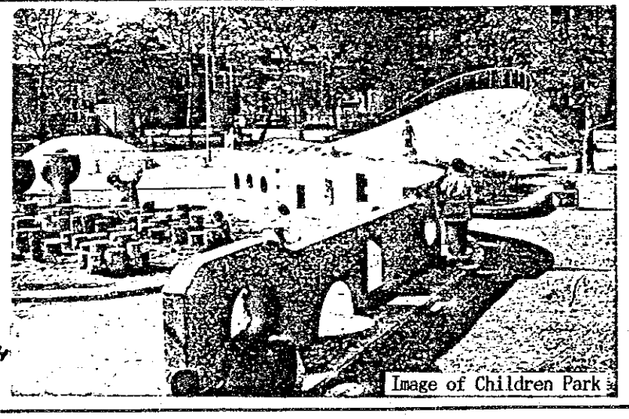
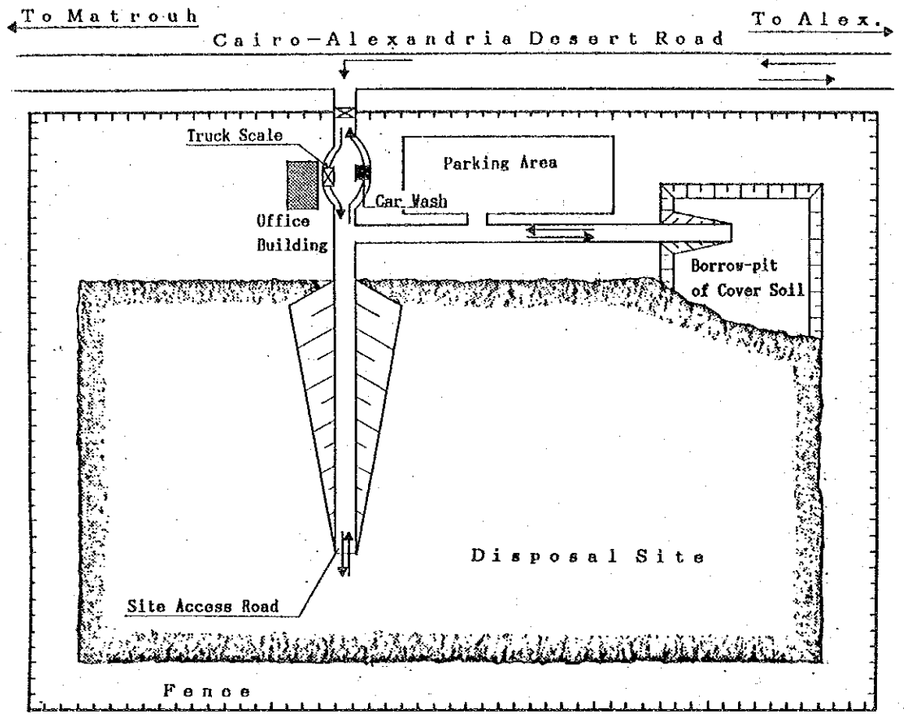


Image of Children Park

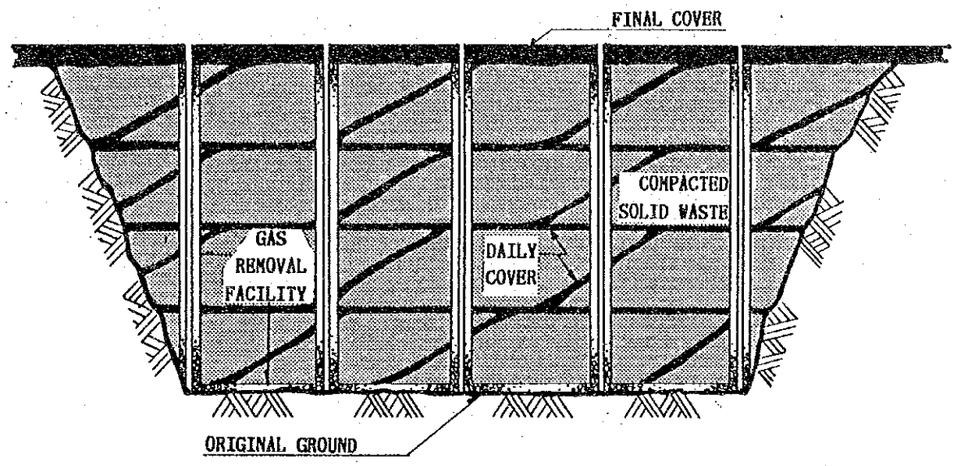
0 100 200m

S.R.FIG 6-2-7 QUARRY FINAL DISPOSAL SITE PLAN

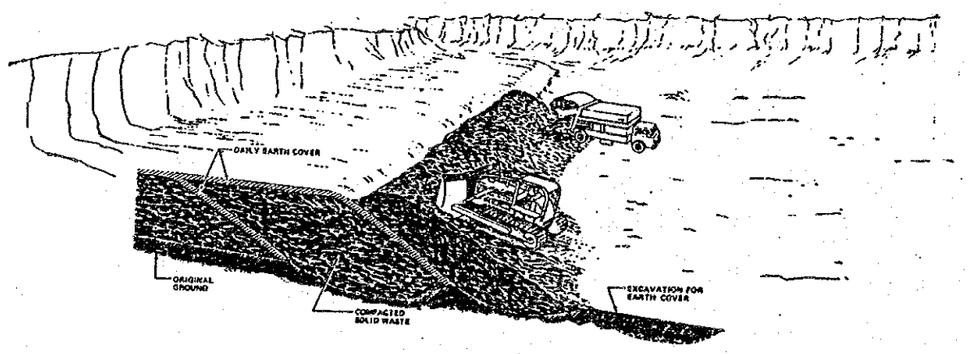
PLAN



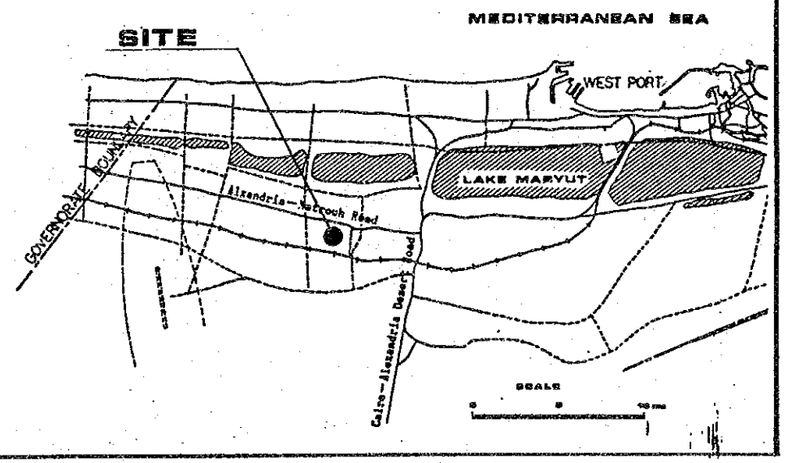
CROSS-SECTION

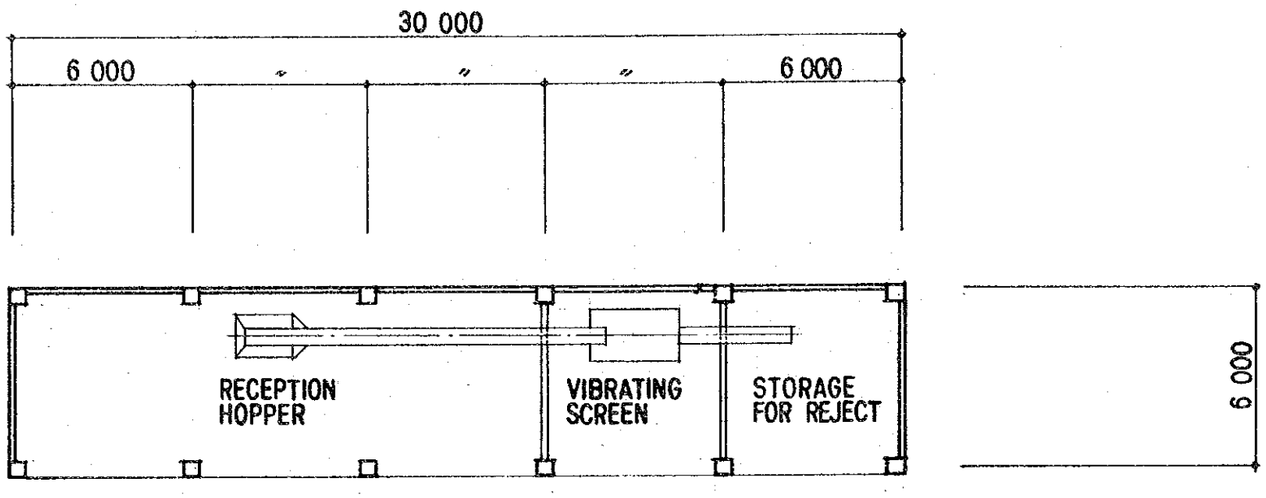


LANDFILL VIEW

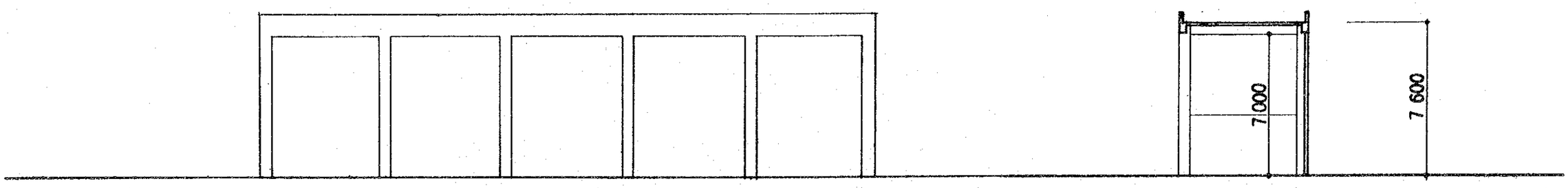


LOCATION MAP





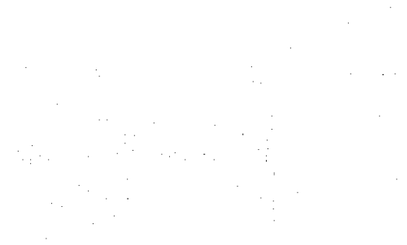
PLAN S = 1/200

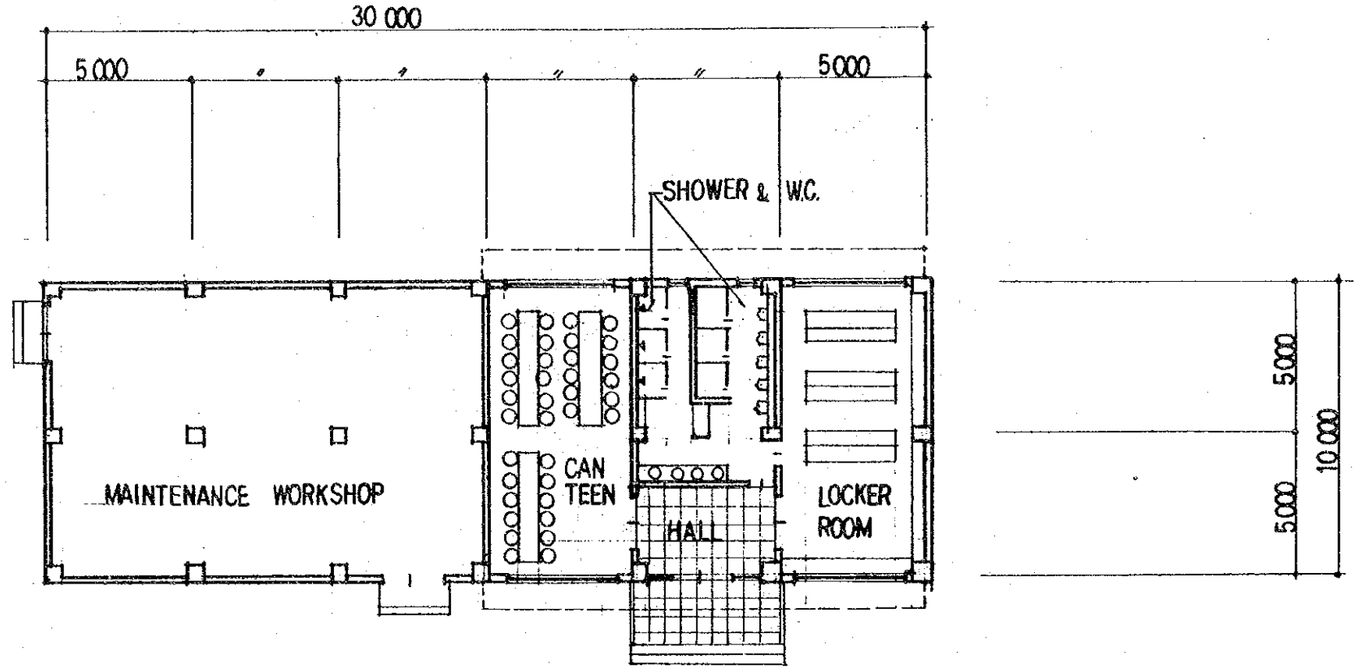


ELEVATION

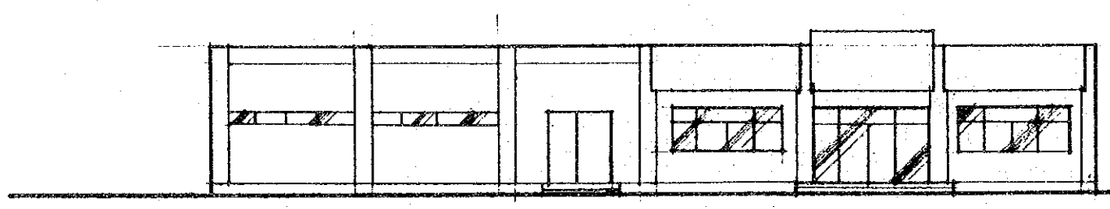
SECTION

Fig. 6-3-1 REFINING SHOP

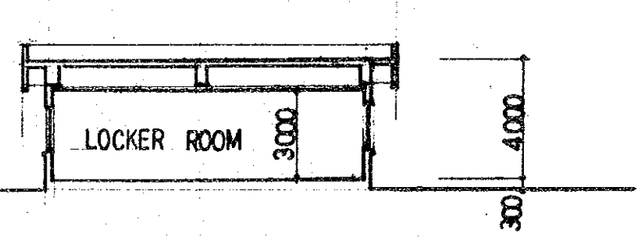




PLAN S-1/200

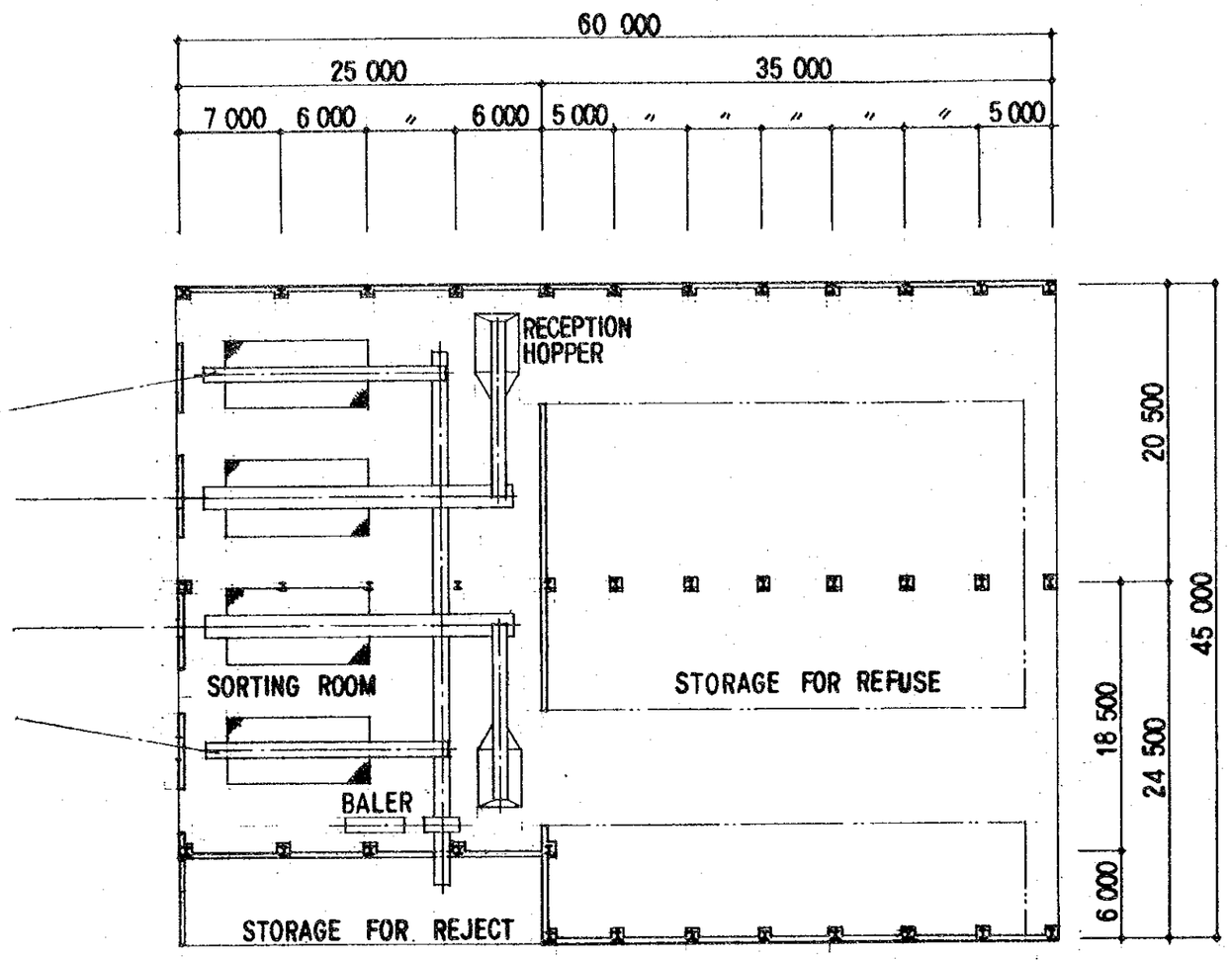


ELEVATION



SECTION

Fig. 6-3-2 WORKSHOP & WORKER'S STATION



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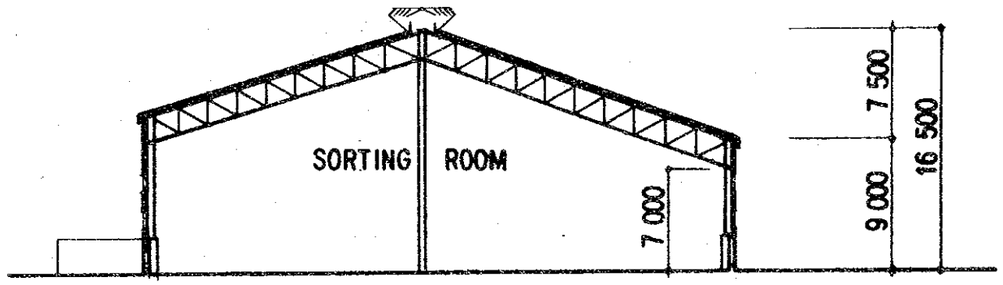
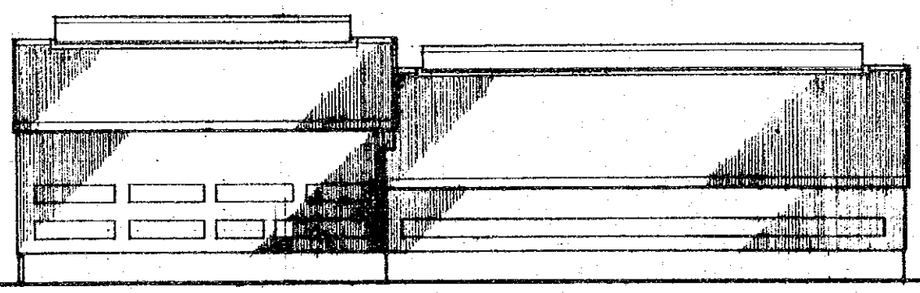


SECTION



ELEVATION

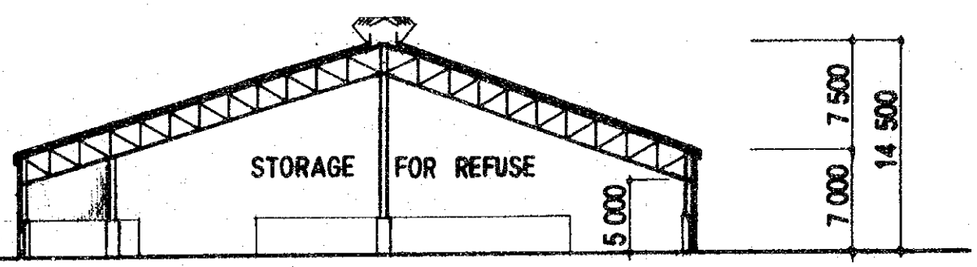


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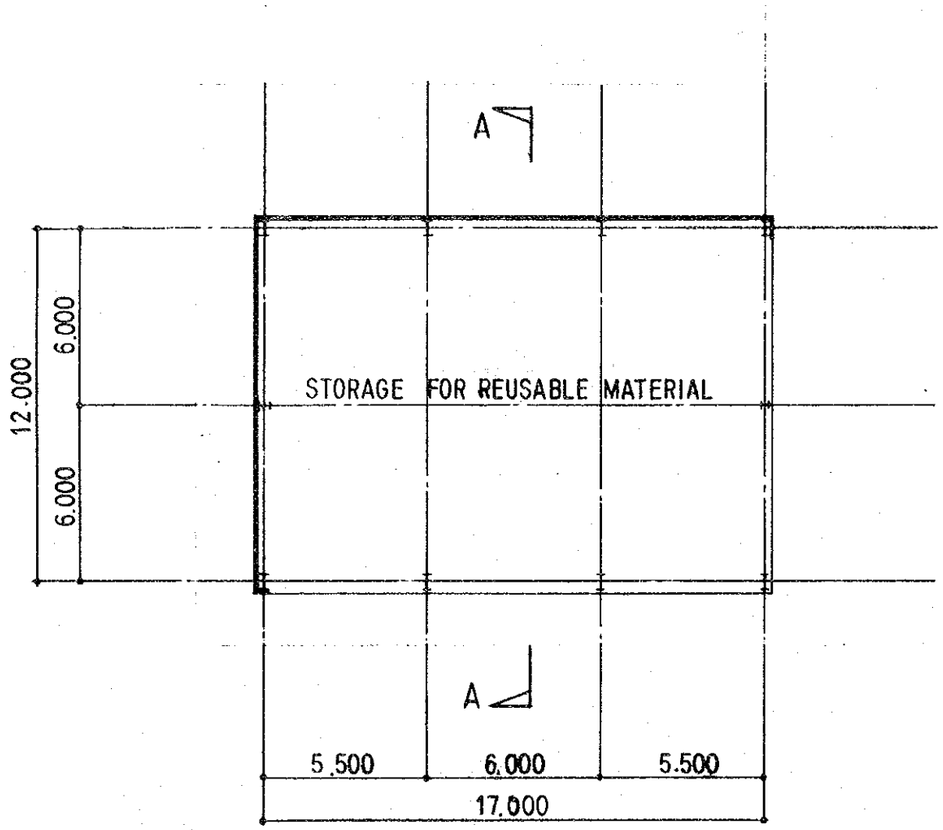
Fig. 6-3-3 STORAGE & SORTING SHOP



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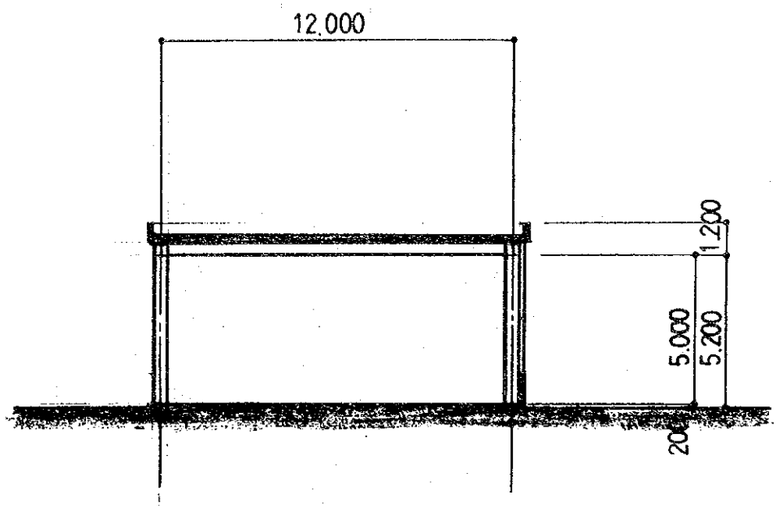
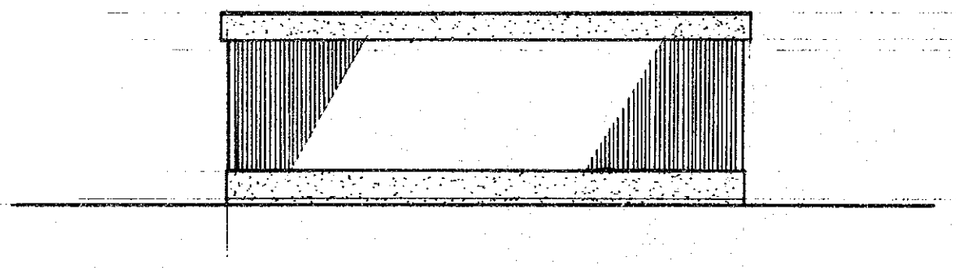


A—A SECTION S=1:200



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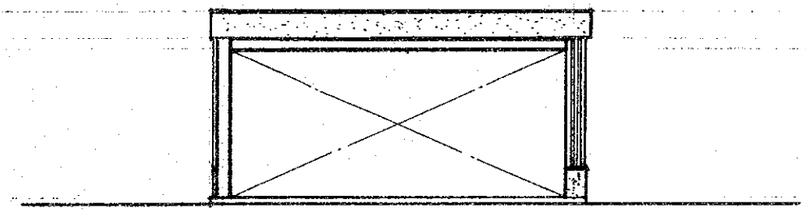

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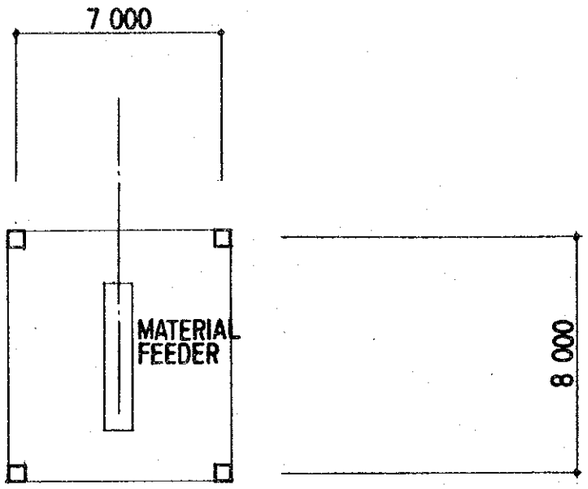
Fig. 6-3-4 STORAGE FOR REUSABLE MATERIAL



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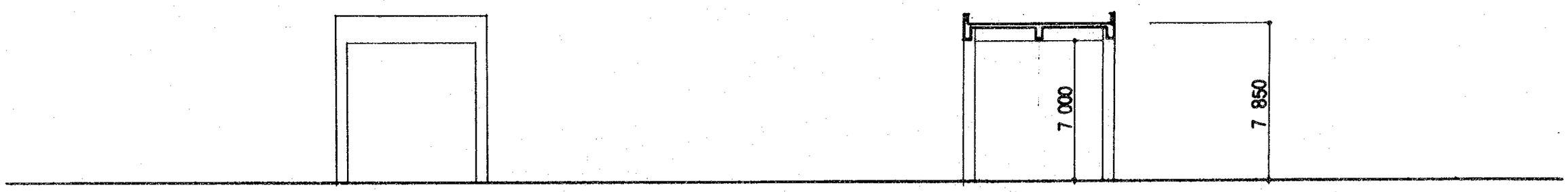
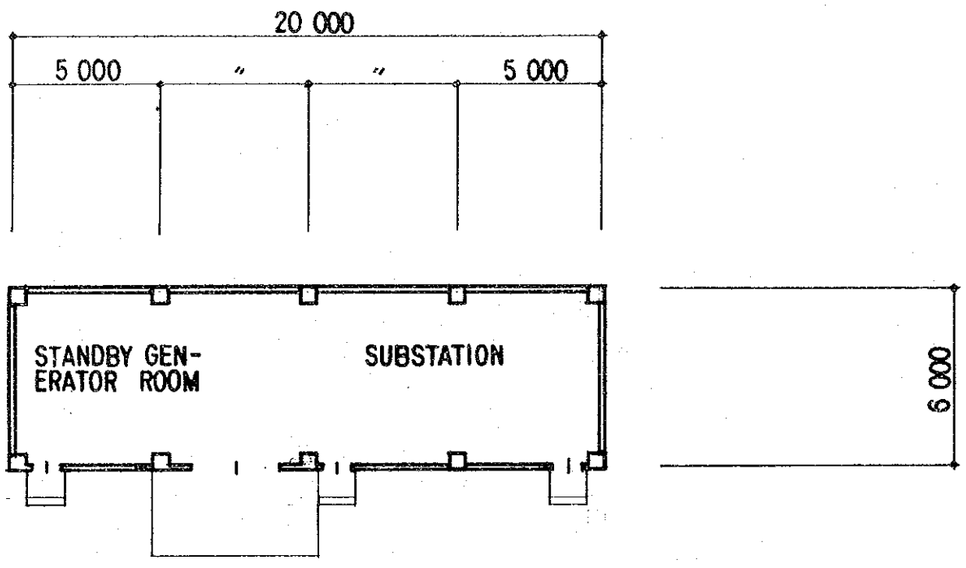


ELEVATION

SECTION

Fig. 6-3-5 MATERIAL DELIVERY SHED



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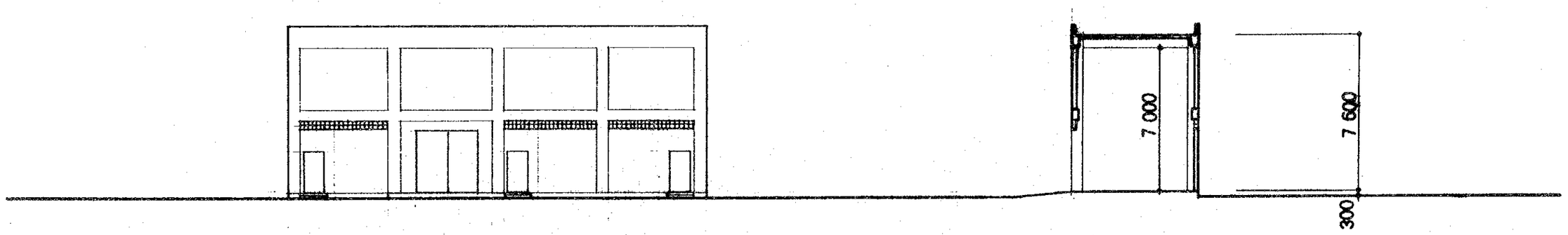
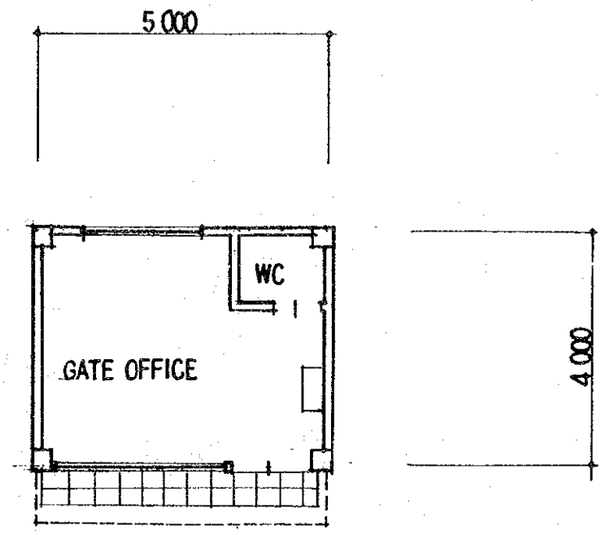


ELEVATION

SECTION

Fig. 6-3-6 SUBSTATION & STANDBY GENERATOR BUILDING



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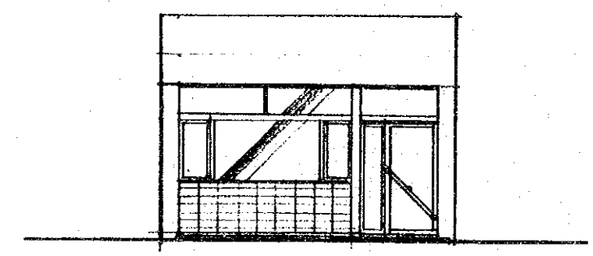
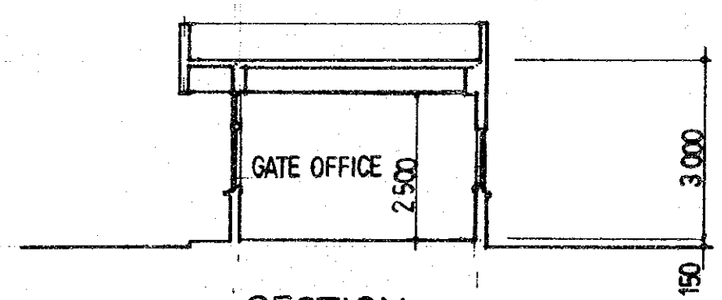
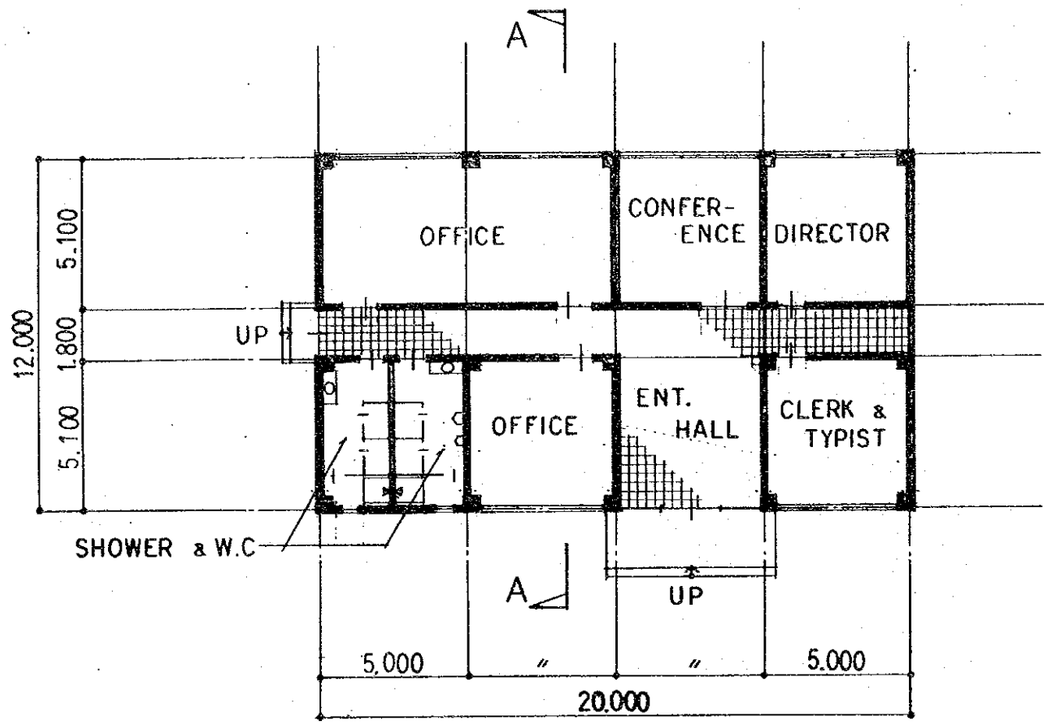


ELEVATION

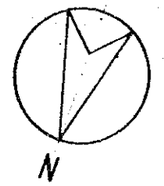


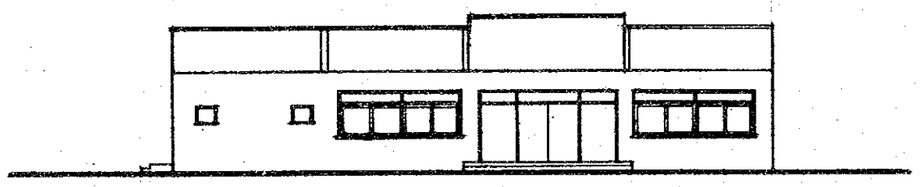
SECTION

Fig. 6-3-7 GATE HOUSE

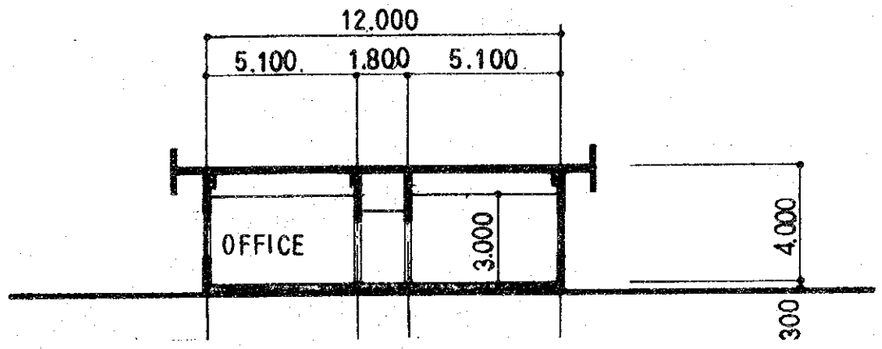


PLAN S=1:200





NORTH ELEVATION S=1:200



A—A SECTION S=1:200

Fig. 6-3-8 ADMINISTRATION BUILDING

CHAPTER 7. MANUAL AND GUIDLINE

7.1 Residential Instrucion

7.1.1 Public Education

Although no public education program was actually carried out during the experiment, some considerations are presented in the following to formulate a plan for the public education program for cleansing in Alexandria.

1) Public Education Programs

The public education for solid waste management, as defined here, is a relatively long-term project and can take many forms. Unlike the public instruction or the campaign, no immediate response is expected for the public education. The forms of the public education used in Japan include a textbook for an elementary school class, a booklet for the general public, facility tours, regional meetings using movies and slides and periodical reports on cleansing services often in a city newsletter. These activities are intended for different groups of people as shown in S.R. Table 7-1-1.

In Alexandria, some of the public education activities listed in S.R. Table 7-1-1 are not practical at the moment. For example, visiting solid waste facilities may not be promising since compost plants and other facilities are either in the testing stage or in the planning stage. The facilities should be equiped with a meeting room, a visitor's path and safety requirement in order to accept visitors.

S.R. Table 7-1-1 PUBLIC EDUCATION ACTIVITIES

Group of People	Public Education Activities
School Children	1) Classroom work with a textbook 2) Facility visit
General Public	3) Regional meetings with movies, slides and/or booklets 4) Periodical reports often in the form of city's newsletter 5) Distributing a booklet on cleansing service to households 6) Facility visit for a group of residents

A regional meeting for public education takes a form of lecturing on cleansing service and public cooperation by using slides, movies and/or booklets. Preparing these materials takes much time, and the location for the meeting cannot be found easily. Therefore, a regional meeting with its full scope is not applicable at this moment. But a regional meeting to urge people to join the city's cleansing effort can be and in fact was conducted as a campaign method.

As for the periodical reports, the city of Alexandria does not publish any newsletter at the moment. Thus, this particular option cannot be used. However, other forms of the information transfer may be possible. For instance, the information can be included in the booklet to be distributed to the citizens, although revising periodically the booklet to include new information could be a costly operation.

These activities which are not practical at present are by no means to be eliminated from our future considerations for public education. As the situation changes to allow for these activities, they should be considered for the public education tools. What follows, however, includes only the discussion on the school textbook and the booklet for the general public.

2) Contents of School Textbook and Booklet

The aim of the textbook for school children is to lead the pupils to understanding the importance of cleansing works as part of public works for the society. The textbook should be used to familiarize the pupils with various aspects of the cleansing works and the necessity of citizens' cooperation. Note that the terminology used in the textbook must be easily understood by the school children. While the school children textbook emphasizes the importance of the cleansing works as a societal activity in more general terminology, the booklet for the general public stresses the actual cleansing activities being taken place in the municipality in more specific terminology. Therefore, the aim of the booklet for the general public is to inform the citizens of the city's cleansing works, the budget and expenditure for the cleansing works and the public cooperation required for the efficient cleansing service.

What to be included in the school children textbook and the general public booklet are, thus, similar, but the tone and specificity of presentation must be different. S.R. Table 7-1-2 compares the topics usually included in these two different booklets. Who prepares to publish these booklets is also different in Japan. The school children textbook is usually prepared by teachers at schools with the help of the city's cleansing department. The general public booklet is, on the other hand, prepared by the personnels in the cleansing department.

S.R. Table 7-1-2 CONTENTS OF BOOKLETS

Information	School Textbook	Public Booklet
Technical aspects of cleansing works (i.e. Collection, haulage, treatment, disposal)	General flow of solid wastes	Specific solid waste system of the city in details
Organization and financial aspects of cleansing works (e.g. Cleansing authority, budget, expenditure)	General description	Specific organization and financial matter of the city
Public cooperation (e.g. Discharge activity, Recycle)	General instructions and possible cooperation	Discharge and recycle instructions, collection fee and penalty

3) Public Education Programs during the Study Period

No public education was conducted due to a shortage of time to develop, implement and evaluate the program. However the following has been done through discussion with the counterparts.

(1) School Textbook
Two Japanese school children textbooks (the cities of Musashino and Ichikawa) were translated into Arabic to be used as a reference. A manual for developing the textbook of this kind was written.

(2) Booklet for General Public
A Japanese booklet on cleansing works (the city of Yokohama) was translated into Arabic to be used as a reference.

7.1.2 Public Communication Plan

1) Organization and Responsibility

Before defining the organizational framework and responsibility for the public communication plan, the observations during the experiment were summarized in the following remarks.

(1) Public Communication programs for municipal cleansing works in Alexandria are technically feasible with the methods given above and others such as use of TV. The senior cleansing personnels (e.g. our counterpart) are capable of developing, implementing and evaluating public communication programs as they have already experienced some public communication programs in the past.

(2) No organizational unit exists for public communication programs at present in Alexandria. Therefore, no long-term and continuous program can be developed and implemented. Short-term public communication programs have been conducted through cleansing experiments. However, these programs have had only a temporary impact on the behavior of people. It is strongly recommended that an

organizational unit for public communication be created in the Governorate of Alexandria.

(3) In order for this organizational unit to work, all the cleansing employees from a top management personnel to cleansing workers should understand the importance of public communication and cooperate with this unit in developing, implementing and evaluating public communication programs. In addition to the cooperation within the cleansing people, the cooperation with other organizations such as the Alexandria Directorate of Health and the Alexandria Directorate of Education is necessary.

(4) The rules for handling garbages and the penalties for violation are not well understood by the citizens as well as the cleansing personnels. These should be clearly understood by all concerned parties in order to carry out an effective and responsible cleansing service. The Utilities Police should be consulted and informed clearly of the rules and their roles and enforce carefully their power on the violation.

Public communication should be carried out by both Governorate and District levels. The Governorate level organization should be responsible for planning and organizing the public communication programs, giving technical assistance, guidance development and personnel training. The District level organization should be responsible for actually developing necessary materials, personnel management and execution of campaign. S.R. Table 7-1-3 presents the summary of the organizational responsibilities.

The staff required to carry out these responsibilities is given in S.R. Table 7-1-4 for the Governorate and District level organizations. The Governorate level organization should be composed of three full-time cleansing personnels and ten part-time workers for campaign and other activities. The District level organization should be composed of two full-time cleansing personnels and five part-time workers for campaign and other activities. Graphic designers and drawers for posters and other artistic works should be part-time, and three such persons should be pooled for both Governorate and District levels.

S.R. Table 7-1-3 ORGANIZATIONAL RESPONSIBILITIES OF PUBLIC COMMUNICATION ACTIVITIES

Activities	Governorate Level	District Level
Public Instruction		
. Instruction sheet . Station panel . Inspection and patrol	. Technical assistance . Guidance development . Personnel training	. Material development . Personnel management . Distribution, instruction and partol . Planning . Summer visitor instruction
Campaign		
. Microphone and vehicle . Posters and badges . Radio and TV programs . Movie theater . Mosques and Churches . Regional meeting	. Organizing a month-long cleansing campaign . Execution of radio, TV, mosques and churches . Organizing summer-time campaign . Material development . Elementary school cleansing campaign	. Execution of a month-long cleansing campaign . Planning and execution of microphone and vehicle posters and badges . Execution of summer-time visitor campaign . Material development . Personnel management
Public Education		
. School class . Booklet . Annual report . TV and radio programs . Regional meeting	. Development of school textbook, booklet and annual report . Use of TV and radio programs developed by the national level organizations or others . Cooperation with other organizations for information exchange	. Supplying information for development of materials . Distribution of materials

S.R. Table 7-1-4 PERSONNEL PLAN

Type	Governorate Level	District Level
Senior cleansing administrative personnel (rank: 2nd or 3rd)	2 (2nd and 3rd)	1 (3rd)
Junior cleansing administrative personnel (rank: 4th or 5th)	1 (4th)	1 (5th)
Part-time workers for campaign, etc.	10 persons x 30 days	5 persons x 30 days
Part-time graphic designers and drawers	3 persons (pooled)	

2) Financial Considerations

The budget allocated for the public communication projects will be spent for the costs of personnel, printing, materials supply, transportation, typing and photocopy and others. S.R. Table 7-1-5 presents the budget plan for the public communication in Alexandria. The total budget allocatrd for the Governorate and each District level organizations should be 9,900 LE/year and 4,700 LE/year, respectively. The total budget for the cleansing public communication in Alexandria should be 38,100 LE/year.

S.R. Table 7-1-5 ANNUAL BUDGET PLAN

Type	Governorate Level (LE/year)	District Level (LE/year)		Total (LE/year)
		for each	for all six	
Wages				
Full-time personnels	3300	1800	10800	14100
Part-time workers*	600	300	1800	2400
Graphic designers and drawers	1000			1000
Printing	3000	1000	6000	9000
Paper and other materials supply	500	300	3000	3500
Transportation	500	300	1800	2300
Typing and photocopy	500	300	1800	2300
Miscellaneous**	500	500	3000	3500
Total	9900	4700	28200	38100

* 2 LE/person/day is assumed.

** Rentals for halls, movies and sliders are included.