*3 Cargo volume was converted to vehicle numbers by the following assumptions:

Line-haul truck: 10.5 tons/vehicle
Pick-up/delivery truck
= (3.5 + 1.6) / 2
= 2.5 tons/vehicle
(Note; 2 cycles per day is assumed.)

Administration Building

1. Administration Office:

Area per person is set to be 10 sq. meter. Calculation is done as follows;

	(persons)		(m^2)		(m^2)
Case 1	20	x	10	=	200
Case 2-1	15	x	10	=	150
Case 2-2	10	x	10	=	100

2. Meeting Room:

	(m^2)		(room)		(m^2)
Case 1	100	x	2	=	200
Case 2-1	80	x	2	=	160
Case 2-2	80	x	1	=	80

3. Training Room:

	(m^2)		(room)		(m^2)
Case 1	150	x	1	=	150
Case 2-1	100	x	1	=	100
Case 2-2	80	x	1	=	80

4 Cafeteria:

It is assumed that sixty (60) per cent of the staff use the cafeteria, and cycle is six (6) times per day. Area per one person is set 1.25 sq. meter.

(Case 1)
4,320 (persons) x 0.6 x 1/6 x 1.25 (m^2/person)
= 540 m^2
= 550 m^2 (rounding)

(Case 2-1)
3,075 (persons) x 0.6 x 1/6 x 1.25 (m^2/person)
= 390 m^2
= 400 m^2 (rounding)

(Case 2-2)
1,250 x 0.6 x 1/6 x 1.25
= 160 m^2
= 200 m^2 (rounding)

5. Doze Facility

It is assumed that the half of the drivers and assistants of the line-haul trucks would use this doze room before or after driving. It is also assumed that the rest would take a rest at the lodging.

(Case 1)
1,150 (persons) x 1/2 x 3.75 (m^2/person)
= 2,156 m^2
= 2,160 m^2 (rounding)

(Case 2-1)
820 (persons) x 0.6 x 1/6 x 1.25 (m^2/person)
= 1,537 m^2
= 1,545 m^2 (rounding)

(Case 2-2)
330 x 0.6 x 1/6 x 1.25
= 618 m^2
= 630 m^2 (rounding)

6. Shower Room

This is used by the office workers, platform workers, drivers and assistant for line-haul trucks.

(Case 1)
(20 + 450 + 1,150)(persons) x 0.6 x 1/10
x 1 (m^2/person)
= 97.2 m^2
= 100 m^2 (rounding)

(Case 2-1)
(15 + 320 + 820)(persons) x 0.6 x 1/10
x 1 (m^2/person)
= 69 m^2
= 70 m^2 (rounding)

(Case 2-2)
(10 + 130 + 330)(persons) x 0.6 x 1/10
x 1 (m^2/person)
= 28 m^2
= 30 m^2 (rounding)

7. Medical Care Room

Thus, the necessary space of the administration building is summarized in Table 8.4.2.

Table 8.4.2 Space of Administration Building

	Administration Office	Meeting Room	Training Room	Cafeteria	Doze Room *1	Shower Room	Medical Care Room	Total (m^2)
Case 1	200	200	150	550	2,160 x 1/4 =540	100	100	1,790
Case 2-1	150	160	100	400	1,545 x 1/4 = 390	70	100	1,320
Case 2-2	100	80	80	200	630 x 1/4 = 160	30	100	750

(Note) *1 Two-story bed will be installed. Cycle ratio is set two times per day. Thus, doze room space is arrived by multiplying 1/2 x 1/2 = 1/4.

Lodging

It is assumed that a half of drivers and assistants of the line-haul truck would use this lodging building and that ten (10) per cent of the pick-up/delivery truck would use this facility.

1. Lodging facility

Time zones that the crews of line-haul truck use this facility and the crew of pick-up/deliver truck use, are different. Thus the larger figure is adopted as a capacity of the facility for the design.

(Case 1)

Line-haul truck
1,150 (persons) x 1/2 x 7.5 (m^2/person)
= 4,300 (m^2)

Pick-up/delivery truck
2,700 (persons) x 7.5 (m^2/person)
x 0.1
= 2,000 (m^2)

Total
4,300 (m^2) + 2,000 (m^2)
= 6,300 (m^2)

(Case 2-1)

- Line-haul truck
820 (persons) x 1/2 x 7.5 (m^2/person)
= 3,100 (m^2)

- Pick-up/delivery truck
1,920 (persons) x 7.5 (m^2/person)
x 0.1
= 1,440 (m^2)

- Total
3,100 (m^2) + 1,440 (m^2)
= 4,500 (m^2)

(Case 2-2)

- Line-haul truck
330 (persons) x 1/2 x 7.5 (m^2/person)
= 2,500 (m^2)

- Pick-up/delivery truck
770 (persons) x 7.5 (m^2/person)
x 0.1
= 580 (m^2)

- Total
2,500 (m^2) + 580 (m^2)
= 3,080 (m^2)

2. Shower room

(Case 1)

(1,150 (persons) x 1/2 + 2,700 (persons) x 0.1) x 0.6 x 1/10
(cycle ratio) x 1 (m^2/person)
= 50 (m^2)

(Case 2-1)

(820 (persons) x 1/2 + 1,920 (persons)
x 0.1) x 0.6 x 1/10 (cycle ratio)
x 1 (m^2/person)
= 40 (m^2)

(Case 2-2)

(330 (persons) x 1/2 + 770 (persons)
x 0.1) x 0.6 x 1/10 (cycle ratio)
x 1 (m^2/person)
= 15 (m^2)

Thus, necessary space of the lodging is summarized in Table 8.4.3.

Table 8.4.3 Necessary Space of Lodging

Case	Lodge (m^2) *1	Shower Room (m^2)	Total (m^2)
Case 1	4,300 x 1/2 = 2,150	50	2,200
Case 2-1	3,100 x 1/2 = 1,550	40	1,590
Case 2-2	2,500 x 1/2 = 1,250	15	1,300

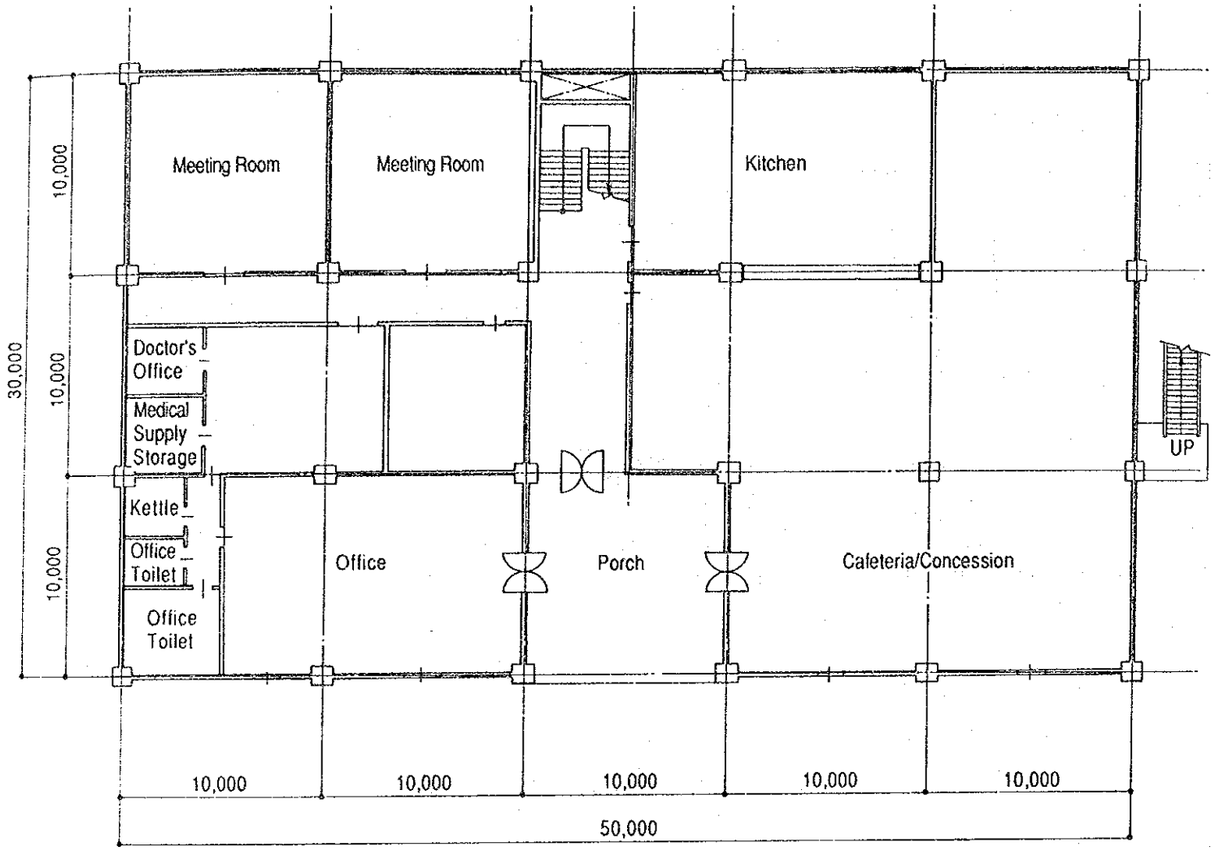
(Note) * Star (*) indicates that two-story bed would be used.

Based upon these data, the structure are prepared and are shown below;

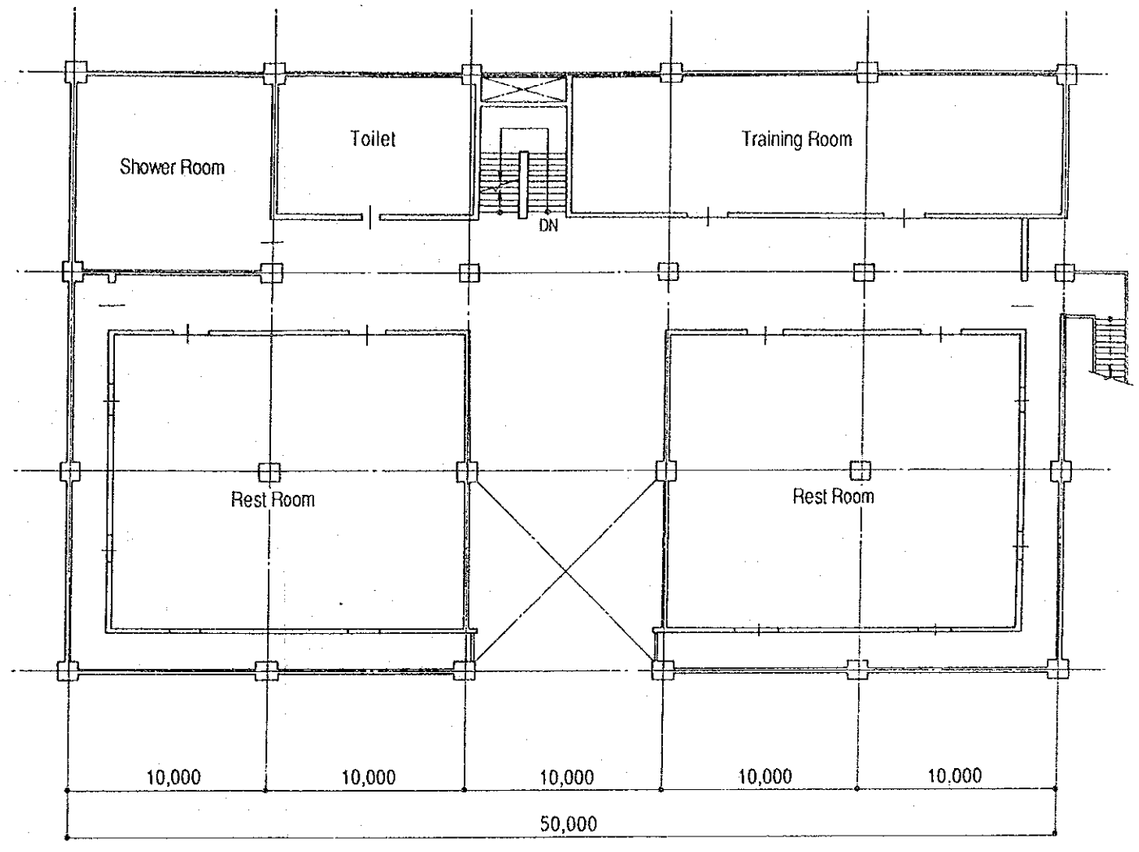
As for the administration building, it is shown in Figs. 8.4.5 through 8.4.7.

As for the lodging building, it is shown in Fig. 8.4.8. Figs. 8.4.9 through 8.4.11 shows general view of office building, warehouse, and service station respectively.

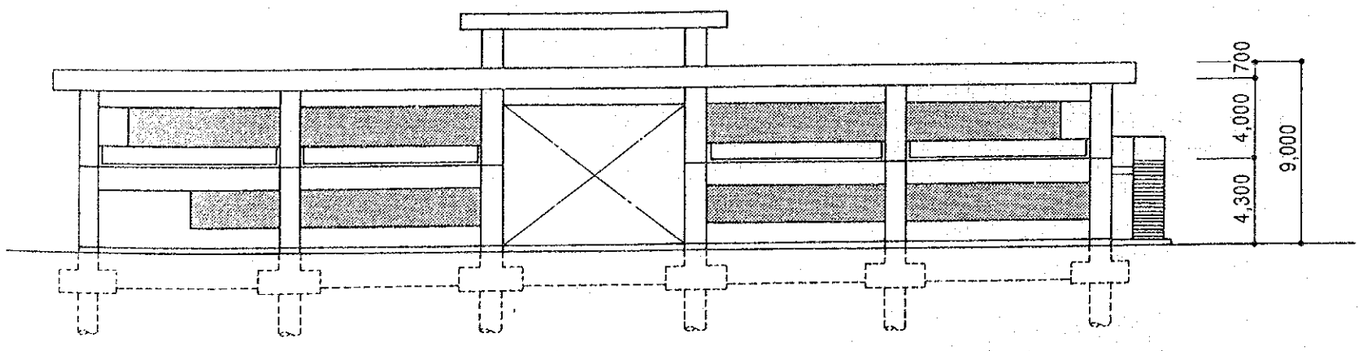
Administration Building (500 Berth)



Plan of 1st Floor S = 1 : 300



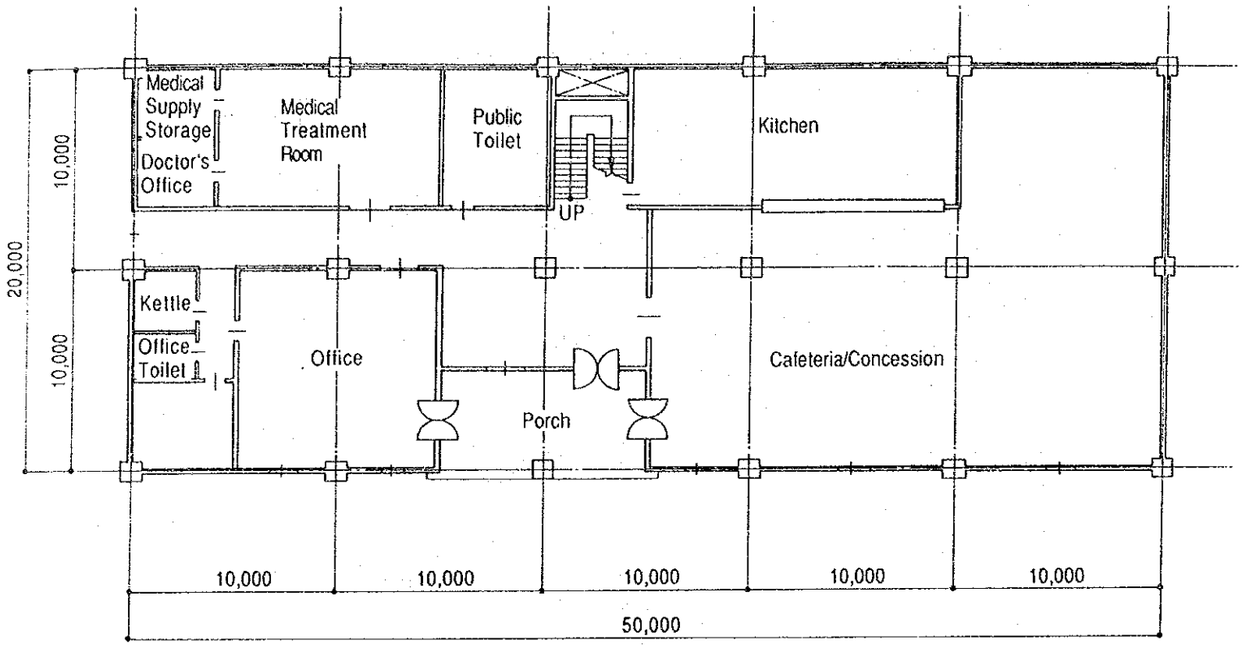
Plan of 2nd Floor S = 1 : 300



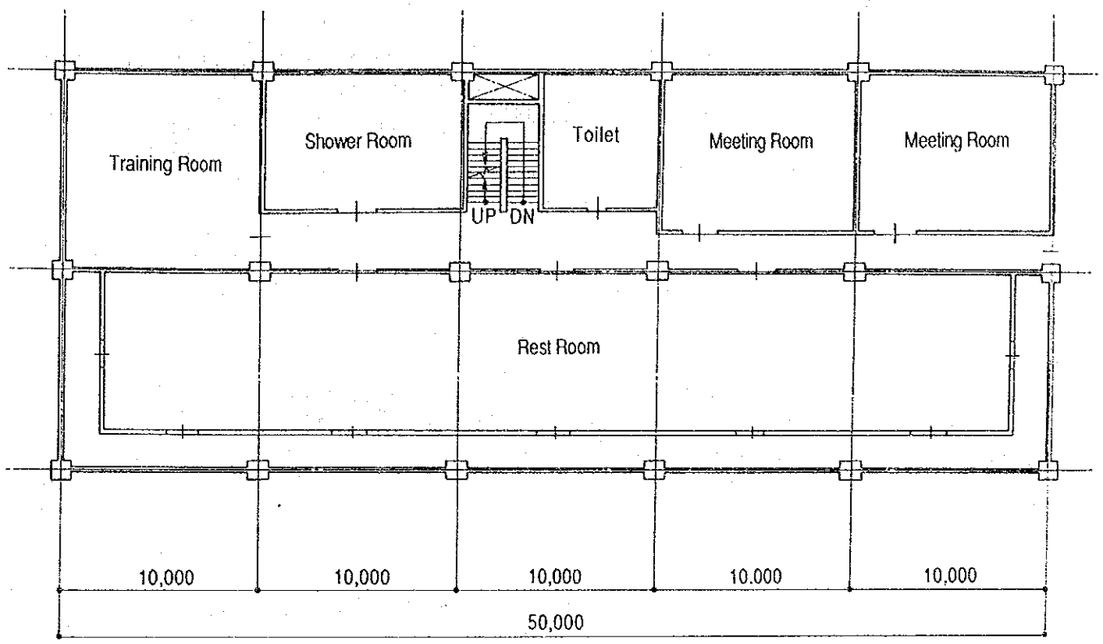
Elevation S = 1 : 300

Fig. 8.4.5 Administration Building (500 Berth)

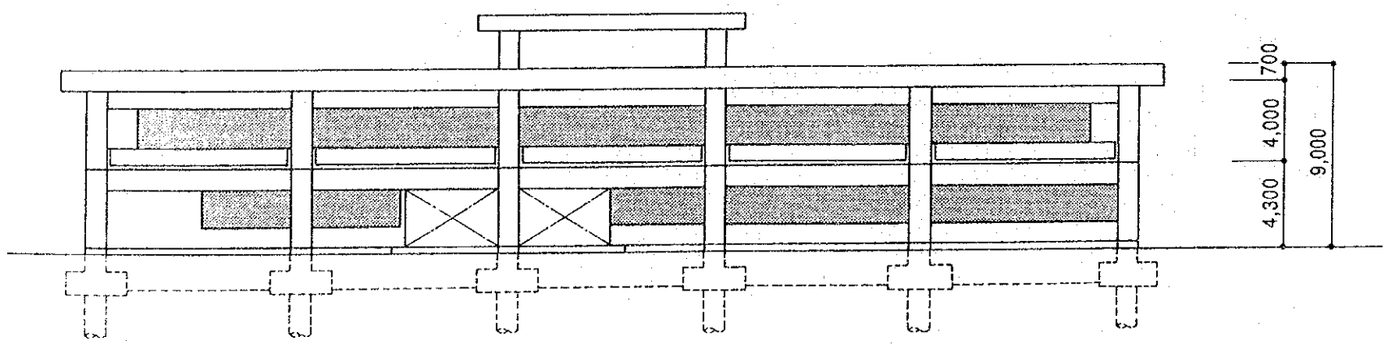
Administration Building (350 Berth)



Plan of 1st Floor S = 1 : 300



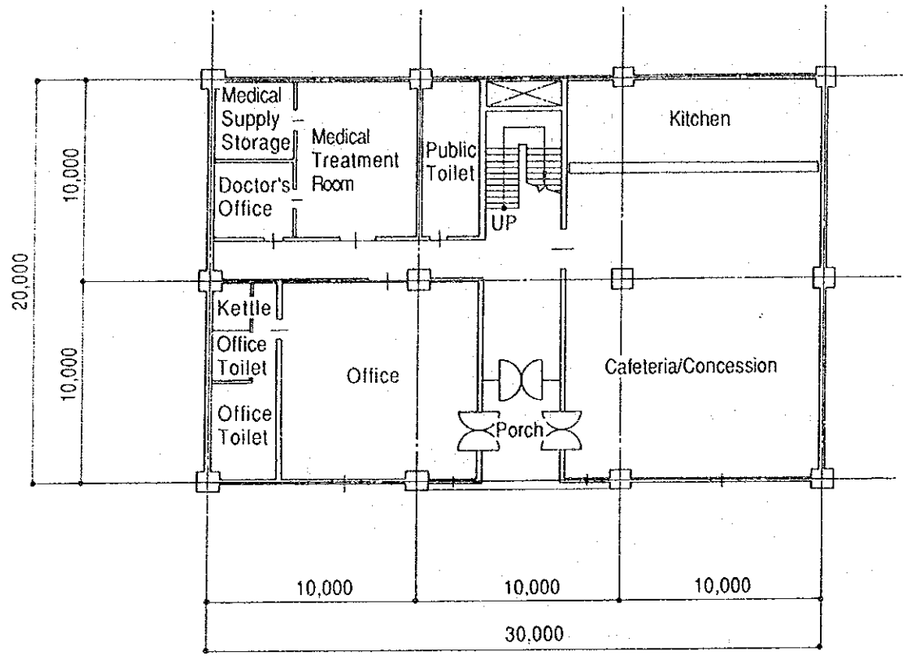
Plan of 2nd Floor S = 1 : 300



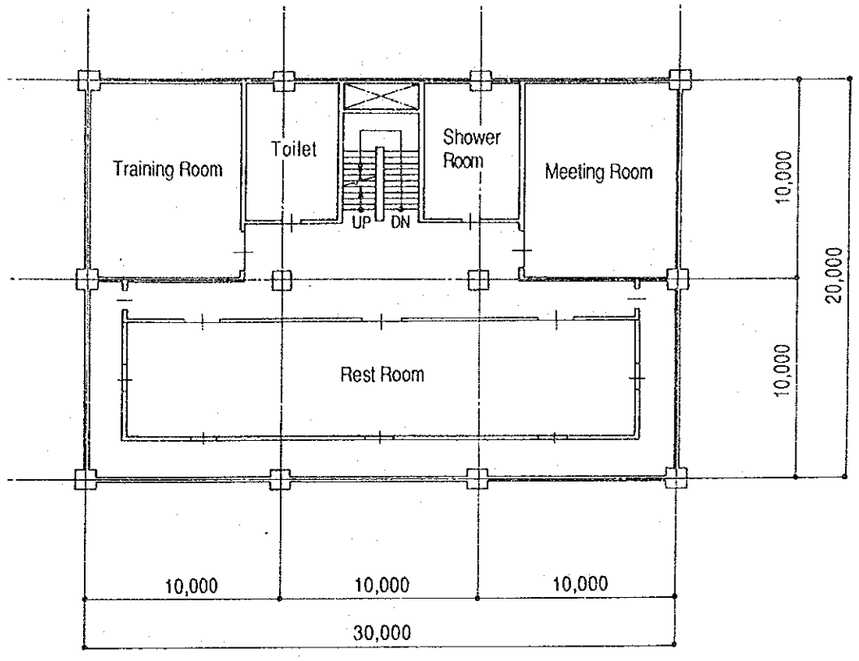
Elevation S = 1 : 300

Fig. 8.4.6 Administration Building (350 Berth)

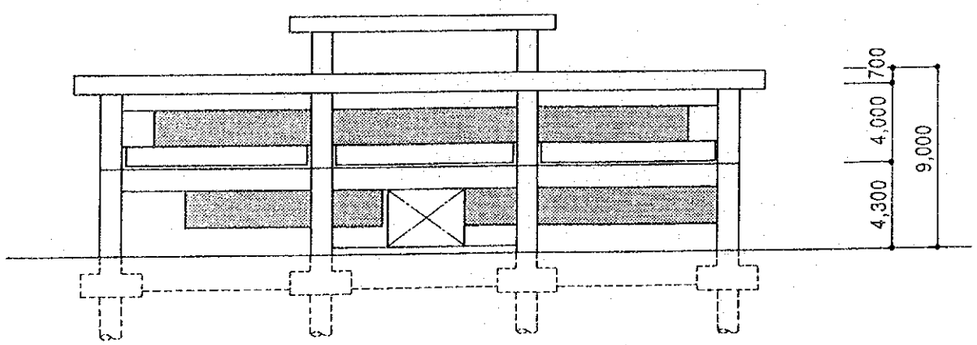
Administration Building (150 Berth)



Plan of 1st Floor S = 1 : 300



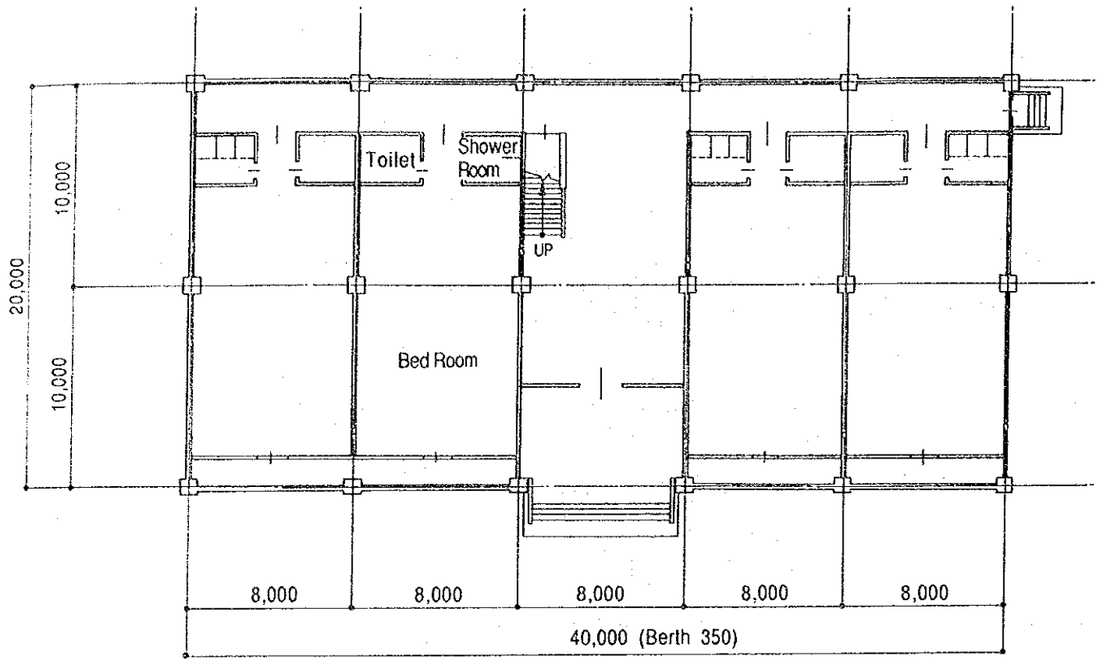
Plan of 2nd Floor S = 1 : 300



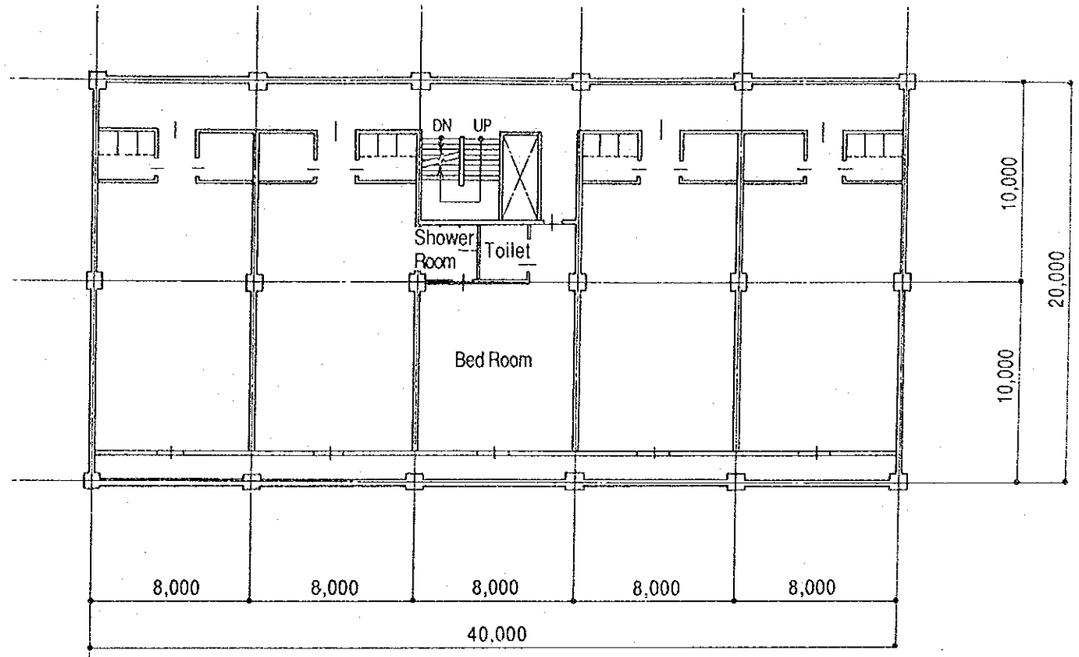
Elevation S = 1 : 300

Fig. 8.4.7 Administration Building (150 Berth)

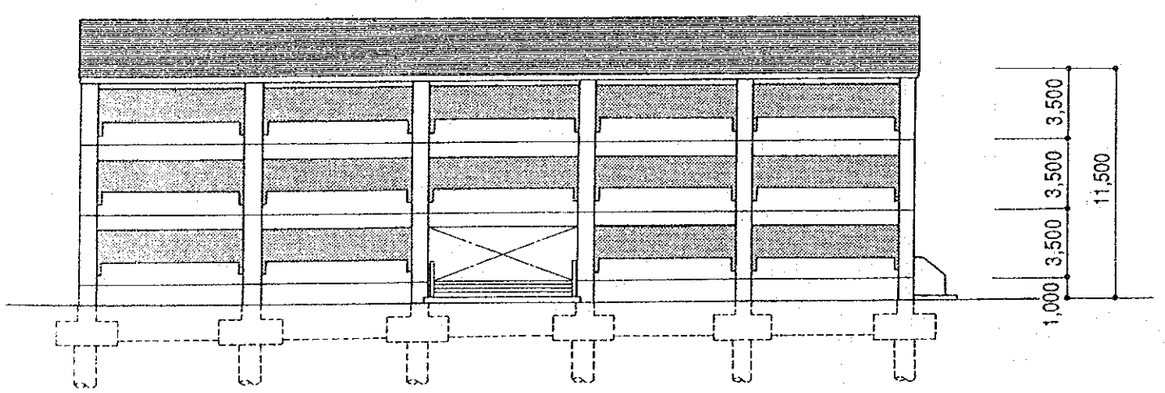
Lodging



Plan of 1st Floor S = 1 : 300

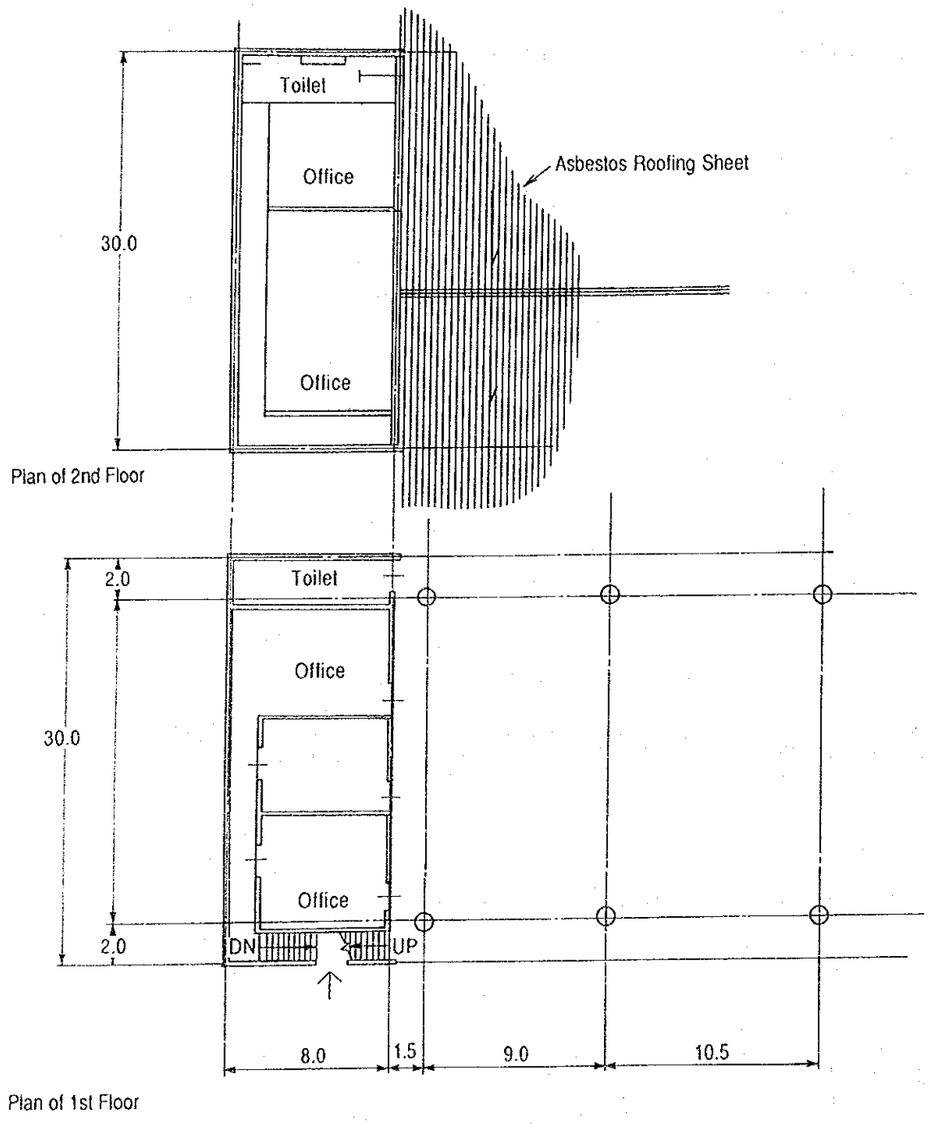


Plan of 2nd & 3rd Floor S = 1 : 300

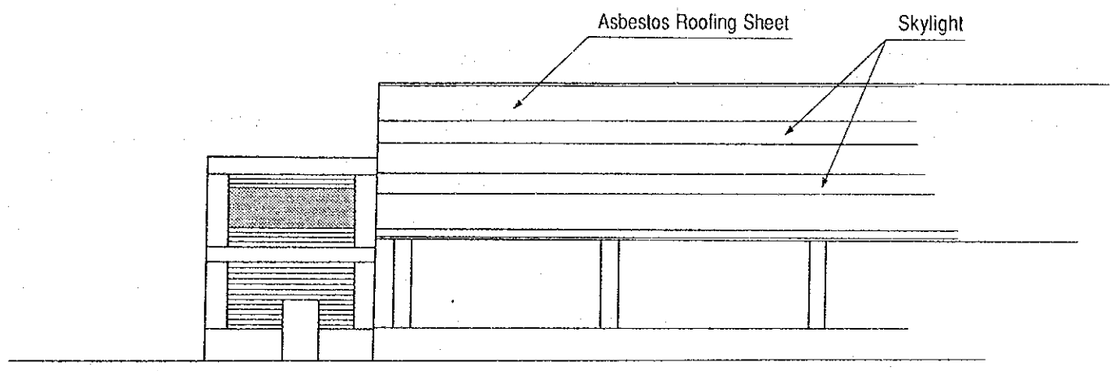


Elevation S = 1 : 300

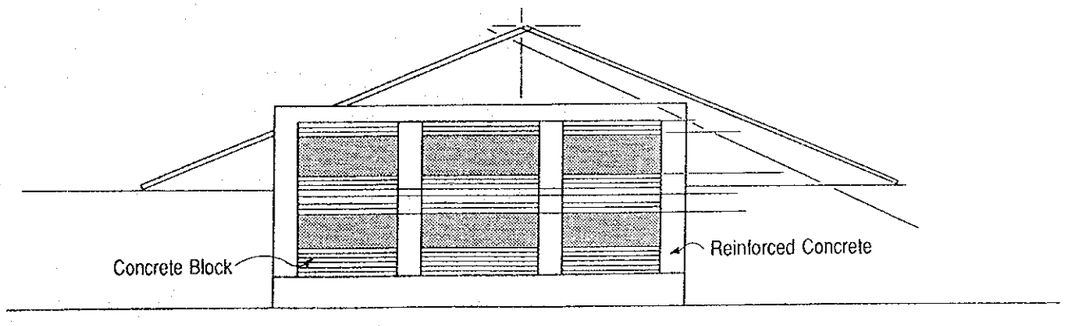
Fig. 8.4.8 Lodging Building



Scale 1 : 300



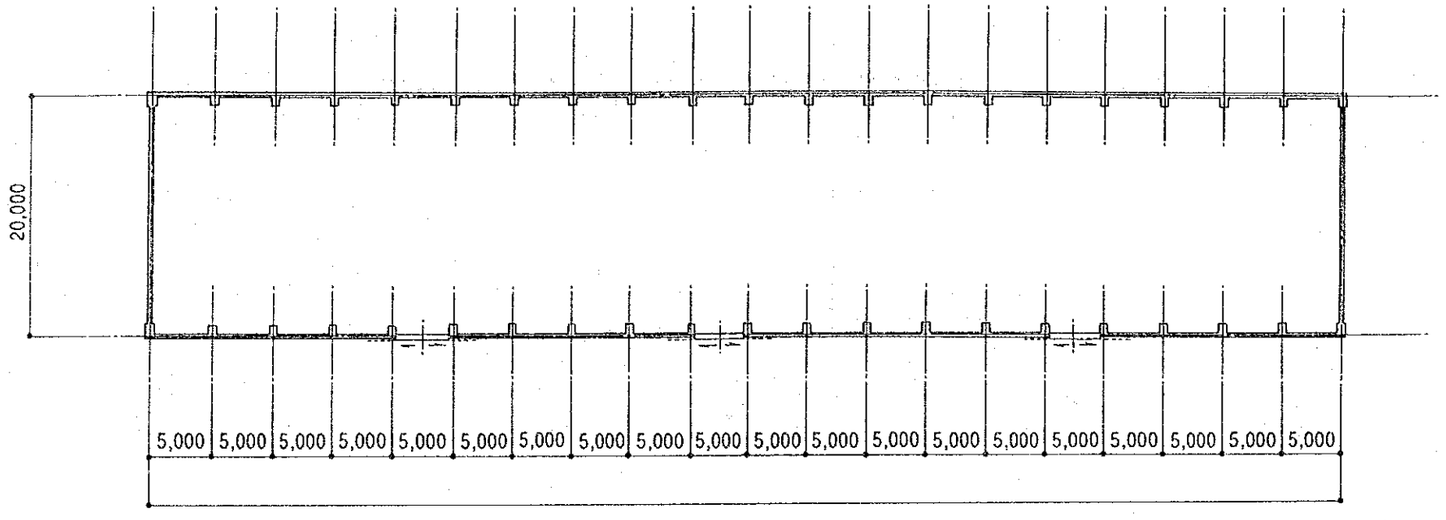
Side View



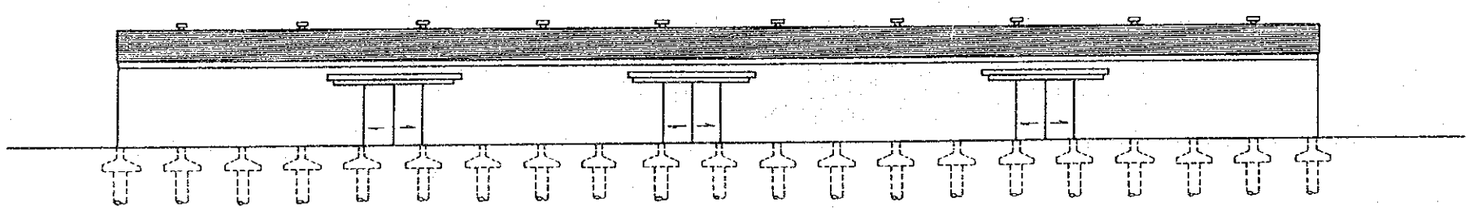
Section

Fig. 8.4.9 General View of Office Building

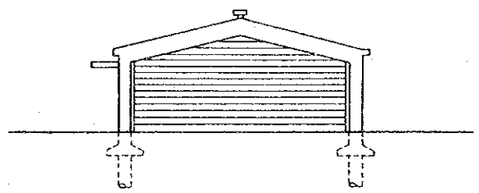
Warehouse



Ground Floor Plan S = 1 : 500



Elevation S = 1 : 500

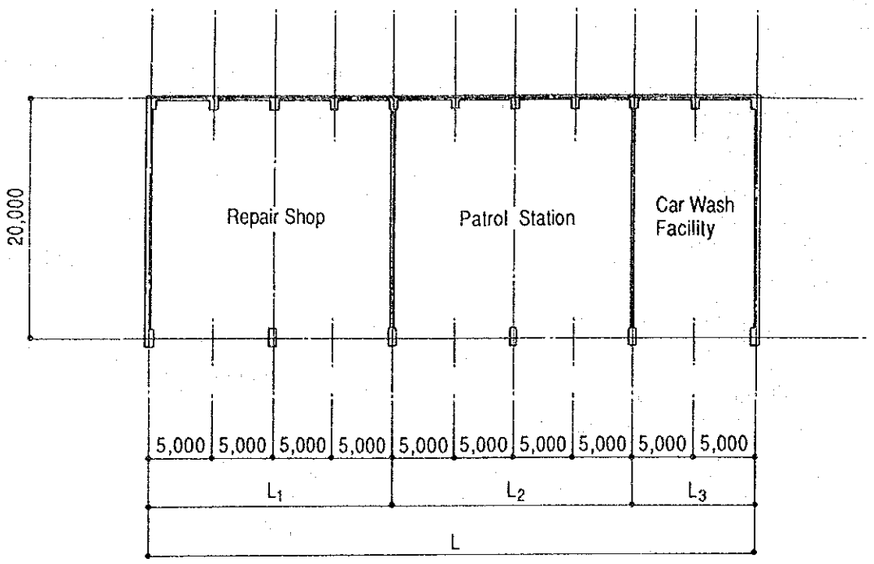


Elevation S = 1 : 500

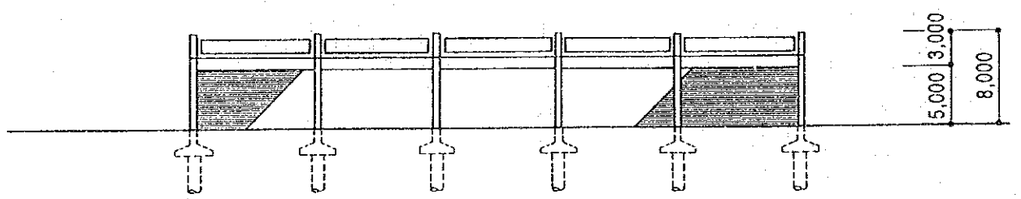
	L				
Alternative -1 (Berth500)	5.000	x	50	=	250.000
Alternative -2-1 (Berth350)	5.000	x	30	=	150.000
Alternative -2-2 (Berth150)	5.000	x	20	=	100.000

Fig. 8.4.10 Warehouse

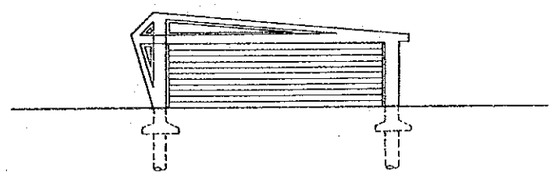
Service Station



Plan S = 1 : 500



Elevation S = 1 : 500



Elevation S = 1 : 500

	L 1	L 2	L 3	L
Alternative -1 (Berth500)	40.000	40.000	20.000	100.000
Alternative -2-1 (Berth350)	20.000	30.000	20.000	70.000
Alternative -2-2 (Berth150)	20.000	20.000	10.000	50.000

Fig. 8.4.11 Service Station

D. Storm water drainage

Surface water during the storm is first collected into the U-ditch, and send to the truck drain (pipe-culvert is used) as shown in Fig. 8.4.12, and then drained into the side ditch. Thus the bottom height of side ditch should be kept at least same as high as that of the surfaces of the drain water.

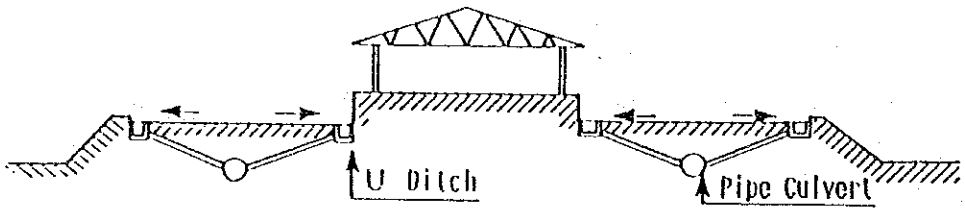


Fig. 8.4.12 Layout of Drainage Facilities

Rainfall intensity, which provides the basic framework of drainage design, is provided by the department of Drainage and Sewerage, the Bangkok Metropolitan Administration (BMA). It sets as follows;

Maximum rainfall intensity; 62 mm/hour
Return period; 2 years

With these conditions, discharge volume was calculated according to the Rational formula. It is shown below;

$$Q = 1/360 \times C \times R \times R$$

where,

Q : Discharge (m^3/Second)
C : Coefficient of discharge
R : Rainfall intensity (= 62 mm/hour)
A : discharge area (hectare)

In addition, minimum slope of the drainage pipe is set 0.3 to 0.5 per cent and minimum diameter of drainage pipe is set ø600 millimeter.

Drainage network is shown in Figs. 8.4.13 through 8.4.15.

E. Sewage Treatment

Waster water discharged from facilities other than car wash is subject of sewage treatment. Sewage treatment requirements are 90 liter/day/person.

(100 litter/day x 0.8 (discharge rate)
x ground water 1.1 = 90 liter/day)

Sewage treatment requirements are shown in Table 8.4.4.

Table 8.4.4 Sewage Treatment Requirements

(unit: m^3/day)

	Person	Unit per Person	Total
Case 1	4,320	90	390
Case 2-1	3,075	90	280
Case 2-2	1,250	90	120

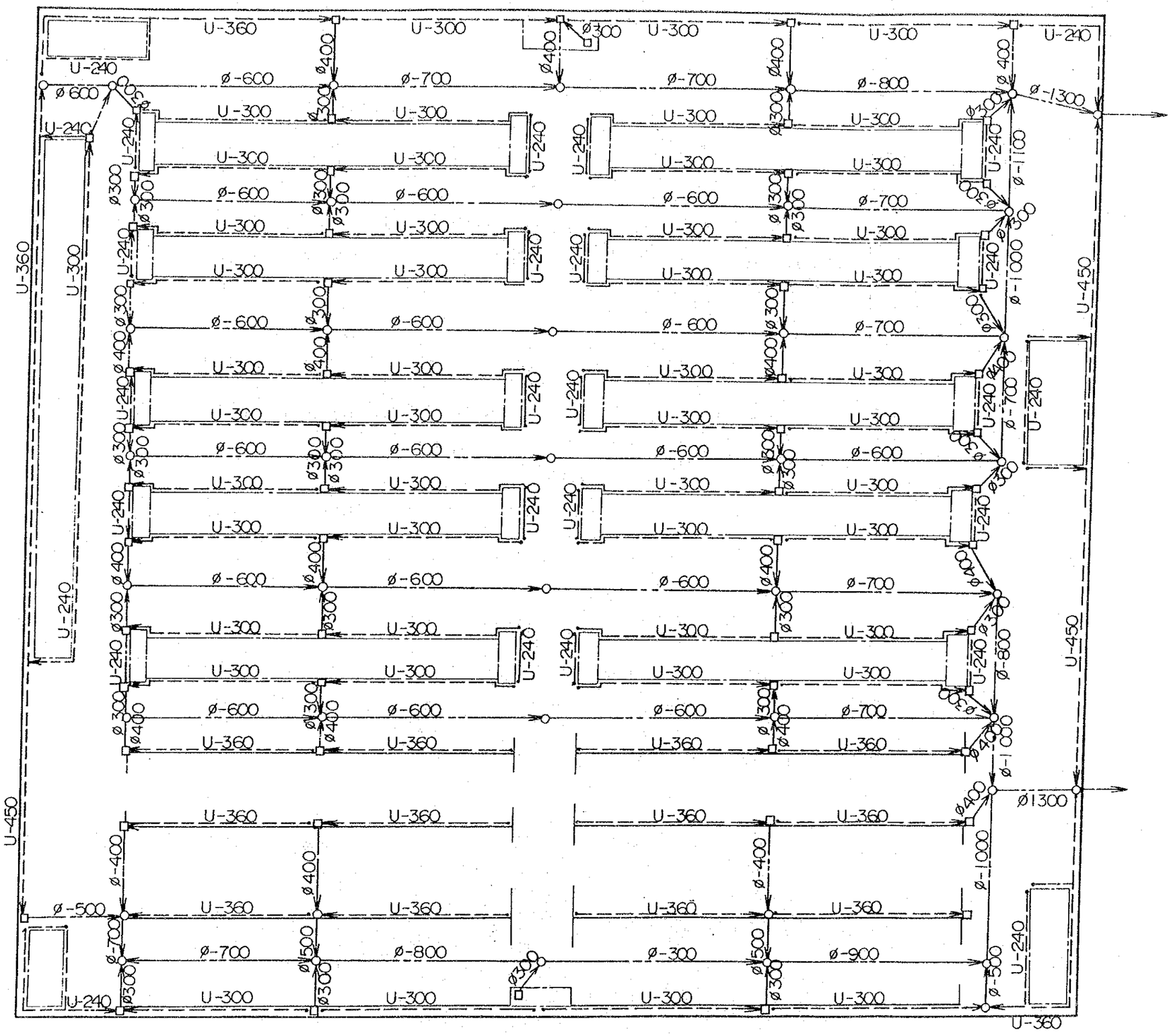


Fig. 8.4.13 Drainage Network (500 Berth)

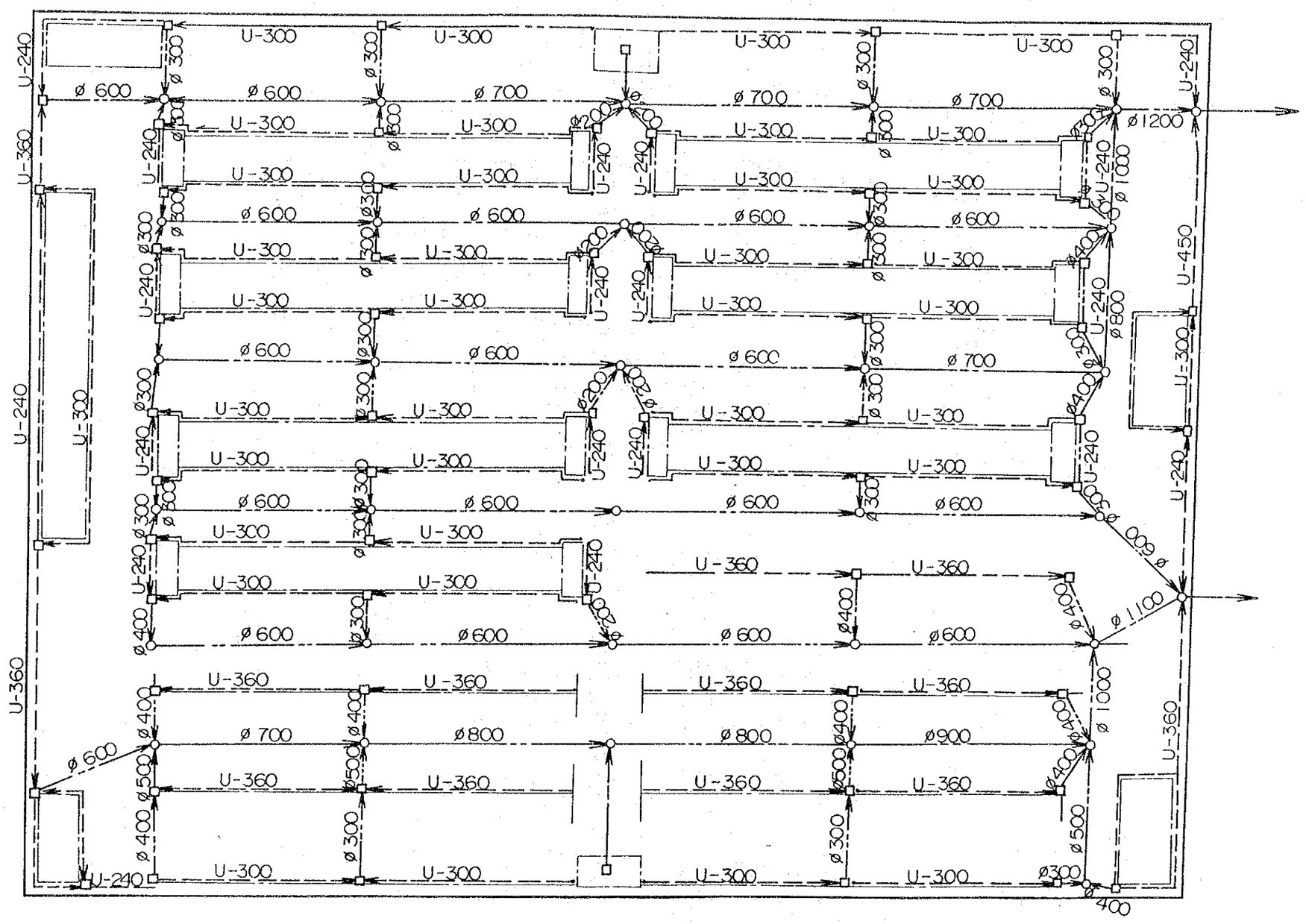


Fig. 8.4.14 Drainage Network (350 Berth)

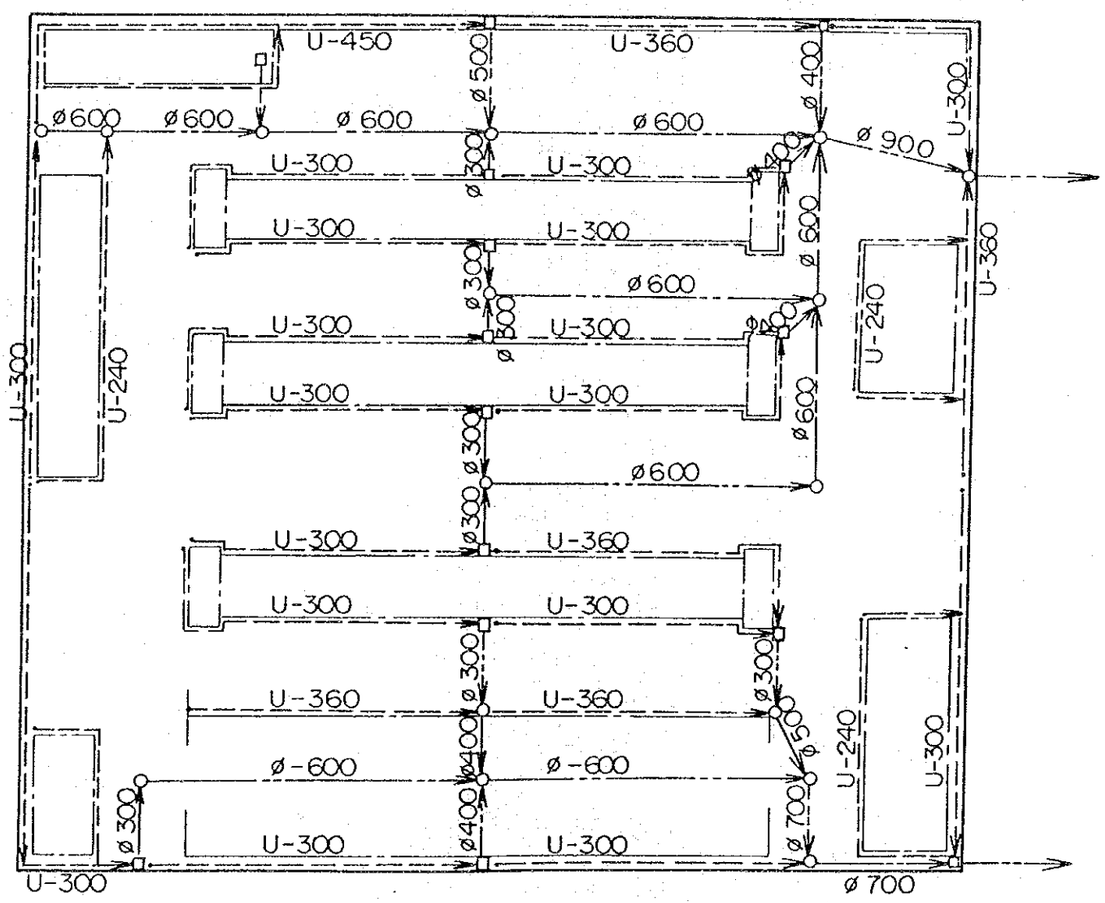


Fig. 8.4.15 Drainage Network (150 Berth)

F. Water Supply

Water supply requirements were the total of the water consumption by workers at he terminals and the water consumption for car washing.

Number of workers and unit consumption for each case are summarized in Table 8.4.5.

Number of trucks that requires car washing daily, was assumed to be five (5) per cent of all trucks that use each truck terminal daily.

Table 8.4.5 Total Daily Water Requirement

Items	General Water Consumption			Water Consumption for Car Washing			Total
	Person	Unit Consu-mption	Require-ment	No. of Cars	Unit Consum-ption	Requir ement	
Case 1	4,320	100	432	97	1,000	97	530
Case 2-1	3,075	100	307	70	1,000	70	380
Case 2-2	1,250	100	125	30	1,000	30	155

(Note) Number of trucks requiring car washing is estimated as follows;

Case 1

Line-haul trucks
6,724 (ton/day) / 10.5 (ton/vehicle)
= 640 (vehicle)

Pick-up/delivery truck
6,724 (ton/day) / 2.6 (ton)
/ 2 (cycle ratio)
= 1,300 (vehicle)

Number of trucks requiring car washing
(640 + 1,300) x 0.05
= 97 (vehicle)

Case 2-1

Line-haul trucks
4,794 (ton/day) / 10.5 (ton/vehicle)
= 460 (vehicle)

Pick-up/delivery truck
4,794 (ton/day) / 2.6 (ton)
/ 2 (cycle ratio)
= 925 (vehicle)

Number of trucks requiring car washing
(640 + 925) x 0.05
= 70 (vehicle)

Case 2-2

Line-haul trucks
1,930 (ton/day) / 10.5 (ton/vehicle)
= 190 (vehicle)

Pick-up/delivery truck
1,970 (ton/day) / 2.6 (ton)
/ 2 (cycle ratio)
= 380 (vehicle)

Number of trucks requiring car washing
(190 + 380) x 0.05
= 30 (vehicle)

Water is supplied by the supply water not by the underground water since the law prohibits the drawing of underground water. In rainy season, rain water can be used for toilet and car washing facility.

G. Power consumption

Size of power receiving facilities for the proposed terminals are calculated under the following assumptions;

Load capacities:

Office	:	100 W/m^2
Workshop	:	100 W/m^2
Platform	:	20 W/m^2
Site boundary	:	1 W/m^2 (exterior lighting, others)

Power consumption for each case is calculated as sown in Table 8.4.6.

Table 8.4.6 Power Consumption

	Case 1	Case 2-1	Case 2-2
Site Boundary	209,530 (m^2) x 1 (w/m^2) = 210 (Kw)	175,025 (m^2) x 1 (w/m^2) = 175 (Kw)	70,810 (m^2) x 1 (w/m^2) = 70 (Kw)
Platform	35,000 (m^2) x 20 (w/m^2) = 700 (Kw)	24,500 (m^2) x 20 (w/m^2) = 490 (Kw)	10,500 (m^2) x 20 (w/m^2) = 210 (Kw)
Office & Workshop	27,360 (m^2) x 100 (w/m^2) = 2,736 (Kw)	18,600 (m^2) x 100 (w/m^2) = 1,860 (Kw)	10,720 (m^2) x 100 (w/m^2) = 1,072 (Kw)
Administration Bldg.	(3,000)	(2,000)	(1,200)
Office	(6,000 x 2 = 12,000)	(4,200 x 2 = 8,400)	(1,800 x 2 = 3,600)
Warehouse	(5,000)	(3,000)	(2,000)
Lodging	(3,360)	(2,400)	(1,920)
Service Station (Repair Shop & Petrol Station)	(4,000)	(2,800)	(2,000)
Total (Kw)	3,646 kwH/D	2,525 kwH/D	1,352 kwH/D

8.4.3 Study of Access Method to the Truck Terminal

This section presents the results of analysis on access method from the trunk road to the truck terminal.

Two method are examined. First, level crossing method, i.e., controlled by the traffic light is examined. Secondly, flyover method is examined.

All the study in this section are conducted based on Case 1 (500 berth).

The following items are studied in this section.

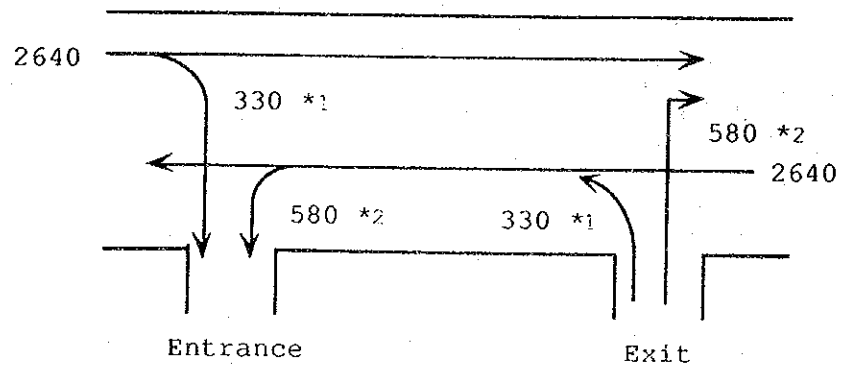
1.. Calculation of traffic congestion ratio due to constructing of the truck terminal.

2.. Consideration of access method (At-grade intersection/flyover intersection) to the truck terminal.

Case 1 (500 berth with stage construction) is adapted to study items mentioned above.

Study of Grade Intersection

A. The traffic volume which utilizes the truck terminal is estimated in Case 1 (500 berth with stage construction). (Fig. 8.4.16)



*1 = Passenger car unit 640 v/d x peak ratio (0.2) x pcu (2.5) = 330
*2 = 300 vehicle of commuting and other cars are included

Fig. 8.4.16 Traffic Volume

B. Measures on Traffic Management

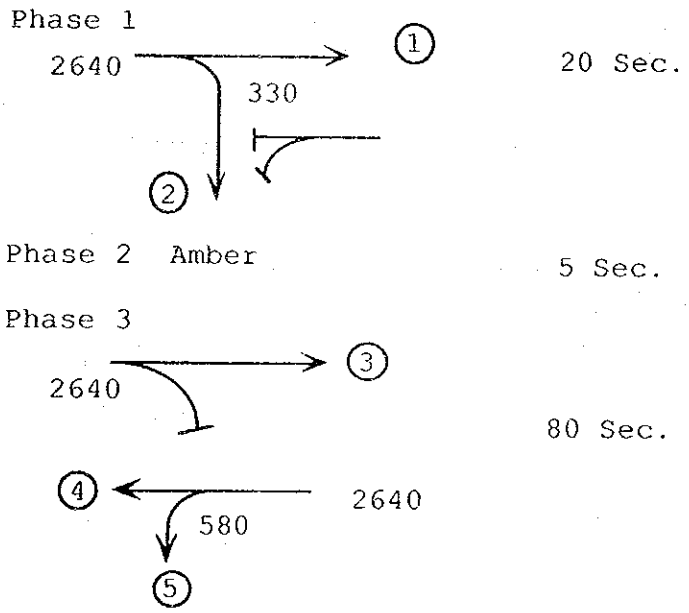
The measures on traffic management is considered as follows since the traffic volume in related to the truck terminal is not so large as is described above.

1. Providing exclusive right turn lanes
2. Installing signal equipment at entrance and exit

C. Entrance

1. Signal Phase

The four signal phasing are taken into consideration as follows;



2. Traffic Congestion

The results of calculation of traffic congestion are shown in Table 8.4.7

Table 8.4.7 Congestion Ratio

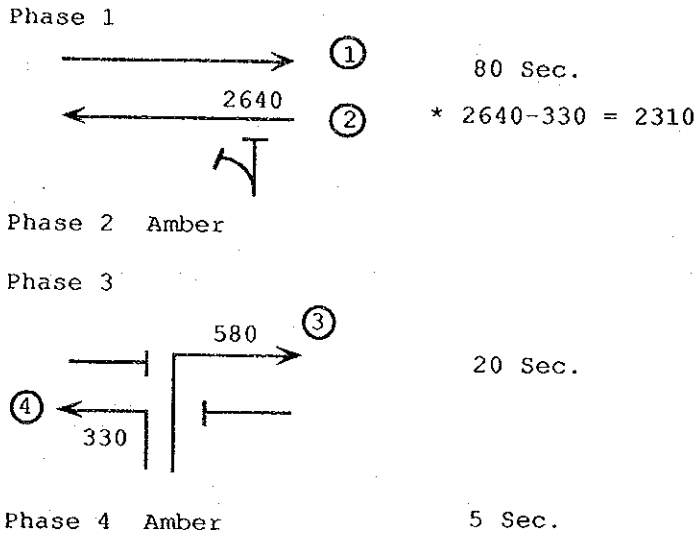
Direction	Traffic Volume (vehicle /hour)	Capacity (vehicle/hour)	Congestion Ratio (volume /capacity)
1	2640-330 = 2310	2000x20/110x2 lanes = 727	
3	2640-330 = 2310	2000x80/110x2 lanes = 2909	2310/(727+2909) = 0.635
2	= 330	1800x20/110x2 lanes = 654	330/654 = 0.504
4	2640-580 = 2060	2000x80/110x2 lanes = 2909	2060/2909 = 0.708
5	580	1800x80/110x1 lane = 1309	580/1309 = 0.443
Total	5280*	8508	

(Note) * 1 is excluded.

D. Exit

1. Signal Phase

The following four signal phasing are taken into consideration.



2. Traffic Congestion

The results of calculation on traffic congestion are shown in Table 8.4.8.

Table 8.4.8 Calculation of Congestion Ratio

Direction	Traffic Volume (vehicle /hour)	Capacity (vehicle/hour)	Congestion Ratio (volume/ capacity)
1	= 2310	2000x80/110x2 lanes = 2909	0.794
2	= 2640	2000x80/110x2 lanes = 2909	0.907
3	= 580	1800x20/110x2 lanes = 654	0.887
4	= 330	1800x20/110x2 lanes = 654	0.504
Total	5,860	7,126	0.822

E. Providing Right Turn Lane

It is essential to provide the exclusive right-turn lanes according to the results of calculation of traffic congestion ratio. The length of this right-turn lanes (2 lanes) is calculated as follows;

130 Line-haul trucks x 80/3600
x 15 x 2 x 1/2
= 50 m.

F. Schematic Plan at Entrance and Exit

Fig. 8.4.17 shows schematic plan of conjunctions at the entrance and the exit.

G. Evaluation

The average congestion ratio at the entrance is 0.62%, while that of at the exit is 0.822. This indicates that the intersections in front of the entrance and the exit have enough capacity to cope with the traffic volume. Any problems cannot be seen in installing the traffic signals at this site since the traffic volume which have no relation to the truck terminal is not so large as to affect the traffic management there. However, it is essential to improve the present condition as follows;

1. to provide the two exclusive right-turn lanes on direction from route to entrance.

2. to provide additional lane for left turn on direction from Bangkok to entrance.

Grade intersection proved its capability to make the flows of the inbound and outbound trucks smooth.

Study of Flyover

This supplementary study on the flyover is conducted by examining the following items;

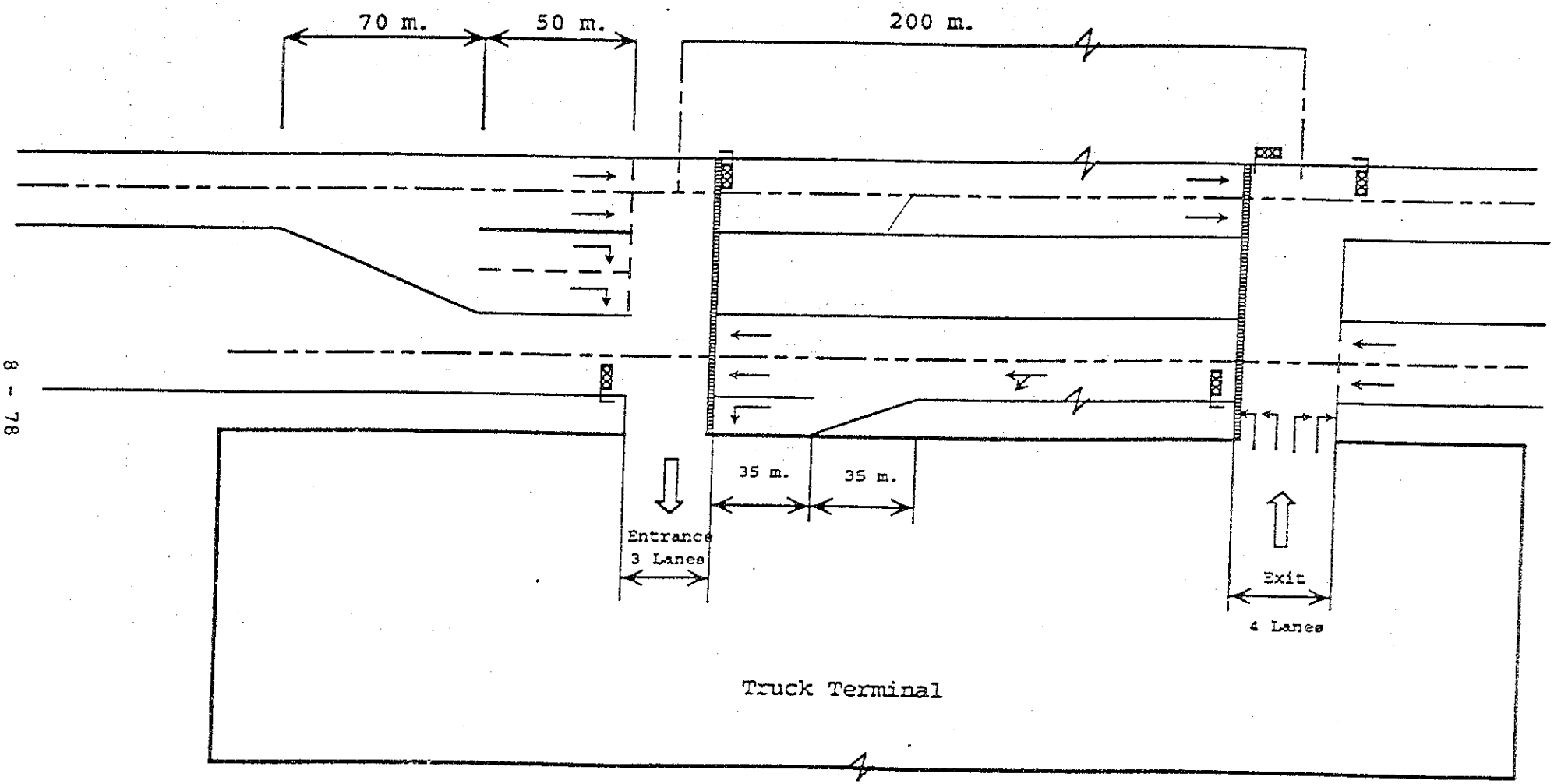


Table 8.4.17 Schematic Plan at Entrance and Exit

A. to ensure the U-turn possible
B. to minimize the construction cost
C. to ensure clearance of 5 meters
D. to set vertical gradient of 10 %

Least cost type of flyover is the diamond type. Its two ramifications are examined in this study.

Diamond flyover:	Separate Type
Diamond flyover:	Integrated Type

Separate type of diamond flyover generates a weaving of out-bound trucks and in-bound trucks, and thus the exit must locates apart 200 meters at least from the entrance.

Integrated type of diamond flyover cannot avoid the crossing of loci of the out-bound truck and the in-bound truck, and thus traffic light should be installed to assure the safety crossings. U-turn traffic has to join and depart from the traffic related with the truck terminal.

Cost is compared in Table 8.4.9.

Table 8.4.9 Construction Cost of Flyover

(unit: million Baht)

	Terminal	U-tern	Total
Diamond Type Flyover: Separate Model	67	53	120
Diamond Type Flyover: Integrated Model	90	40	130

Results of the examination are summarized in Fig. 8.4.18.

1. The grand crossing with two-lanes for the right-turn traffic and with traffic light can guarantee sufficient capacity to cope with the estimated traffic volume.

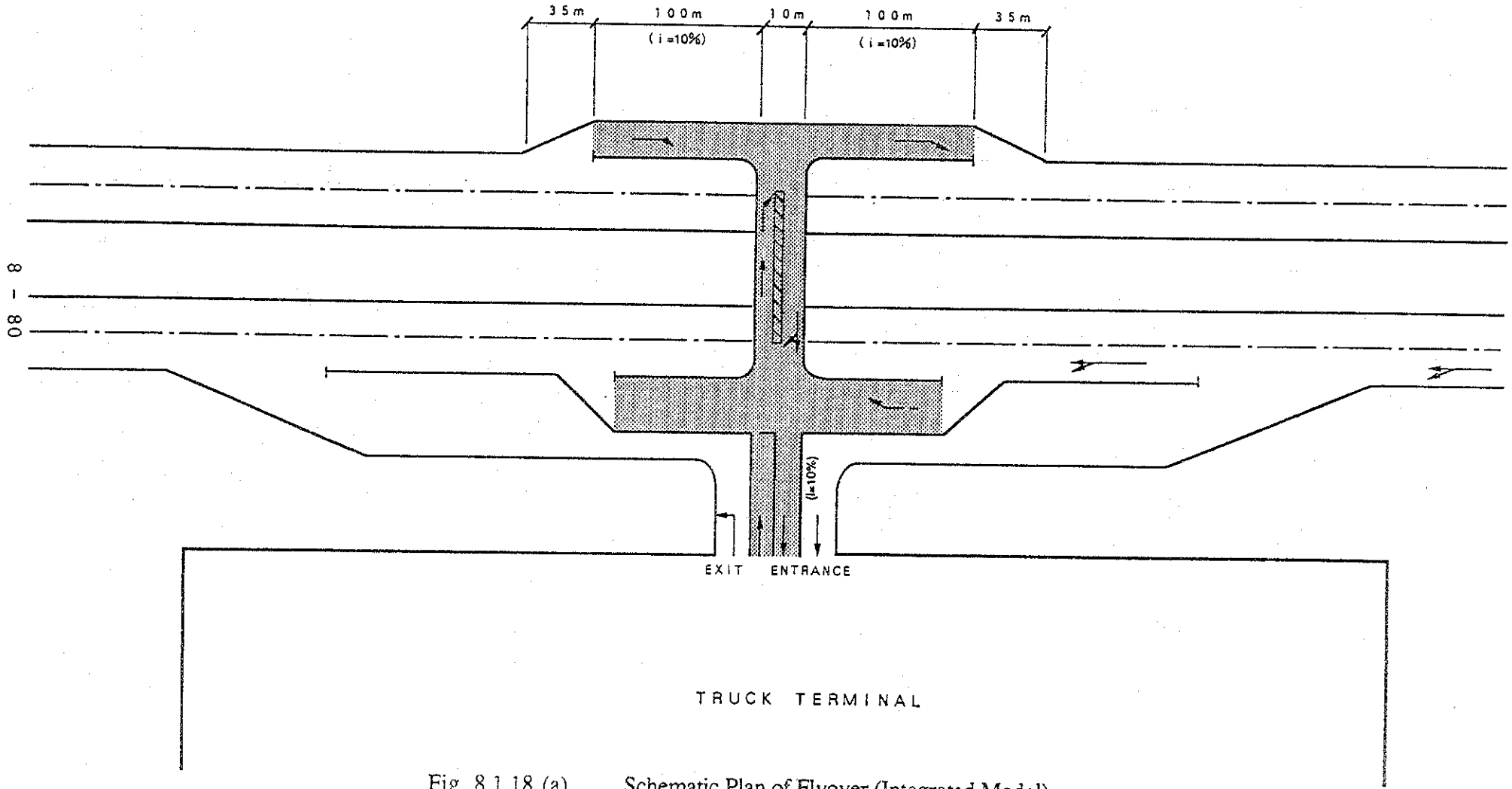


Fig. 8.1.18 (a) Schematic Plan of Flyover (Integrated Model)

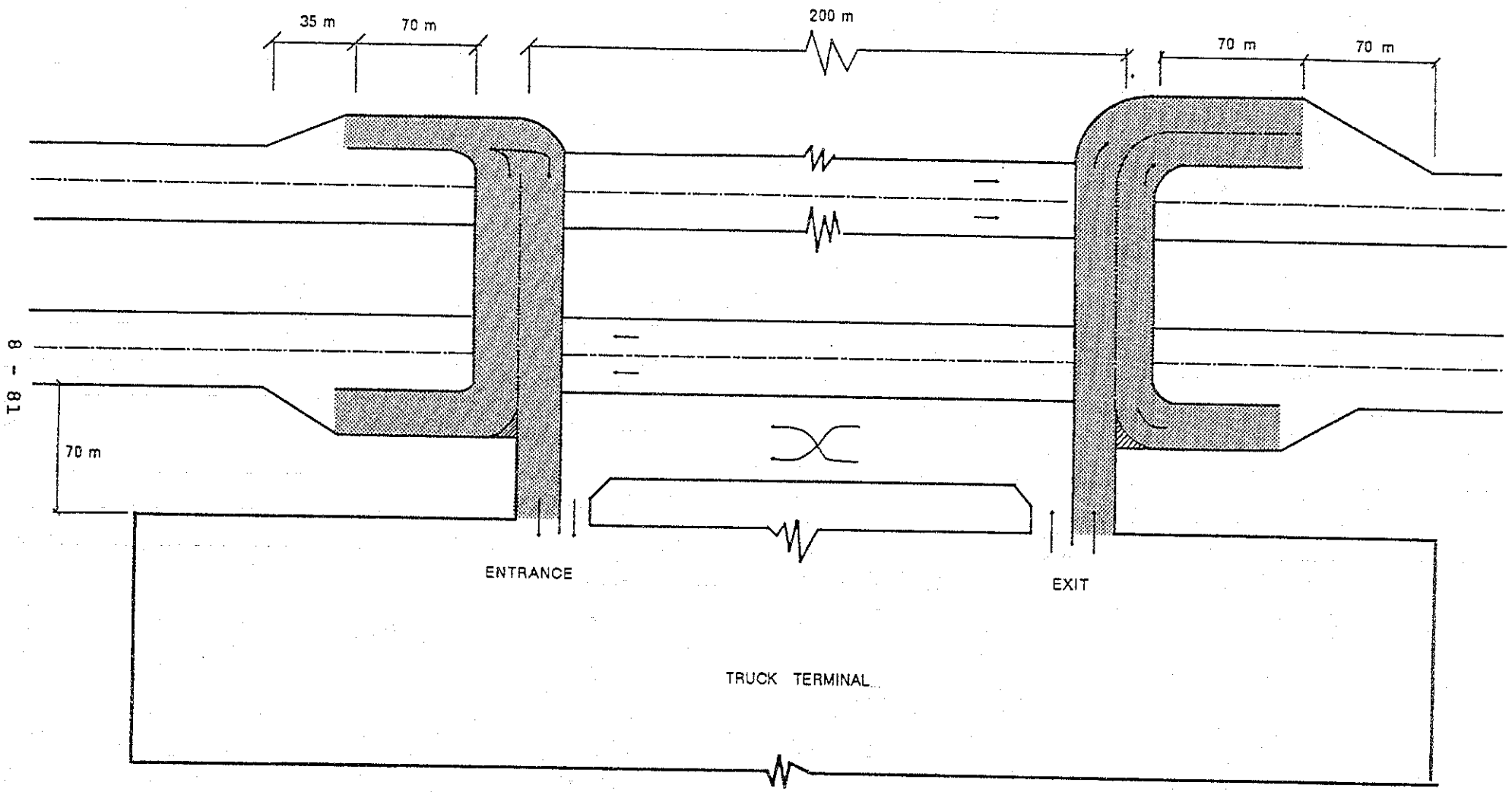


Fig. 8.1.18 (b) Schematic Plan of Flyover (Separated Model)

2. There are two models for level crossing flyover. Of two, the separate type generate less problems in traffic management, and requires less amount of construction cost, equivalent to 90% of the integrated model.

Grand crossing type costs one-fortieth of the flyover (separate model), and very attractive. However, it raises the traffic safety problems since the vehicle runs at the speed of 100 kilometers per hour or over at the site. Selection of model requires coordination with Department of Highway.

Level crossing type is the most advantageous device for traffic management. However, coordination with DOH in cost sharing are required since it needs larger amount of construction cost.

CHAPTER 9

COST ESTIMATION

CHAPTER 9 COST ESTIMATION

9.1 Estimation of Work Quantity

9.1.1 General

Work quantity is itemized into eleven categories.

The specification of quality of the structure is the major factor to determine the cost of the structure. "Preliminary design" guideline is the foundation of this cost estimate. Other cost affecting factors are the followings:

A. Geological factor

Geological information was acquired from the Board of Investment (BOI). Also, interviews with members of Industrial Estate Authority Thai, local general contractors were conducted.

According to the interviews and information from BOI, below the top soil is thirty meters of thin stratum. Load bearing rock layers lay about fifty (50) meter below the ground level. Twenty (20) to twenty-five centimeter (25) of single-year-subsidence was recognized, and five (5) to (10) centimeter subsidence are measured annually from the following year. Therefore, some margin of error in this cost estimate is unavoidable, and it should be adjusted when accurate information is available.

B. Earthworks

At this stage, level of soil improvement is not specified. Hazardous waste, historic artifacts, unknown ground objects are examples that affect the work quantity.

C. Drainage

Entire length, depth, and location of drainage system is subject to further revision in accordance with the soil condition. Work quantity is to be adjusted accordingly.

D. Foundation

In preliminary design, "friction pile" foundation construction method is used. The number of piles and length are functions of geological condition. When geological survey is conducted, and its data is available, the construction cost should be adjusted.

E. Entrance System

The issue of the terminal entrance system, whether flyover/viaduct or at-grade intersection is to be applied has been discussed As a result of studies on the traffic conflict aspect and economic situation, latter (T-junction) with traffic signal control system is adopted.

F. Approach

The terminal is assumed to be very close to the main road so that the construction cost for the approach road is not included.

G. Utilities

Quantities for the utilities (electric power supply, water supply, telecommunication and water discharge) outside of the terminal are not included in the estimate.

9.1.2 Work Quantities

Quantities regarding the preliminary design are summarized in the table of "Construction cost" and "Construction schedule".

Table 9.1.1 Construction Cost (Case 1)

WORK ITEM	UNIT	UNIT PRICE (BAHT)	QUANTITY	AMOUNT (BAHT)	REMARKS
1 EARTHWORKS					
Earth Filling	m3	72	131,075	9,437,400	
Sub Total	"			9,437,000	
2 DRAINAGE					
U-ditch U-240	m	667	1,103	735,701	
" U-300	"	810	4,956	4,014,360	
" U-360	"	1,009	1,683	1,698,147	
" U-450	"	1,425	527	750,975	
Concrete pipe Culvert ø 300	"	481	648	311,688	
" ø 400	"	642	495	317,790	
" ø 500	"	827	105	86,835	
" ø 600	"	1,044	1,859	1,940,796	
" ø 700	"	1,413	840	1,186,920	
" ø 800	"	1,782	390	694,980	
" ø 900	"	2,251	110	247,610	
" ø 1000	"	2,720	180	489,600	
" ø 1100	"	3,229	55	177,595	
" ø 1300	"	4,150	85	352,750	
Catch Basin	Ea	850	58	49,300	
Manhole	"	5,200	42	218,400	
Sub Total				13,273,000	
3 FOUNDATIONS					
Piling (R.C 22 X 22cm-20.0m)	Nos	19,565	3,381	66,149,265	
Sub Total				66,149,000	
4 PAVING					
Asphaltic Paving	m2	368	199,380	73,371,840	
Sub Total				73,372,000	
5 PLATFORM					
Roof	m2	500	59,500	29,750,000	
Column with Footing	Ea	71,202	360	25,632,720	
Shutter Wall	"	160,000	340	54,400,000	
Asphaltic Paving	m2	368	35,000	12,880,000	
Retaining Wall	m	8,753	3,500	30,635,500	
Sub Total				153,298,000	
6 BUILDINGS					
Administration Building	m2	9,000	3,000	27,000,000	
Office Building	"	4,500	12,000	54,000,000	
Sub Total				81,000,000	
7 WAEREHOUSE & LODGING					
Warehouse	m2	3,500	5,000	17,500,000	
Lodging	m2	2,500	3,360	8,400,000	
Sub Total				25,900,000	
8 FACILITIES					
Repair Shop	Ls	2,000,000	1	2,000,000	
Petro Station	"	2,000,000	1	2,000,000	
Car Wash	"	1,000,000	1	1,000,000	
Truck Scale (50t)	"	1,000,000	4	4,000,000	
Sewerage Treatment Plant	"	2,000,000	1	2,000,000	
Substation	"	2,000,000	1	2,000,000	
Water Reservoir	Ea	1,007,205	3	3,021,615	
Sub Total				16,022,000	
9 GREENBELT & FENCE					
Green Belt	m2	266	10,150	2,699,900	
Fence	m	3,237	2,010	6,506,370	
Sub Total				9,206,000	
10 INTERSECTION					
Eath Excavation	m3	71	391	27,761	
Concrete Paving	m2	665	1,304	867,160	
Traffic Signal	Ea	500,000	5	2,500,000	
Sub Total				3,395,000	
11 MARKING , SIGNS & MISCELLANEOUS	Ls	2,000,000	1	2,000,000	
Sub Total				2,000,000	
TOTAL CONSTRUCTION COST				453,052,000	

Table 9.1.2 Construction Cost (Case 2-1)

WORK ITEM	UNIT	UNIT PRICE (BAHT)	QUANTITY	AMOUNT (BAHT)	REMARKS
1 EARTHWORKS					
Earth Filling	m3	72	105,663	7,607,736	
Sub Total	"			7,608,000	
2 DRAINAGE					
U-ditch U-240	m	667	1,152	768,384	
" U-300	"	810	3,736	3,026,160	
" U-360	"	1,009	1,266	1,277,394	
" U-450	"	1,425	90	128,250	
Concrete pipe Culvert ø 200	"	300	138	41,400	
" ø 300	"	481	703	338,143	
" ø 400	"	642	280	179,760	
" ø 500	"	827	120	99,240	
" ø 600	"	1,044	1,865	1,947,060	
" ø 700	"	1,413	538	760,194	
" ø 800	"	1,782	285	507,870	
" ø 900	"	2,251	110	247,610	
" ø 1000	"	2,720	98	266,560	
" ø 1100	"	3,229	45	145,305	
" ø 1200	"	3,737	35	130,795	
Catch Basin	Ea	850	61	51,850	
Manhole	"	5,200	33	171,600	
Sub Total				10,088,000	
3 FOUNDATIONS					
Piling (R.C 22 X 22cm-20.0m)	Nos	19,565	2,345	45,879,925	
Sub Total				45,880,000	
4 PAVING					
Asphaltic Paving	m2	368	165,825	61,023,600	
Sub Total				61,024,000	
5 PLATFORM					
Roof	m2	500	41,650	20,825,000	
Column with Footing	Ea	71,202	252	17,942,904	
Shutter Wall	"	160,000	238	38,080,000	
Asphaltic Paving	m2	368	24,500	9,016,000	
Retaining Wall	m	8,753	2,450	21,444,850	
Sub Total				107,309,000	
6 BUILDINGS					
Administration Building	m2	9,000	2,000	18,000,000	
Office Building	"	4,500	8,400	37,800,000	
Sub Total				55,800,000	
7 WAEREHOUSE & LODGING					
Warehouse	m2	3,500	3,000	10,500,000	
Lodging	m2	2,500	2,400	6,000,000	
Sub Total				16,500,000	
8 FACILITIES					
Repair Shop	Ls	2,000,000	1	2,000,000	
Petro Station	"	2,000,000	1	2,000,000	
Car Wash	"	1,000,000	1	1,000,000	
Truck Scale (50t)	"	1,000,000	3	3,000,000	
Sewerage Treatment Plant	"	2,000,000	1	2,000,000	
Substation	"	2,000,000	1	2,000,000	
Water Reservoir	Ea	1,007,025	2	2,014,050	
Sub Total				14,014,000	
9 GREEN BELT & FENCE					
Green Belt	m2	266	9,200	2,447,200	
Fence		3,237	1,820	5,891,340	
Sub Total				8,339,000	
10 INTERSECTION					
Earth Excavation	m3	71	391	27,761	
Concrete paving	m2	665	1,304	867,160	
Traffic Signal	Ea	500,000	5	2,500,000	
Sub Total				3,395,000	
11 MARKING , SIGNS & MISCELLANEOUS	Ls	2,000,000	1	2,000,000	
Sub Total				2,000,000	
TOTAL CONSTRUCTION COST				331,957,000	

Table 9.1.3 Construction Cost (Case 2-2)

WORK ITEM		UNIT	UNIT PRICE (BAHT)	QUANTITY	AMOUNT (BAHT)	REMARKS
1 EARTHWORKS						
Earth Filling		m3	72	44,175	3,180,600	
Sub Total		"			3,181,000	
2 DRAINAGE						
U-ditch	U-240	m	667	556	370,852	
"	U-300	"	810	1,964	1,590,840	
"	U-360	"	1,009	542	546,878	
"	U-450	"	1,425	133	189,525	
Concrete pipe Culvert	ø 300	"	481	192	92,352	
"	ø 400	"	642	117	75,114	
"	ø 500	"	827	62	51,274	
"	ø 600	"	1,044	827	863,388	
"	ø 700	"	1,413	71	100,323	
"	ø 900	"	2,251	47	105,797	
Catch Basin		Ea	850	14	11,900	
Manhole		"	5,200	16	83,200	
Sub Total					4,081,000	
3 FOUNDATIONS						
Piling (R.C 22 X 22cm-20.0m)		Nos	19,565	1,204	23,556,260	
Sub Total					23,556,000	
4 PAVING						
Asphaltic Paving		m2	368	64,960	23,905,280	
Sub Total					23,905,000	
5 PLATFORM						
Roof		m2	500	17,850	8,925,000	
Column with Footing		Ea	71,202	108	7,689,816	
Shutter Wall		"	160,000	102	16,320,000	
Asphaltic Paving		m2	368	10,500	3,864,000	
Retaining Wall		m	8,753	1,050	9,190,650	
Sub Total					45,989,000	
6 BUILDINGS						
Administration Building		m2	9,000	1,200	10,800,000	
Office Building		"	4,500	3,600	16,200,000	
Sub Total					27,000,000	
7 WAEREHOUSE & LODGING						
Warehouse		m2	3,500	2,000	7,000,000	
Lodging		m2	2,500	1,920	4,800,000	
Sub Total					11,800,000	
8 FACILITIES						
Repair Shop		Ls	1,500,000	1	1,500,000	
Petro Station		"	1,500,000	1	1,500,000	
Car Wash		"	500,000	1	500,000	
Truck Scale	(50t)	"	1,000,000	1	1,000,000	
Sewerage Treatment Plant		"	1,000,000	1	1,000,000	
Substation		"	1,000,000	1	1,000,000	
Water Reservoir		Ea	1,007,205	1	1,007,205	
Sub Total					7,507,000	
9 GREEN BELT & FENCE						
Green Belt		m2	266	5,850	1,556,100	
Fence		m	3,237	1,150	3,722,550	
Sub Total					5,279,000	
10 INTERSECTION						
Earth Excavation		m3	71	236	16,756	
Concrte Paving		m2	665	788	524,020	
Traffic		Ea	500,000	5	2,500,000	
Sub Total					3,041,000	
11 MARKING , SIGNS & MISCELLANEOUS		Ls	1,500,000	1	1,000,000	
Sub Total					1,000,000	
TOTAL CONSTRUCTION COST					156,339,000	

Table 9.1.4 Construction Schedule (Case 1)

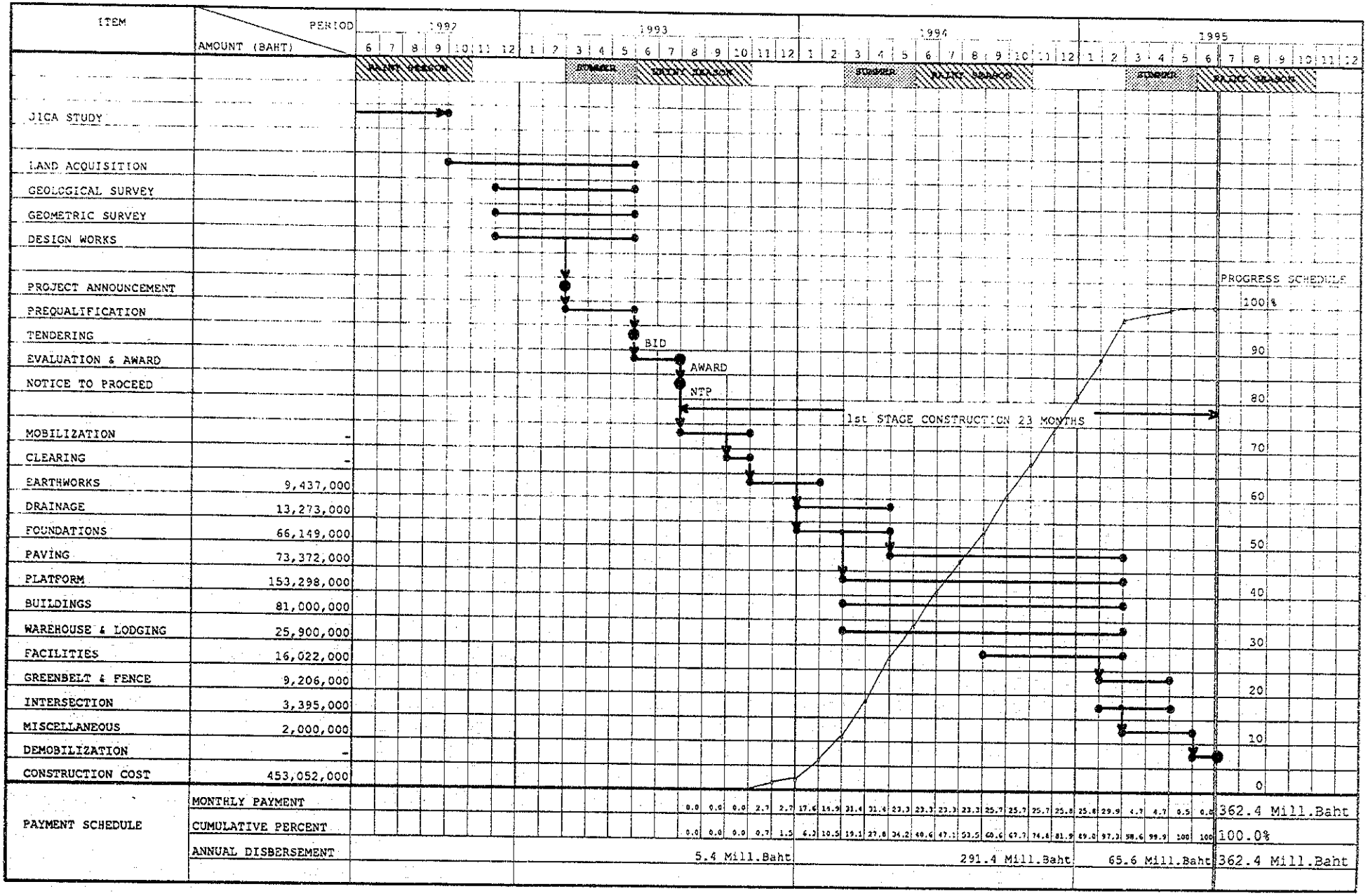


Table 9.1.4 Construction Schedule (Case 1)

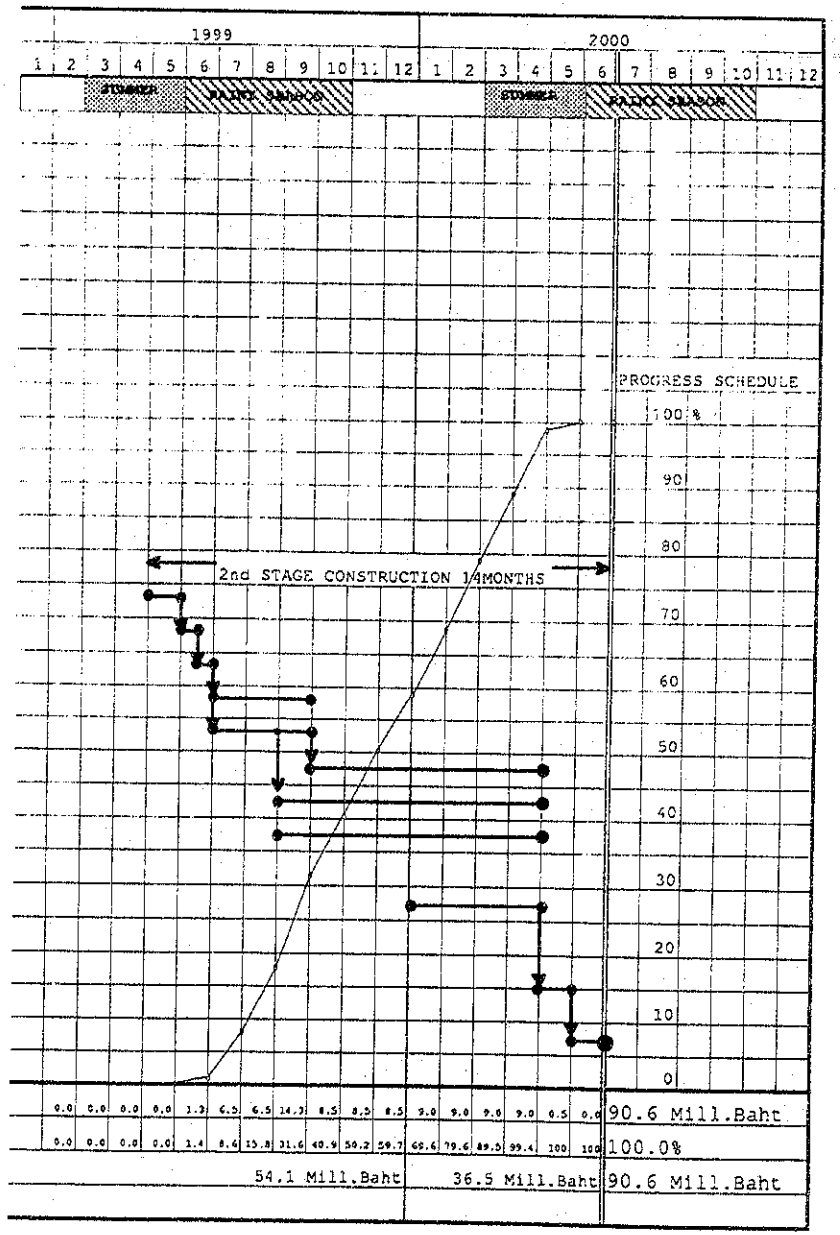


Table 9.1.5 Construction Schedule (Case 2-1)

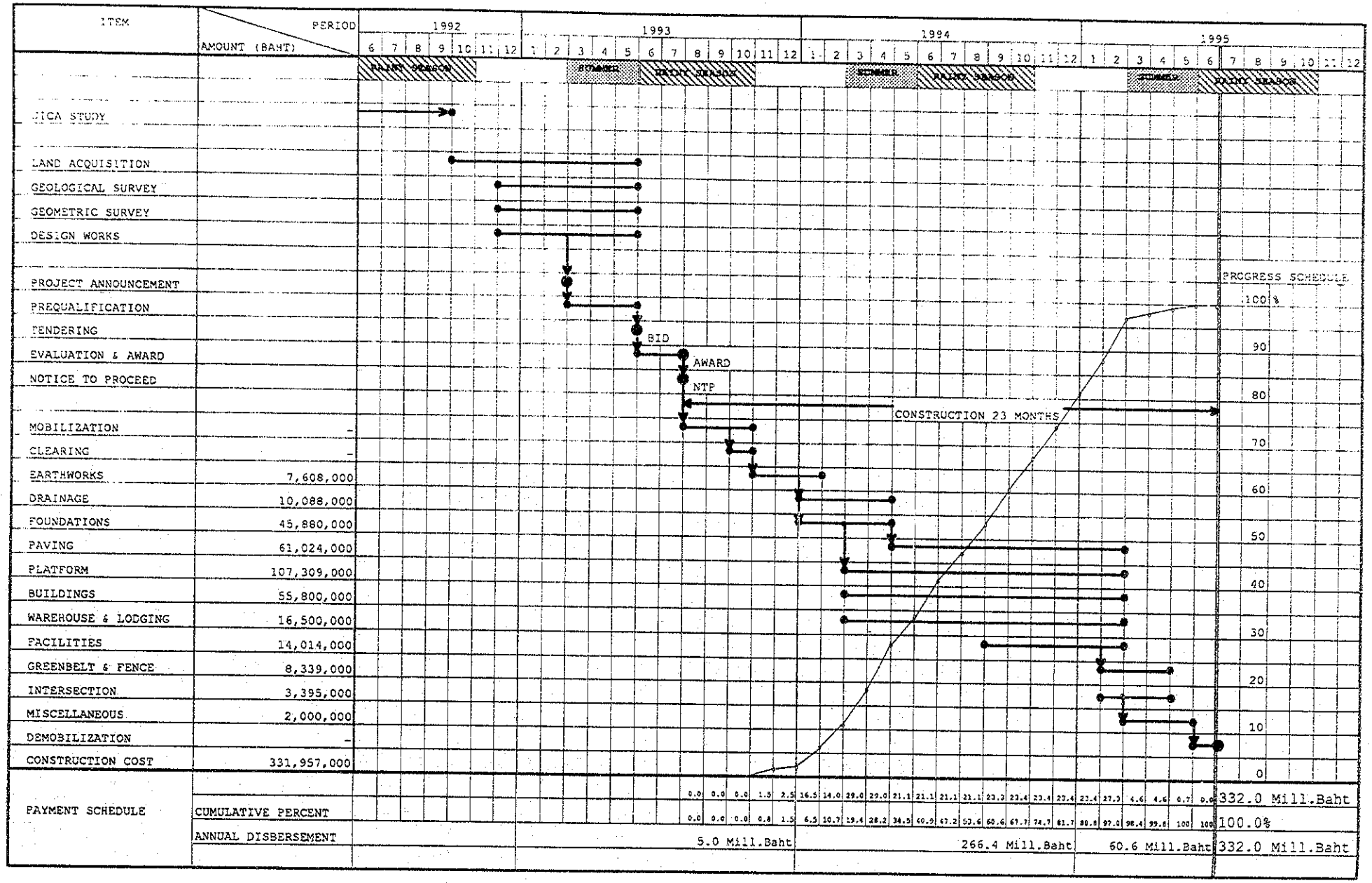
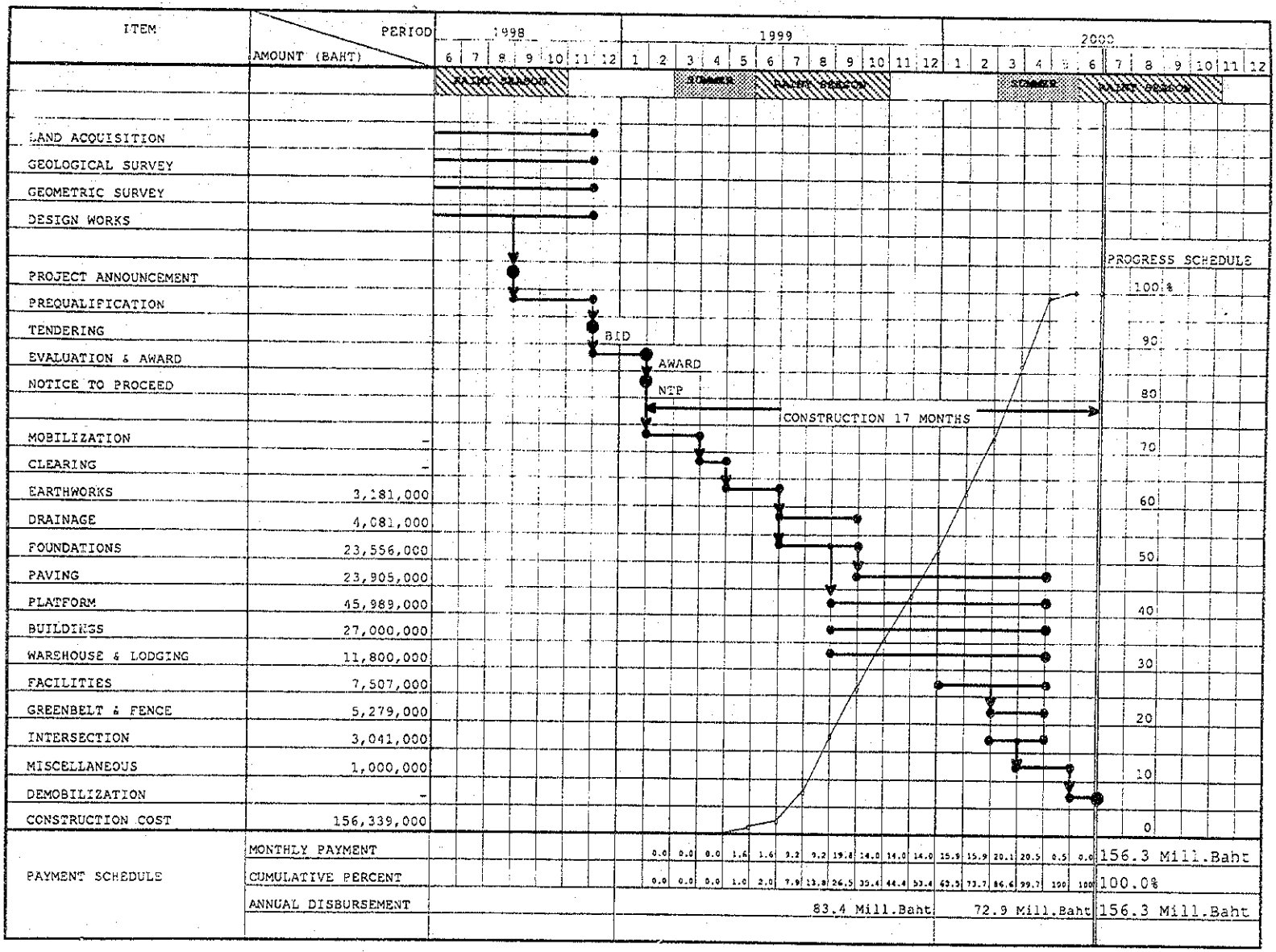


Table 9.1.6 Construction Schedule (Case 2-2)



9.2 Unit Construction Cost Estimation

9.2.1 General

Thailand, according to our study, is capable of supplying all the construction materials, workers, and equipments to construct the terminal. Those three items, material prices, workers' wages, and equipment costs are the basics of the cost estimate.

9.2.2 Price Escalation

The cost estimate is based on the 1992 price, and is not adjusted by inflation factors. However, the consumer price index movement in recent years is the basis of the cost estimate, and it gives some idea for the future construction price increase.

Thai economy was affected by the second oil crisis in the early 1980s; its consumer price was raised by 20 % on the average. During the years from 1984 to 1987, the consumer prices were stabilized, and stayed to 3 to 5% annual increase. Recent construction boom in Thailand raised the consumer prices.

"Price index" issued by the Department of Business and Economics is listed in Table 9.2.1. The average annual price increase from the year 1987 to 1991 is about seven (7) percent. The price of galvanized iron pipe increased by 13%, and the price of asphalt remained the same.

Table 9.2.1 Price Index

ITEM	INDEX IN 1991	ANNUUAL HIKE (%)
(M) Construction Material	139.5	8.6785
(S) Steel	130.5	6.8815
(C) Cement	161.6	12.7478
(G) Iron Sheet	137.1	8.2080
(I) Genenal Consumer Price	121.9	5.0754
(F) Disel Fuel	128.0	6.3659
(A) Asphalt	100.0	0.0000
(E) Machinety and Equipment	121.8	5.0538
(GIP) Galvanized Iron Pipe	163.3	13.0437
(AC) Asbestos Pipe	111.2	2.6895
(PVC) PVC Water Pipe	120.8	4.8375
(W) Inslated Wire	147.6	10.2228
(PE) High Density Polyethlen Pipe	130.4	6.8610
AVERAGE		6.9743

9.2.3 Basic Prices

Basic prices listed in Table 9.2.1 are quoted from the following sources:

ITEM	DESCRIPTION
Material Price	• Data set forth by Department of Economic relations (DOH) • Advertising book (Material Directory) • Interview to general contractors • Others
Workers' Wages	• By refereeing to the labor's law in Thailand • Advertisement in newspaper (Job wanted) • Interview to general contractors • The team's experience • Others
Equipment Cost	• Leasing/Rental fee in Bangkok Metro area • Interview to general contractor • By refereeing to Japanese price book • Others

9.2.4 Unit Prices

Unit prices are quoted from other similar projects. When the numbers from similar projects are not detailed enough, lump-sum estimation method is used.

9.2.5 Construction Cost

Construction cost was calculated by multiplying work quantity with unit price.

9.3 Operation and Maintenance Cost Estimation

9.3.1 General

Operation and Maintenance cost for the truck terminal are estimated on one-year basis.

Unit prices for water supply and electric supply are quoted from the price table set by the Metropolitan Waterworks Authority and Metropolitan Electricity Authority respectively. Unit prices used for the calculation are reasonable at this preliminary design stage.

9.3.2 Operation and Maintenance Cost

Estimated operation and maintenance costs are attached on the following pages.

9.4 Annual Investment

9.4.1 General

The construction cost estimate, construction schedule and maintenance and operation plan are the determinants of the annual investment for the truck terminal.

9.4.2 Estimated Annual Investment Needs

Estimated annual investment are attached on the following pages.

Table 9.4.1 Operation and Maintenance Cost (Case 1)

(Unit: 1,000 Baht)

	Item	Basis for Estimation	1st 1996	2nd 1997	3rd 1998	4th 1999	5th 2000
OPERATION COST	Water supply General water	307 m3/D x 25D x 12M = 92,100 m3 8 Bt/m3 x 92,100 m3 = 736,500 Bt	737	737	737	737	737
	ditto Car washing	70 m3/D x 25D x 8M = 14,000 m3 8 Bt/m3 x 14,000 m3=112,000 Bt	112	112	112	112	112
	Sewerage treatment	(736,800 + 112,000) x 20% = 169,760	170	170	170	170	170
	Electric power supply	2,525Kwh/D x 25D x 12M=757,500Kwh 2 Bt/Kwh x 757,500Kwh = 1,515,000Bt	1,515	1,515	1,515	1,515	1,515
	Administration cost	Basic salary = 3,420,000 Bt Allowance = 855,000 Bt Overhead = 342,000 Bt 4,617,000 Bt	4,617	4,617	4,617	4,617	4,617
	Security cost	90,000 Bt/Person x 10 p. = 900,000 Bt	900	900	900	900	900
	Sub total		8,051	8,051	8,051	8,051	8,051
MAINTENANCE COST	Overlaying	(185,865 + 24,500) x 1/2 = 105,183m2 200Bt/m2 x 105,183m2 =21,036,600 Bt		21,037		21,037	
	Cleaning/ Sweeping	7 Worker/D x 25D x 12M = 2,100 W 180Bt/w x 2,100 w = 378,000 Bt	378	378	378	378	378
	Re-Painting	(5,000+3,600+4,000+24,500)x0.5m2 = 18,430 m2 260Bt/m2 x 18,430m2 = 4,271,800 Bt					4,792
	Sub total		378	21,415	378	21,415	5,170
Grand total OM Cost VAT 7%			*9,019* 8,429 590	*31,528* 29,465 2,063	*9,019* 8,429 590	*31,528* 29,465 2,063	*14,146* 13,220 925

Basis for Estimation	6th 2001	7th 2002	8th 2003	9th 2004	10th 2005
432 m3/D x 25D x 12M = 129,600 m3 8 Bt/m3 x 129,600 m3 = 1,036,800 Bt	1,037	1,037	1,037	1,037	1,037
97 m3/D x 25D x 8M = 19,400 m3 8 Bt/m3 x 19,400 m3=155,200 Bt	155	155	155	155	155
(1,036,800 + 155,200) x 20% = 238,400 Bt	238	238	238	238	238
3,646 Kwh/D x 25D x 12M= 1,093,800 Kwh 2 Bt/Kwh x 1,093,800 Kwh = 2,187,600 Bt	2,188	2,188	2,188	2,188	2,188
Basic salary = 4,332,000 Bt Allowance = 1,083,000 Bt Overhead = 433,200 Bt 5,848,200 Bt	5,848	5,848	5,848	5,848	5,848
90,000 Bt/Person x 15 p. = 1,350,000 Bt	1,350	1,350	1,350	1,350	1,350
	10,816	10,816	10,816	10,816	10,816
(13,515 + 10,500) x 1/2 = 12,008m2 200Bt/m2 x 12,008m2 =2,401,600 Bt	21,037	2,402	21,037	2,402	21,037
10 Worker/D x 25D x 12M = 3,000 W 180Bt/w x 3,000 w = 540,000 Bt	540	540	540	540	540
(5,000+3,600+4,000+35,000)x0.5m2 = 23,680 m2 260Bt/m2 x 23,680m2 = 6,156,800 Bt					6,157
	21,577	2,942	21,577	2,942	27,733
	34,660 32,393 2,267	*14,721* 13,758 963	*34,660* 32,393 2,267	*14,721* 13,758 963	*41,248* 38,550 2,698

Table 9.4.2 Operation and Maintenance Cost (Case 2-1)

(Unit: 1,000 Baht)

	Item	Basis for Estimation	1st 1996	2nd 1997	3rd 1998	4th 1999	5th 2000	6th 2001	7th 2002	8th 2003	9th 2004	10th 2005
OPERATION COST	Water supply General water	307 m3/D x 25D x 12M = 92,100 m3 8 Bt/m3 x 92,100 m3 = 736,500 Bt	737	737	737	737	737	737	737	737	737	737
	ditto Car washing	70 m3/D x 25D x 8M = 14,000 m3 8 Bt/m3 x 14,000 m3=112,000 Bt	112	112	112	112	112	112	112	112	112	112
	Sewerage treatment	(736,800 + 112,000) x 20% = 169,760	170	170	170	170	170	170	170	170	170	170
	Electric power supply	2,525Kwh/D x 25D x 12M=757,500Kwh 2 Bt/Kwh x 757,500Kwh = 1,515,000Bt	1,515	1,515	1,515	1,515	1,515	1,515	1,515	1,515	1,515	1,515
	Administration cost	Basic salary = 3,420,000 Bt Allowance = 855,000 Bt Overhead = 342,000 Bt 4,617,000 Bt	4,617	4,617	4,617	4,617	4,617	4,617	4,617	4,617	4,617	4,617
	Security cost	90,000 Bt/Person x 10 p. = 900,000 Bt	900	900	900	900	900	900	900	900	900	900
	Sub total		8,051	8,051	8,051	8,051	8,051	8,051	8,051	8,051	8,051	8,051
MAINTENANCE COST	Overlaying	(165,825 + 10,500) x 1/2 = 88,163m2 200Bt/m2 x 88,163m2 =17,632,600 Bt		17,633		17,633		17,633		17,633		17,633
	Cleaning/ Sweeping	7 Worker/D x 25D x 12M = 2,100 W 180Bt/w x 2,100 w = 378,000 Bt	378	378	378	378	378	378	378	378	378	378
	Re-Painting	(3,000+2,400+2,800+24,500)x0.5m2 = 16,350 m2 260Bt/m2 x 16,350m2 = 4,251,000 Bt					4,251					4,251
	Sub total		378	18,011	378	18,011	4,629	18,011	378	18,011	378	22,262
Grand total			*9,019*	*27,885*	*9,019*	*27,885*	*13,567*	*27,885*	*9,019*	*27,885*	*9,019*	*32,434*
OM Cost			8,429	26,061	8,429	26,061	12,680	26,061	8,429	26,061	8,429	30,312
VAT 7%			590	1,824	590	1,824	888	1,824	590	1,824	590	2,122

Table 9.4.3 Operation and Maintenance Cost (Case 2-2)

(Unit: 1,000 Baht)

	Item	Basis for Estimation	1st 2001	2nd 2002	3rd 2003	4th 2004	5th 2005	6th 2006	7th 2007	8th 2008	9th 2009	10th 2010
OPERATION COST	Water supply General water	125 m3/D x 25D x 12M = 37,500 m3 8 Bt/m3 x 37,500 m3 = 300,000 Bt	300	300	300	300	300	300	300	300	300	300
	ditto Car washing	30 m3/D x 25D x 8M = 6,000 m3 8 Bt/m3 x 6,000 m3=48,000 Bt	48	48	48	48	48	48	48	48	48	48
	Sewerage treatment	(300,000 + 48,000) x 20% = 69,600	70	70	70	70	70	70	70	70	70	70
	Electric power supply	1,352Kwh/D x 25D x 12M=405,600Kwh 2 Bt/Kwh x 405,600Kwh = 811,200Bt	811	811	811	811	811	811	811	811	811	811
	Administration cost	Basic salary = 2,556,000 Bt Allowance = 369,000 Bt Overhead = 255,600 Bt 3,450,600 Bt	3,451	3,451	3,451	3,451	3,451	3,451	3,451	3,451	3,451	3,451
	Security cost	90,000 Bt/Person x 5 p. = 450,000 Bt	450	450	450	450	450	450	450	450	450	450
	Sub total		5,129	5,129	5,129	5,129	5,129	5,129	5,129	5,129	5,129	5,129
MAINTENANCE COST	Overlaying	(64,960 + 10,500) x 1/2 = 37,730m2 200Bt/m2 x 37,730m2 =7,546,000 Bt		7,546		7,546		7,546		7,546		7,546
	Cleaning/ Sweeping	4 Worker/D x 25D x 12M = 1,200 W 180Bt/w x 1,200 w = 216,000 Bt	216	216	216	216	216	216	216	216	216	216
	Re-Painting	(2,000+1,920+2,000+10,500)x0.5m2 = 8,210 m2 260Bt/m2 x 8,210m2 = 2,134,600 Bt					2,135					2,135
	Sub total		216	7,762	216	7,762	2,351	7,762	216	7,762	216	9,897
Grand total OM Cost VAT 7%			*5,720* 5,345 374	*13,794* 12,891 902	*5,720* 5,345 374	*13,794* 12,891 902	*8,004* 7,480 524	*13,794* 12,891 902	*5,720* 5,345 374	*13,794* 12,891 902	*5,720* 5,345 374	*16,078* 15,026 1,052

Table 9.4.4 Annual Investment (Case 1)

(unit: 1,000 Baht)

Items	1st. STAGE					2nd STAGE				Grand Total
	1992	1993	1994	1995	Sub total	1998	1999	2000	Sub Total	
A. Preparatory Works										
1. Engineering Works	7,551	37,754	0	0	45,305	0	0	0	0	45,305
2. Land Acquisition	0	0	0	0	0	0	0	0	0	0
Sub-total	7,551	37,754	0	0	45,305	0	0	0	0	45,305
B. Construction Works										
3. Earthworks	0	5,393	2,697	0	8,090	0	1,347	0	1,347	9,437
4. Drainage	0	0	7,584	0	7,584	0	5,689	0	5,689	13,273
5. Foundations	0	0	52,199	0	52,199	0	13,950	0	13,950	66,149
6. Paving	0	0	54,718	13,680	68,398	0	2,130	2,844	4,974	73,372
6.1 Apron & Parking (71,758&31,515m2)	(0)	(0)	(21,133)	(5,284)	(26,417)	(0)	(2,130)	(2,844)	(4,974)	(31,391)
6.2 Road (114,080 & 0 m2)	(0)	(0)	(33,585)	(8,396)	(41,981)	(0)	(0)	(0)	(0)	(41,981)
7. Platform	0	0	89,423	17,886	107,309	0	22,993	22,996	45,989	153,298
8. Buildings	0	0	54,000	10,800	64,800	0	8,100	8,100	16,200	81,000
8.1 Structure	(0)	(0)	(53,133)	(10,627)	(63,760)	(0)	(7,860)	(7,860)	(15,720)	(79,480)
8.2 Utilities	(0)	(0)	(867)	(173)	(1,040)	(0)	(240)	(240)	(480)	(1,520)
9. Warehouse & Lodging	0	0	21,582	4,318	25,900	0	0	0	0	25,900
10. Facilities	0	0	9,343	4,672	14,015	0	0	2,007	2,007	16,022
10.1 Electricity Sub-station	(0)	(0)	(1,333)	(667)	(2,000)	(0)	(0)	(0)	(0)	(2,000)
10.2 Other Facilities	(0)	(0)	(8,010)	(4,005)	(12,015)	(0)	(0)	(2,007)	(2,007)	(14,022)
11. Green Belt & Fence	0	0	0	9,206	9,206	0	0	0	0	9,206
12. Intersection	0	0	0	3,395	3,395	0	0	0	0	3,395
13. Marking, Signs & Miscellanuous	0	0	0	1,500	1,500	0	0	500	500	2,000
Sub-total	0	5,393	291,546	65,457	362,396	0	54,209	36,447	90,656	453,052
C. Supervision										
14. Supervision	0	270	14,577	3,273	18,120	0	2,710	2,551	5,261	23,381
D. Total (A to C)	7,551	43,417	306,123	68,730	425,821	0	56,919	38,998	95,917	521,738
E. Value Added Tax (7 % of D)	529	3,039	21,429	4,811	29,807	0	3,984	2,730	6,714	36,522
F. Grand Total (D + E)	8,080	46,456	327,552	73,541	455,628	0	60,903	41,728	102,631	558,260
G. Accumulative Figures (%)	2%	12%	84%	100%	-	0%	59%	100%	-	-

Table 9.4.5 Annual Investment (Case 2-1)

(unit: 1,000 Baht)

Items	1992	1993	1994	1995	Total
A. Preparatory Works					
1. Engineering Works	5,533	27,663	0	0	33,196
2. Land Acquisition	0	0	0	0	0
Sub-total	5,533	27,663	0	0	33,196
B. Construction Works					
3. Earthworks	0	5,072	2,536	0	7,608
4. Drainage	0	0	10,088	0	10,088
5. Foundations	0	0	45,880	0	45,880
6. Paving	0	0	48,818	12,206	61,024
7.1 Apron & Parking (23,355 m2)	(0)	(0)	(18,563)	(4,641)	(23,204)
7.2 Road (41,605 m2)	(0)	(0)	(30,255)	(7,565)	(37,820)
7. Platform	0	0	89,423	17,886	107,309
8. Buildings	0	0	46,500	9,300	55,800
9.1 Structure	(0)	(0)	(45,633)	(3,127)	(48,760)
9.2 Utilities	(0)	(0)	(867)	(173)	(1,040)
9. Warehouse & Lodging	0	0	13,750	2,750	16,500
10. Facilities	0	0	9,342	4,672	14,014
11.1 Electricity Sub-station	(0)	(0)	(1,333)	(667)	(2,000)
11.2 Other Facilities	(0)	(0)	(8,009)	(4,005)	(12,014)
11. Green Belt & Fence	0	0	0	8,339	8,339
12. Intersection	0	0	0	3,395	3,395
13. Marking, Signs & Miscellanuous	0	0	0	2,000	2,000
Sub-total	0	5,072	266,337	60,548	331,957
C. Supervision					
14. Supervision	0	254	13,317	3,027	16,598
D. Total (A to D)	5,533	32,989	279,654	63,575	381,751
E. Value Added Tax (7 % of E)	387	2,309	19,576	4,450	26,723
F. Grand Total (E + F)	5,920	35,298	299,230	68,025	408,474
G. Accumulative Figures (%)	1%	10%	83%	100%	-

Table 9.4.6 Annual Investment (Case 2-2)

(unit; 1,000 Baht)

Items	1998	1999	2000	Total
A. Preparatory Works				
1. Engineering Works	15,634	0	0	15,634
2. Land Acquisition	0	0	0	0
Sub-total	15,634	0	0	15,634
B. Construction Works				
3. Earthworks	0	3,181	0	3,181
4. Drainage	0	4,081	0	4,081
5. Foundations	0	23,556	0	23,556
6. Paving	0	10,245	13,660	23,905
6.1 Apron & Parking (23,355 m2)	(0)	(3,683)	(4,911)	(8,594)
6.2 Road (41,605 m2)	(0)	(6,562)	(8,749)	(15,311)
7. Platform	0	22,993	22,996	45,989
8. Buildings	0	13,500	13,500	27,000
8.1 Structure	(0)	(13,260)	(13,260)	(26,520)
8.2 Utilities	(0)	(240)	(240)	(480)
9. Warehouse & Lodging	0	5,900	5,900	11,800
10. Facilities	0	0	7,507	7,507
10.1 Electricity Sub-station	(0)	(0)	(1,000)	(1,000)
10.2 Other Facilities	(0)	(0)	(6,507)	(6,507)
11. Green Belt & Fence	0	0	5,279	5,279
12. Intersection	0	0	3,041	3,041
13. Marking, Signs & Miscellanuous	0	0	1,000	1,000
Sub-total	0	83,456	72,883	156,339
C. Supervision				
14. Supervision	0	4,173	3,644	7,817
D. Total (A to C)	15,634	87,629	76,527	179,790
E. Value Added Tax (7 % of E)	1,094	6,134	5,357	12,585
F. Grand Total (E + F)	16,728	93,763	81,884	192,375
G. Accumulative Figures (%)	9%	57%	100%	-

CHAPTER 10

ECONOMIC EVALUATION

CHAPTER 10 ECONOMIC EVALUATION

10.1 General

10.1.1 Effects of Truck Terminal

The effect accruing to tangible and intangible effects were analysed. In addition, a sensitivity analysis was performed for the factors most influential to the project's feasibility.

Table 10.1.1 compares the condition of transporting general cargoes "with" and "without" truck terminals and summarizes the effects of the terminals.

In brief, implementation of truck terminals will bring about:

A. Reduction of turn-around time of the line-haul truck.

B. Effective material handling for loading, unloading and sorting cargoes.

C. Traffic congestion relief in the urban area and a contribution to the promotion of urban renewals.

D. Higher level of transport services in scheduled operation of line-haul trucks and delivery trucks.

E. Centralization of transport demand and supply information for quick response to customers' orders.

F. Increase not only in the productivity of cargo transport but also in the quality of transport services, and eventual increase in the value of the trucking industry.

G. Modernization of the management of the trucking industry and working conditions of drivers and assistants, which may largely contribute to the increase in tax revenues and workers' welfare, and the decline in traffic accidents.

H. Significant steps toward establishment of an industrialized country.

Table 10.1.1 Effects of Truck Terminal

<Collection (from Consignor to Terminal)>

"Without" Truck Terminal	"With" Truck Terminal	Effects of Truck Terminal
- General cargo at less than truck load is brought to a private terminal by consignor's truck. - General cargo at full truck load is brought to a private terminal by forwarder's 10-wheel truck.	- Delivery districts and routes are fixed precedingly for collecting general cargos from scattered consignors with various volumes of packages. To make this operation more efficient, sub-depots located at a walking distance from expected consignors are preferable particularly for collecting small packages from various consignors. Retail shops and supermarkets with small space for storing consignor's packages are often utilized as sub-depots. - Scheduled operation of the cargo collection is possible from scattered consignors and regular customers such as wholesalers and manufacturers.	- Consolidation of small-scale forwarders at the terminal means to consolidate the small transport demand of each forwarder to form a large demand volume. - This enables delivery trucks to operate efficiently and save on operating costs per cargo ton carried. - Compared with the cargo delivery to the terminal by each consignor, the collection system provided by the truck terminal will reduce the total delivery distance between consignors and the terminal. - Scheduled operation of the cargo collection will ensure the scheduled shipment from customers even with small volumes. - Consignors can avoid having to arrange delivery trucks by themselves.

<Cargo Handling (Collection - Line-hauling)>

"Without" Truck Terminal	"With" Truck Terminal	Effects of Truck Terminal
- A light truck sent from a consignor stops at the roadside of a forwarder's shophouse for unloading, and a 10-wheel truck for the line-haul also parks at the roadside for loading. These are often impediments to general road traffic and pedestrians. - Generally, the loading and unloading of cargoes to/from trucks involves vertical motion of goods, and this can causes damage to cargoes if they fall, thus reducing handling efficiency.	- The premises of the truck terminals are isolated from general traffic. - The loading and unloading of cargoes to/from trucks is usually carried out at a flat level between the truck and terminal platform.	- The truck terminal will contribute to eliminating traffic congestion which may take place along the roadside of the forwarder's shophouse during loading and unloading. - Cargo movement at a flat level between the truck and platform will reduce the likelihood of cargo damage and increase the efficiency of cargo handling.

<Line-hauling>

"Without" Truck Terminal	"With" Truck Terminal	Effects of Truck Terminal
- Line-haul trucks may not operate in a city area during the restricted hours. Therefore, 10-wheel trucks which arrive at the city at a restricted hour have to wait at the city boundary until the restriction is lifted, and, similarly, those which are leaving the city cannot operate during the restricted hours. - The return-haul trucks are not necessarily carrying cargoes. Generally, a branch office or an agent of the forwarder in Bangkok does not take care of the return-haul cargoes. Therefore, trucks have to spend some time looking for return-haul cargoes, otherwise they have to return empty to Bangkok.	- A truck terminal is planned to be located outside of the city area. Therefore, it is free from restricted hours of heavy truck operation. - The consideration of small-scale forwarders and truckers will enlarge the capacity of line-haul services with various destinations. The information concerning the cargo transport supply and demand is integrated in the terminal.	- A scheduled operation of line-haul trucks becomes possible. - Transport services will be improved in punctuality, speed and safety. - A higher level of transport services will induce the development of industries. - Large scale cargo transport service can absorb the fluctuation of transport demand and respond to customers' need for flexibility. - Proper management of information and customer's orders will reduce instances of empty truck operation and decrease turn-around times.

<Handling (Line-hauling, Delivery)>

"Without" Truck Terminal	"With" Truck Terminal	Effects of Truck Terminal
- Cargo loading and unloading is carried out at the roadside in front of the forwarder's shophouse. This may cause traffic congestion in the immediate area. - General cargoes are unloaded from the 10-wheel truck and sorted for each destination district on the roadside and loaded onto light trucks for delivery in the city area. - Cargo handling requires vertical motion for loading and unloading. This may cause damage to cargoes by accidental mis-handling.	- The truck terminal has its own premises and the cargo handling is performed at a flat level between the truck and platform. - All the general cargoes carried by the line-haul truck are unloaded and sorted for each destination district on the platform and loaded onto delivery trucks. - The loading and unloading of cargoes is mostly horizontal, increasing the case with which to handle the cargoes.	- The truck terminal will reduce the operation of heavy trucks in the city area and contribute to the dispursement of traffic generating facilities outside of the city. - The efficiency of cargo handling will increase, and the likelihood of damage to cargoes will decrease.

<Delivery (from Terminal to Consignees)>

"Without" Truck Terminal	"With" Truck Terminal	Effects of Truck Terminal
- A branch office or agent prepares delivery trucks to distribute the general cargoes transported by line-haul trucks, after they are sorted for respective destination districts. - Line-haul trucks are used for delivering cargoes to final destinations, unless return-haul cargoes are ready for transport.	- Delivery trucks start operation in the morning and distribute the cargoes, which have been previously sorted by direction, to consignees. - Line-haul trucks in principle are not used for cargo delivery in the city.	- Effective use of delivery trucks becomes possible, because of the increase in cargo handling volume at the consolidated place (truck terminal) of small-scale forwarders. - Cargoes can be delivered by light trucks. The use of heavy trucks for cargo delivery involves a higher operation costs.

10.1.2 Study Cases

The implementation schedule of the projects was assumed to begin with the final engineering in 1992 and the terminal operation in 2000. There is a ramification for the construction of 500 trucking terminal berths. One method is to construct 350 berths at the first stage and construct an additional 150 berths at the same site in the second stage (Case 1). The second method is to construct the remaining 150 berths at another site in the second stage. As for the latter case, two types of economic analysis can be performed. One is to analyze the two truck terminal constructions as one integrated project, and the second is to analyze each truck terminal project individually.

Consequently, four cases were determined for the economic analysis in this study.

Case 1 Land for 500 berths in one truck terminal will be acquired. Construction stages are segmented into two stages.

First stage :	350 berths
	operation starts in 1995
Second stage :	150 berths
	operation starts in 2000

Case 2-1 First, a truck terminal with 350 berths will be constructed and operation will start in 1995.

This truck terminal will be analysed as an independent case.

Case 2-2 The remaining 150 berths will be constructed in a different place from the first terminal (with 350 berths) and operation will start in 2000.

This truck terminal will also be analyzed as an independent case.

Case 3 Land for a 350 berth truck terminal will be acquired and the terminal will be constructed with operation starting in 1995. The remaining 150 berths will be constructed in a different place from the first terminal (with 350 berths) and operation will start in 2000.

10.2 Economic Benefit

10.2.1 Types of Benefit

Among the effects of truck terminals enumerated in the preceding section, the measurement of economic benefits was attempted for :

A. the effective use of line-haul trucks
B. the effective cargo handling for loading/unloading and sorting general cargoes by direction
C. the relief of traffic congestion.
D. negative effects

A. Effective Use of Line-haul Trucks

The benefits quantified from the efficiency of the line-haul operation comprise the following two elements:

1. The first is the reduction of turn-around times of line-haul trucks. This produces an extensive operation of line-haul trucks per unit period (year) and saves the fixed cost of truck operation per km.

2. The second is the reduction of idle time under the existing traffic restriction. Truck terminals are designed to be located out of the traffic restriction area for effective truck operation. This reduces the idle time accrued to line-haul trucks in the "without" terminal category.

B. Effective Cargo Handling

Greater efficiency in cargo handling can be expected for all the general cargoes loaded and unloaded at the project terminals, regardless of their origins or destinations.

C. Relief of Traffic Congestion.

The benefit of traffic congestion relief as a result of truck terminal implementation comprises the following two elements:

1. The first is the reduction of trip lengths of collection/delivery trucks. Under the "with" situation, assuming three truck terminals, the distance travelled by the collection and delivery trucks will be one third that of the "without" situation.

2. The second is the reduction of truck trips. The effective use of collection and delivery trucks, such as collection and delivery by the same truck to and from the truck terminal, will bring about the reduction of truck trips in Bangkok.

D. Negative Effects

The effects of truck terminals mentioned above are positive benefits. However, the terminal can also bring about negative benefits unless countermeasures are taken. A major factor which can cause negative benefits is the longer distance between consignors/consignees and the terminal berth would be located in the outskirts of the city area.

The increase in travel distance of delivery trucks between consignors/consignees entails additional truck operating costs, but on the other hand, the relatively smaller territory of delivery and collection under the "with" situation can work to reduce the truck operating costs. It was ascertained whether or not the two factors offset each other in this study, and the results show that they almost offset each other.

In order to overcome the negative effects of the terminal it is imperative to operate the delivery trucks as efficiently as possible. Measures to be taken for this are as follows:

1. Collecting Cargoes:

The existing cargo collecting system usually involves the sending of cargo to a forwarder's shop house by the consignor himself. This system is not economical when the demand for forwarders increases. Therefore, the system should be changed to enhance the efficiency of collecting cargoes from consignors to the terminal as follows:

a) to dispatch a delivery truck to consignors from the terminal and collect cargoes up to the carrying capacity.

b) to consolidate small-scale forwarders to obtain scale benefits and to reduce the idle capacity of delivery trucks.

c) allocate a service area to each group of consolidated forwarders so as to raise the density of customers for each group and eventually reduce the collecting distance and costs.

2. Distribution Cargoes:

The existing cargo distribution system usually consists of a transfer of the cargo from a line-haul truck to delivery trucks in front of the forwarder's shop house. The line-haul truck is also involved in the distribution service with the delivery trucks.

In the new system, the line-haul truck should not be used for delivery services but specifically for terminal to terminal transport. In order to recover the loss derived from the outlying terminal, efficient use of delivery trucks for cargo distribution and collection indispensable. Therefore, the terminal system should incorporate the following improvements:

a) to consolidate small-scale forwarders so as to increase the efficiency of truck operations.
b) to collaborate on distribution services with the consolidated forwarder groups and assign service areas to them.

A study was undertaken to ensure the above consequences, and it was intended that benefits would be quantified under "with" and "without" truck terminal situations. Because of the lack of data and information, a simplification was made using some geometric models and assumptions.

10.2.2 Line-Haul Truck Operating Cost Savings

A. Fixed Cost Savings in 10-Wheel Truck Operation.

The economic benefit derived from savings in idle times of truck operations is highly related to the truck utilization rate, that is the reduction of the number of trucks required for the future transport demand.

B. Idle Time Cost Saving in 10-wheel Truck Operation.

The period of existing traffic restriction for 10-wheel trucks is 6:00 - 10:00 in the morning and 15:00 - 21:00 in the afternoon and evening. Under this circumstance heavy truck adjusts its operation by avoiding travel in the restriction period. Assuming the ordinary working time 8:00 - 18:00, it was surmised that the adjustment of line-haul truck operations was taken at the loading/unloading places, roadsides and some other places for the period of time 8:00 - 10:00 and 15:00 - 18:00.

The average idle time of line-haul truck operations was conservatively estimated at 1 hour for inbound trips and 1.5 hours for outbound trips. The average number of drivers per heavy truck was assumed to be 1.5 persons, based on the results of interviews with forwarders and a field survey. Taking the above assumptions as the typical case for the line-haul operation of a 10-wheel truck of "without" truck terminal situation, the idle time costs were calculated.

Accordingly, assumptions were made for the annual operation distance of line-haul trucks based on the review of "Study of Trucking Industry : Phase II, 1987", results of interviews with forwarders in Bangkok, and analysis of a truck operation diagram of the project terminal.

In the existing situation, the round trip for a distance of up to 600km takes, on the average, 4 days or requires 6-7 trips per working month of 26 days.

According to the statistics of Department of Land Transport (DLT), it was estimated that the average trip distance weighted by volume is about 300 km. So the average round trip distance of heavy trucks becomes 600 km.

A reduction of the idle time per one round trip caused by the existing traffic restriction is estimated to be at least 2.5 hours. Also, the curtailment of the trip time caused by excluding the portion of the trip between the outskirts of Bangkok and the inner city is estimated at 2 hours. Totally, 4.5 hours of reduced travel time per round trip will extend the truck's operating distance to 850 km per round trip assuming the average speed to be 55 km per hour.

Taking the above two models as the typical cases for the line-haul operation of a 10-wheel truck for the "without" truck terminal situation, the fixed capital costs were calculated with several assumptions as shown in Table 10.2.1.

The benefit from the curtailment of line-haul truck's fixed cost in 1995 is calculated as follows:

Total operating distance of heavy truck:
(59,816 trips (inbound) + 137,569 (trips) (outbound)) x 314 km/trip
= 62,070,000 km

Saving in Line-haul truck 's fixed operation cost:
62,070,000 km/trip x 0.917 Baht/km = 44,629,000 Baht

Table 10.2.1 Comparison of Fixed Costs of 10-Wheel Truck For "With" and "Without" Situations

Particulars	"Without" Truck Terminal	"With" Truck Terminal
(1) Annual Capital Cost:		
a) Vehicle Cost (Economic) including Tyres (B) :	900,000	900,000
b) Annual Kilometrs (km) :	85,000	120,000
c) Truck Service Life (year) :	12	8
d) Interest Rate (% p.a.) :	12	12
e) Salvage Value (10% of a)) :	90,000	90,000

Note : Equation to derive annual capital cost (B/year):

$$A = (P \times CR) - (L \times SF)$$

where, A = annual capital cost
P = economic value of vehicle
L = salvage value of vehicle
CR = capital recovery factor
SF = sinking fund factor

Capital Recovery Factor and Sinking Fund Factor are defined as follows:

$$CR = \frac{i(1+i)^n}{(1+i)^n - 1}$$

$$SF = \frac{i}{(1+i)^n - 1}$$

where, i = annual rate of interest
n = estimated service life of vehicle

Annual Capital Cost (B/year) :	141,564	173,855
(2) Other Fixed Costs (B/year) :		
f) Basic Salaries:		
Driver	66,000	66,000
Assistant	36,000	36,000
Sub-total	102,000	102,000
g) Allowance	32,600	39,100
h) Overhead	53,800	64,600
Other Fixed Costs (B/year) :	188,400	205,700
(3) Fixed Costs: (1)+(2) (B/year)	329,964	379,555
(B/km)	3,882	3,163
(4) Saving in Fixed Costs (B/km) :	0.719	

The benefit from the time saving of line-haul truck in 1995 is calculated as follows:

Total duration of time:
(59,816 trips (inbound) x 1.0 hour/trips) + (137,569 trips (outbound) x 1.5 hours/trip)
= 266,169 hours

Time saving of line-haul truck operation:
266,169 hour/year x 52.95 Baht/hour(labor cost saving)
= 14,094,000 Baht

10.2.3 Handling Cost Savings

The use of a platform in the terminal is expected to improve the efficiency of cargo handling and to increase cargo handling capacity.

To determine the improvement of handling efficiency, the quantities of work were compared between "with project" case and "without project" case. Table 10.2.2. shows the results.

Table 10.2.2 Comparison of the Quantities of Work

"Without Project" Case	"With Project" Case
- horizontal movement l=5m coefficient of friction k=0.1 - vertical movement up l=1.5m down l=1.5m coefficient of friction k=0.5	- horizontal movement l=20m coefficient of friction k=0.1 - vertical movement l=0m
J=Wx5x0.1+Wx1.5+Wx1.5x0.5 =2.75W	J=Wx20x0.1 =2W

Based on the above assumptions and the results of the interview survey, the improvement of the handling efficiency was estimated at 25%. The number of laborers required for a 10-wheel truck-load averages about 8 persons at present, and it was assumed that the improvement of handling efficiency would result in a decline to 6 persons.

10.2.4 Congestion Cost Savings

The marginal social cost of road use in metropolitan Bangkok consists principally of congestion costs, namely the costs that road users impose upon other road users by adding their vehicles to the stream of traffic and thereby increasing delay. If the marginal costs of the traffic congestion were estimated, benefits from traffic congestion relief could easily be calculated.

Based on this concept traffic congestion relief benefits were estimated with the results of the "The Survey of Urban Transport Costs and Fares in SEATAC Region, Phase I, 1990" in this study. The marginal cost of congestion was estimated by comparing the change in vehicle operating and travel time costs with the change in pcu-kilometers shown in Table 10.2.3.

Table 10.2.3 Congestion Cost

		Congestion Cost	Road Damage Cost	Bus Subsidy Cost	Total Cost
Light Truck(good)	Morning Peak	18.02	0.00	0.00	18.02
	E vening Peak	13.35	0.00	0.00	13.35
	Off Peak	9.88	0.00	0.00	9.88
	Representative Cost				10.96
Medium Truck	Morning Peak	27.02	0.10	0.00	27.12
	E vening Peak	20.02	0.10	0.00	20.12
	Off Peak	14.83	0.10	0.00	14.93
	Representative Cost				16.54
Heavy Truck	Morning Peak	45.04	0.25	0.00	45.29
	E vening Peak	33.37	0.25	0.00	33.62
	Off Peak	24.71	0.25	0.00	24.96
	Representative Cost				27.65

Source : The Survey of Urban Transport Costs and Fares in SEATAC Region, Phase I, 1990

A. Reduction of Truck Trips

The effective use of collection and delivery trucks such as collection and delivery by the same truck to and from the truck terminal will bring about the reduction of truck trips in Bangkok.

In the existing freight forwarding system, the consignor brings the cargoes to freight forwarder terminals, which are scattered throughout Central Bangkok. The Study Team's survey clarifies that the average number of forwarders' offices which the consignors' truck visits per one triop is two, and the consignors' truck returns to the consignor's office with empty load. Under the "with project" condition, the collection and delivery trucks are expected to operate very effectively. Although the immediate beneficiary is not specified because of the uncertainty of the participants, social congestion cost savings can be estimated. The average reduction of collection/delivery truck trips per 10.5 tons (= the average cargo volume of a heavy truck) was estimated at 0.11 trip/10.5 tons in Chapter 6.

The benefit accruing to a reduction of truck trips for cargo collection in 1995 is calculated as follow:

Curtail trip/ year:
1,444,472 ton (outbound) x 0.055 trip/ton = 79,446 trip.

Total curtailed trip length:
79,446 ton x 4 km/trip = 317,984 km

Benefit of congestion relief:
317,984 km x 16.54 Baht/trip.km (marginal social cost of medium truck) = 5,257,000 Baht.

The effect of the trip reduction for cargo delivery was not taken as the benefit attributable to the truck terminal because of the diversity of its delivery system. Thus the results are conservative in the benefit calculation of this feasibility analysis.

B. Curtailment of Trip Lengths of Collection/Delivery Trucks.

Under the "with" situation assuming three truck terminals, the distance travelled by the collection and delivery trucks will be reduced. This reduction in average trip length will produce a traffic congestion costs savings.

The average trip length under the "with" situation can be estimated using the following numerical expression.

$$L(w)=L(w/o)x(A(w)/A(w/o))$$

where,

L(w):	average trip length in case of "with truck terminal"
L(w/o):	average trip length in case of "without truck terminal"
A(w):	delivery/collection area in case of "with truck terminal"
A(w/o):	delivery/collection area in case of "without truck terminal"

The average trip length of light trucks in Bangkok is assumed to be 4 km based on the results of "The Study on Medium to Long-term Improvement/Management Plan of Road and Transport in Bangkok, 1990"(JICA). Thus the benefit of reduced trip lengths was calculated. The estimated future congestion cost savings per 10.5 ton which is the average volume of a heavy truck in 1995, is shown in Table 10.2.4.

The benefit from reduction of trip length in 1995 is calculated as follows:

(59,816 trips (inbound) + 137,569 trips (outbound)) x 118.48 Baht/trip
= 23,386,000 Baht

Table 10.2.4 Congestion Cost Saving per the Volume of Heavy Truck

		without Truck Terminal		with Truck Terminal	
	Marginal Social Cost per Vehicle-km (baht/kmveh.)	Trip Length (km/10.5t)	Marginal Social cost (baht/10.5t)	Trip Length (km/10.5t)	Marginal Social cost (baht/10.5t)
Light Truck	13.34	80 20 trip x4km/trip	1067.20	-	-
Medium Truck	20.14	-	-	97.26 3 trip x20km/trip 16.13trip x2.31km/trip	1958.82
Heavy Truck	33.67	30	1010.10	-	-
Total			2077.30		1958.82
Benefit of Truck Terminal					118.48 baht/10.5t

10.2.5 Benefit Estimates

Savings in operation costs of the 10-wheel line-haul truck and the savings in cargo handling costs were analysed by comparing "without" and "with" truck terminal situations. Also, savings in traffic congestion costs were analyzed in a similar manner using marginal social congestion costs.

The economic benefits, therefore, were based on the above results and the estimated future tonnage to be handled at the truck terminal.

The economic benefits of the terminal have been estimated for the target years from 1995 to 2015, the terminating year of the project life of 20 years.

The summary of these benefits is presented in Table 10.2.5. The composition of each economic benefit item at the year 2000 is shown in Fig. 10.2.1.

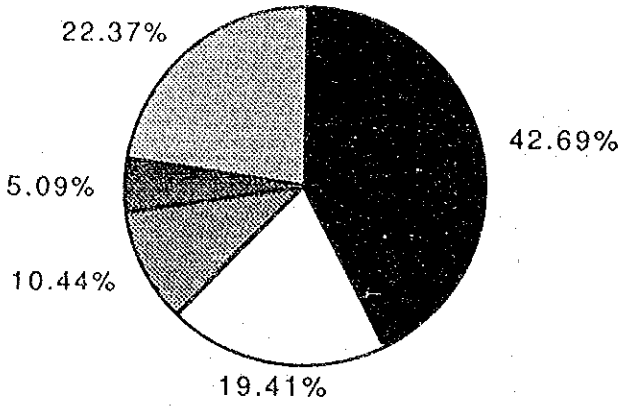
Table 10.2.5 Total Benefits of Truck Terminal

(unit : 1,000 Baht)

Year	Savings in Line-Haul Truck Operation Costs (Reduction of Fixed Costs of Heavy Truck)	Savings in Line-Haul Truck Operation Costs (Reduction of Waiting Times)	Savings in Handling Costs	Congestion Relief Benefit (Reduction of Truck Trips)	Congestion Relief Benefit (Reduction of Trip Lengths)	Total Benefits
1992	0	0	0	0	0	0
1993	0	0	0	0	0	0
1994	0	0	0	0	0	0
1995	44,629	14,094	7,600	5,257	23,386	94,965
1996	48,272	16,578	8,936	5,698	25,296	104,779
1997	51,301	19,161	10,321	6,071	26,883	113,736
1998	54,518	21,744	11,705	6,468	28,568	123,003
1999	57,935	24,674	13,274	6,891	30,359	133,133
2000	61,565	27,999	15,053	7,342	32,261	144,219
2001	63,502	30,814	16,571	7,566	33,276	151,728
2002	65,499	32,845	17,666	7,797	34,323	158,131
2003	67,560	35,010	18,834	8,036	35,403	164,843
2004	69,685	37,316	20,080	8,281	36,516	171,879
2005	71,878	39,779	21,408	8,534	37,665	179,265
2006	74,140	42,399	22,826	8,795	38,850	187,010
2007	76,473	45,198	24,337	9,064	40,073	195,145
2008	78,879	48,179	25,948	9,341	41,334	203,682
2009	81,362	51,355	27,666	9,627	42,635	212,645
2010	83,923	54,743	29,498	9,921	43,977	222,061
2011	86,564	58,359	31,453	10,224	45,361	231,961
2012	89,289	62,213	33,537	10,537	46,789	242,364
2013	92,100	66,321	35,759	10,859	48,262	253,300
2014	94,999	70,699	38,129	11,191	49,781	264,799
2015	97,990	75,368	40,655	11,533	51,348	276,894

(unit : 1,000 Baht)

Economic Benefit Accruing to the Trucking Companies	(%)	Economic Benefit Accruing to the National Economy	(%)
0		0	
0		0	
0		0	
66,322	(69.8%)	28,643	(30.2%)
73,786	(70.4%)	30,993	(29.6%)
80,783	(71.0%)	32,953	(29.0%)
87,967	(71.5%)	35,036	(28.5%)
95,883	(72.0%)	37,250	(28.0%)
104,616	(72.5%)	39,603	(27.5%)
110,886	(73.1%)	40,842	(26.9%)
116,011	(73.4%)	42,120	(26.6%)
121,405	(73.6%)	43,438	(26.4%)
127,082	(73.9%)	44,798	(26.1%)
133,065	(74.2%)	46,200	(25.8%)
139,364	(74.5%)	47,646	(25.5%)
146,008	(74.8%)	49,137	(25.2%)
153,006	(75.1%)	50,675	(24.9%)
160,383	(75.4%)	52,262	(24.6%)
168,164	(75.7%)	53,898	(24.3%)
176,376	(76.0%)	55,585	(24.0%)
185,038	(76.3%)	57,325	(23.7%)
194,180	(76.7%)	59,120	(23.3%)
203,827	(77.0%)	60,972	(23.0%)
214,013	(77.3%)	62,881	(22.7%)



Legend:

42.69%:	Saving in Line-haul Truck Operation Cost (Curtailment of Fixed Cost)
19.41%:	Saving in Line-haul Truck Operation Cost (Reduction of Waiting Time)
10.41%:	Saving in Handling Cost
5.09%:	Congestion Relieving Cost (Curtailment of Truck Trips)
22.37%:	Congestion Relieving Cost (Reduction of Trip Length)

Fig. 10.2.1 Composition of Economic Benefits by Item

10.3 Economic Cost

10.3.1 Construction Cost

Table 10.3.1 shows the economic cost in comparison with the financial cost.

Table 10.3.1 Comparison of Economic and Financial Costs

	Economic Cost (million Baht)	Per Cent against Financial Cost (%)
Case 1	626.4	65%
Case 2-1	468.0	64%
Case 2-2	217.8	65%
Case 3	685.8	64%

A unit price was established for each construction item using basic cost elements such as labour, materials, equipment, overhead, profit, etc.

An implementation schedule was assumed to begin with the detailed engineering in 1992 and operation in 1995 for each case. Based on these implementation schedules, the disbursement programs detailed in Chapter 9 were assumed. Table 10.3.2 shows the case setting.

Table 10.3.2 Case Setting

	1995	2000
Case 1	Operation commencement of 350 berth truck terminal	Operation commencement of additional 150 berth truck terminal (expansion of facilities within same site)
Case 2-1	Operation commencement of 350 berth truck terminal	
Case 2-2		Operation commencement of 150 berth truck terminal (establishment of new truck terminal)
Case 3	Operation commencement of 350 berth truck terminal	Operation commencement of 150 berth truck terminal (establishment of new truck terminal)

The economic costs were computed under the economic conditions prevailing in 1992.

Economic construction costs were obtained from information in the DOH report where conversion factors had been determined on the basis of past studies.

According to this information, conversion factors for eliminating the tax portion of the costs were determined for each work item of this study. Also, no price distortion factors were applied to labour costs because of the apparent excessive supply to unskilled labours market in Thailand. Therefore, economic labour cost is the same as the financial labour cost. The municipal tax rate of 3.3% was applied to the economic cost of supervision. Applied conversion factors are shown as follow:

Item		Conversion Ratio
	:	16%
Engineering works		
Earth works	:	13%
Drainage	:	16%
Foundation	:	10%
Paving	:	10%
Platform	:	16%
Building	:	16%
Warehouse & Lodging	:	16%
Facilities	:	16%
Green Belt	:	13%
Intersection	:	16%
Marking, Signs, & Miscellaneous	:	13%
Supervision	:	3%

The economic cost of land acquisition for the proposed truck terminal was calculated according to the rent charge of the warehouse obtained from the supplementary survey. It assumes the substitutive land use is for factory or warehouse. This assumption is the most possible land use at the spot concerned judging from the existing conditions of land use near the candidate area. To estimate the economic cost in view of marginal productivity of land, the following steps were taken.

A. subtraction of value added-tax portion from the rent fee
B. estimation of the present total value with a long-term interest rate of 12%
C. subtraction of building and facilities costs from the total present value
D. adjustment of economic land acquisition cost compared with the land conditions

Table 10.3.3. shows how the economic land price is set.

Table 10.3.3 Estimation of Economic Land Price

	Estimation of economic land price	
1.	conditions of warehouse (per unit):	
	floor space	880m^2
	size of land	1,250m^2
	rent fee	756,500 Baht/year
2.	facilities and operation cost:	667,500 Baht/year
3.	profit	89,000 Baht/year
4.	profit without tax	83,178 Baht/year
5.	present value of iii) over the whole project life	744,554 Baht/year
6.	present unit value	744,554 Baht/1,250 m^2 = 596 Baht/m^2 (=2,384 Baht/wah^2)
7.	land price of 176.9 rai (for 500 berth)	168.6 million Baht/176.9 rai

10.3.2 Operation and Management Costs

The estimates of operation and maintenance costs for the proposed truck terminal are based on the concept of basic management services, which will provide water, electric power, security service, general administration, and the physical maintenance of internal roads, parking and buildings.

Conversion factor into the economic cost was set at the average conversion rate (15%).

10.4 Evaluation

Based on the estimated economic cost and benefit flows, the comparison was made by using such methods as the Net Present Value (NPV), Benefit/Cost Ratio (B/C) and Internal Rate of Return (IRR) for the respective study cases.

A discount rate of 12% was applied to produce the NPV and B/C ratios.

The residual value of the land was considered not to be added in the last year of the project life span as a minus cost element.

The results of the above cost and benefit analysis were summarized in Table 10.4.1, and the details are presented in Tables 10.4.2 through 10.4.5.

Table 10.4.1 Economic Indicators of Study Cases

	IRR (%)	NPV (unit:1000 Baht)	B/C
Case 1	17.39	249,732	1.60
Case 2-1	15.60	131,409	1.28
Case 2-2	16.7	36,196	1.30
Case 3	20.24	316,946	1.54

From the summary of cost and benefit flows for the economic internal rate of return (IRR), the following results were found :

Finding 1. Every case shows IRR higher than 12% of opportunity cost of capital, and proves to be feasible.

Finding 2. It is better to construct first 350 berths at one site and next 150 berths at a different site (Case 3), than to construct them at the same site in the years 1995 and 2000 (Case 1).

This is attributable to the timing of land acquisition of 150 berths, which is planned at five years after the first land acquisition for 350 berths. In other word, Case 1 is enforced to invest excessively to the land that will not generate any economic benefit for five years.

Table 10.4.2 Cost and Benefit Flows for Economic Evaluation (Case 1)

(unit ; 1,000 Baht)

Year	Costs			Benefit	Balance
	Investment	Operation & Maintenance Cost	Total		
1992	6,578	0	6,578	0	-6,578
1993	214,975	0	214,975	0	-214,975
1994	261,355	0	261,355	0	-261,355
1995	62,255	0	62,255		-62,255
1996	0	7,165	7,165	104,779	97,614
1997	0	25,046	25,046	113,736	88,690
1998	0	7,165	7,165	123,003	115,838
1999	47,013	25,046	72,059	133,133	61,074
2000	34,191	11,229	45,420	144,219	98,799
2001	0	27,534	27,534	151,728	124,194
2002	0	11,694	11,694	158,131	146,437
2003	0	27,534	27,534	164,843	137,309
2004	0	11,694	11,694	171,879	160,185
2005	0	32,768	32,768	179,265	146,497
2006	0	27,534	27,534	187,010	159,476
2007	0	11,694	11,694	195,145	183,451
2008	0	27,534	27,534	203,682	176,148
2009	0	11,694	11,694	212,645	200,951
2010	0	32,768	32,768	222,061	189,293
2011	0	27,534	27,534	231,961	204,427
2012	0	11,694	11,694	242,364	230,670
2013	0	27,534	27,534	253,300	225,766
2014	0	11,694	11,694	264,799	253,105
2015	0	32,768	32,768	276,894	244,126

NPV =	249,732
B/C ratio =	1.60
IRR =	17.39%

Table 10.4.3 Cost and Benefit Flows for Economic Evaluation (Case 2-1)

(unit ; 1,000 Baht)

Year	Costs			Benefit	Balance
	Investment	Operation & Maintenance Cost	Total		
1992	4,813	0	4,813	0	-4,813
1993	172,922	0	172,922	0	-172,922
1994	238,025	0	238,025	0	-238,025
1995	52,279	0	52,279	16,619	-35,660
1996	0	7,166	7,166	73,345	66,179
1997	0	22,153	22,153	79,615	57,462
1998	0	7,165	7,165	86,102	78,937
1999	0	22,153	22,153	93,193	71,040
2000	0	10,778	10,778	100,953	90,175
2001	0	22,153	22,153	106,210	84,057
2002	0	7,165	7,165	110,692	103,527
2003	0	22,153	22,153	115,390	93,237
2004	0	7,166	7,166	120,316	113,150
2005	0	25,766	25,766	125,485	99,719
2006	0	7,165	7,165	130,907	123,742
2007	0	22,153	22,153	136,602	114,449
2008	0	7,166	7,166	142,577	135,411
2009	0	22,153	22,153	148,851	126,698
2010	0	10,778	10,778	155,443	144,665
2011	0	22,153	22,153	162,373	140,220
2012	0	7,165	7,165	169,655	162,490
2013	0	22,153	22,153	177,310	155,157
2014	0	7,166	7,166	185,359	178,193
2015	0	25,766	25,766	193,826	168,060
				NPV =	131,409
				B/C ratio =	1.28
				IRR =	15.60%

Table 10.4.4 Cost and Benefit Flows for Economic Evaluation (Case 2-2)

(unit ; 1,000 Baht)

Year	Costs			Benefit	Balance
	Investment	Operation & Maintenance Cost	Total		
1992	0	0	0	0	0
1993	0	0	0	0	0
1994	0	0	0	0	0
1995	0	0	0	0	0
1996	0	0	0	0	0
1997	0	0	0	0	0
1998	76,557	0	76,557	0	-76,557
1999	72,193	0	72,193	0	-72,193
2000	69,041	0	69,041	0	-69,041
2001	0	4,544	4,544	45,518	40,974
2002	0	10,958	10,958	47,439	36,481
2003	0	4,544	4,544	49,453	44,909
2004	0	10,958	10,958	51,564	40,606
2005	0	6,359	6,359	53,779	47,420
2006	0	10,958	10,958	56,103	45,145
2007	0	4,544	4,544	58,544	54,000
2008	0	10,958	10,958	61,105	50,147
2009	0	4,544	4,544	63,793	59,249
2010	0	12,773	12,773	66,618	53,845
2011	0	4,544	4,544	69,588	65,044
2012	0	10,958	10,958	72,709	61,751
2013	0	4,544	4,544	75,990	71,446
2014	0	10,958	10,958	79,440	68,482
2015	0	6,359	6,359	83,068	76,709

NPV =	36,196
B/C ratio =	1.30
IRR =	16.70%

Table 10.4.5 Cost and Benefit Flows for Economic Evaluation (Case 3)

(unit ; 1,000 Baht)

Year	Costs			Benefit	Balance
	Investment	Operation & Maintenance Cost	Total		
1992	4,813	0	4,813	0	-4,813
1993	172,922	0	172,922	0	-172,922
1994	238,025	0	238,025	0	-238,025
1995	52,279	0	52,279	94,965	42,686
1996	0	7,165	7,165	104,779	97,614
1997	0	22,153	22,153	113,736	91,583
1998	76,557	7,165	83,722	123,003	39,281
1999	72,193	22,153	94,346	133,133	38,787
2000	69,041	10,778	79,819	144,219	64,400
2001	0	26,697	26,697	151,728	125,031
2002	0	18,123	18,123	158,131	140,008
2003	0	26,697	26,697	164,843	138,146
2004	0	18,123	18,123	171,879	153,756
2005	0	32,125	32,125	179,265	147,140
2006	0	18,123	18,123	187,010	168,887
2007	0	26,697	26,697	195,145	168,448
2008	0	18,123	18,123	203,682	185,559
2009	0	28,900	26,697	212,645	185,948
2010	0	25,495	23,551	222,061	198,510
2011	0	25,495	26,697	231,961	205,264
2012	0	28,900	18,123	242,364	224,241
2013	0	19,619	26,697	253,300	226,603
2014	0	28,900	18,123	264,799	246,676
2015	0	19,619	32,125	276,894	244,769

NPV =	316,946
B/C ratio =	1.54
IRR =	20.24%

Finding 3. Each segment of the terminal project (Cases 2-1 and 2-2) proves to be feasible, however both show slightly lower IRRs than Cases 1 and 3.

The followings are the conclusions of the economic analysis:

A. It is concluded that the construction of two truck terminals (500 berths in total) at different places is more preferable than one truck terminal with 500 berths. Because the former proves more feasible, and each segment of the project shows sufficient level of IRR to justify the project.

B. The truck terminal with 500 at one site is recommended if the land acquisition in the year 1999 for the additional 150 berths is invalid, and if the land for additional terminal is available at far distant place from the urban area.

C. Without 350 berths terminal by 1995, the Thailand is to lose benefits such as saving in line-haul truck operation cost, congestion relieving benefit, saving of cargo handling cost, and other indirect effects. This is a great loss to the country.

10.5 Sensitivity Analysis

A sensitivity test was undertaken to ensure the feasibility of the truck terminal for a range of -20% and +20%, and other two extreme cases.

The results are expressed by IRRs corresponding to the above changes in costs and benefits as shown in Tables 10.5.1.

Table 10.5.1 Summary of Sensitivity Analysis

	+ 20%	+ 10%	Constant	- 10%	- 20%
Change in Cost Only	14.53%	15.87%	IRR = 17.39%	19.14%	21.19%
Change in Benefit Only	20.47%	18.97%		15.71%	13.92%
Case with 20% increase in cost and 20% decrease in benefit: IRR = 11.29%					

The following are the findings of the sensitivity analysis:

A. From the economic viewpoint, the project will not be particularly sensitive to cost escalation since a 20% variation in project costs will only produce a 2.9% reduction in the return.

B. The IRR was found to be more sensitive to the decrease in benefits. Even in this case, IRR keeps 13.92%, higher than the opportunity cost of capital (=12%).

C. In the case with 20% increase in cost and 20% decrease in benefit, IRR falls at 11.29%, slightly lower than the opportunity cost of capital (12%).

D. Almost all the cases except one extreme case prove the economic feasibility of the project.

Based on these results of the sensitivity test, it can be concluded that the truck terminal project in Bangkok is economically feasible and justifiable for immediate implementation.

CHAPTER 11

FINANCIAL EVALUATION

CHAPTER 11 FINANCIAL EVALUATION

11.1 General

The financial analysis in this study aims at;

A. Setting charges appropriate both for the truck terminal company and the trucking companies,

B. Determining necessary and minimum level of the government support to the project. Candidates cover a provision of land, a capital participation, provision of infrastructure etc., and

C. Examining the project feasibility and preparing a financial plan.

Analysis starts with setting the model charge, then proceeds to determine the project cost by case, in which the government itself finances some part of the investment to the project.

Secondly, basic case was analyzed. This is the case that the whole investment is financed by the private investor. The lowest feasibility is attached to this case.

Thirdly, other cases with the less financial burden of the private investor with the larger burden of the government are evaluated to determine the appropriate measures of the government support to the project. This coincides the deeper involvement of the government.

Finally, recommendation of the government role is shown, which forms a combination of various policy measures. In measuring the magnitude of each policy on the project viability, the best combination of government supports is determined to assure the financial capability of the terminal project.

Detail calculation sheets are attached in Appendix.

11.2 Forecast of Revenue

Revenue forecast is obtained by multiplying unit charge of facility with each facility area.

Facility area is set according to the freight volume handled at the truck terminal. Unit charge of the terminal berth is set between a range that makes the total revenue equivalent to the total economic benefit and that makes the truck company's revenue equal to zero.

Some other supplementary factors are also taken into consideration in setting charge.

11.2.1 Classification of Revenue

Truck terminal company can receive three kinds of revenue accruing to its facility users. Each charge item consists of various sub-items.

A. Berth Charge Revenue:

Any trucking company should agree a rental contract of berth and pay monthly charge for its use.

B. Related Facilities' Charge Revenue:

Trucking companies are to use other terminal facilities such as parking area, warehouse and lodging. Those are indispensable for operation of line-haul trucks. Other supplementary facilities are offered at a low price. Sub-items of this charge covers the following items;

1. Parking,
2. Meeting room,
3. Training room,
4. Rest room,
5. Office,
6. Warehouse, and
7. Lodging

C. Rental Revenue from Tenants:

This accrues to the companies that operate in the terminal. These independent companies are indispensable for workers in the terminal, and be managed by the more appropriate entities than the terminal company. Sub-item are as follow;

1. Canteen,
2. Gas station, and
3. Repair shop.

11.2.2 Setting of Model Charge

Model charge provides the preliminary charge level for analysis. This is changed upwards to guarantee the project viability in the latter stage. Charge setting work proceeds the following steps:

A. Conversion of Japanese charge system into Thai Baht,
B. Setting of a possible range of charge,
C. Setting of a charge escalation rate and a revision interval,
D. Impact analysis of model charge on the truck company and the general prices, and
E. Determination of model charge.

In the following spaces, each item is explained in detail.

A. Conversion of Japanese Charge System into Thai Baht

This sets the absolute level of charge system as a whole. Reason to refer to the Japanese price system is attributable to the fact that this type of truck terminal is the first one in the Thailand and has no data helpful to set the Thai standard.

Japanese price system, consisting of seven major items, is obtained by averaging the corresponding charges of four major truck terminals in the Tokyo Metropolitan area. These are tabulated in Table 11.2.1.

Table 11.2.1 Charge Levels of Public Truck Terminals in Japan

(Unit; Japanese Yen/m2/month)

Unit Charge of Lease Contract	Keihin Truck Teminal	Itabashi Truck Teminal	Adachi Truck Teminal	Kasai Truck Teminal	Total
1. Berth	1,110	1,110	1,400	1,450	1,268
2. Parking	620	620	750	800	698
3. Administration Building					
(a) Meeting Room	1,800	1,800	2,300	2,400	2,075
(b) Training Room	1,800	1,800	2,300	2,400	2,075
(c) Canteen	1,800	1,850	2,200	2,200	2,013
(d) Rest Room *1	37,800	33,600	27,300	35,200	33,475
4. Office	1,800	1,600	2,300	2,400	2,025
5. Warehouse	1,400	710	-	-	1,055
6. Loding	37,800	33,600	27,300	-	32,900
7. Service Station					
(a) Gas Station	-	-	-	-	0
(b) Repair Shop *2	1,900,000	1,420,000	-	-	1,660,000
(c) Car Washing Shop	-	-	-	-	-

(Note): *1 Unit of this charge is set per room/month.
Averge of room area is 13 sq. meter per room.
*2 Unit of this charge is set per whole area of one factory.

B. Setting of Possible Range of Charge

Two levels: maximum and minimum levels are set by the total amount of economic benefit and by the principle of break-even point. The former gives the maximum limit, and the latter minimum limit.

Results indicate both limits as follows;

Table 11.2.2 Possible Charge Range

(unit; Baht/m^2)

Item	Charge		
	Berth	Parking	Lodging
Maximum Level	134	75	352
Minimum Level	23	13	60

Each criterion is explained below;

1. Maximum criteria; economic benefit

Anyone who receives the economic benefit has to pay the charge equivalent to the total amount of economic benefit for its use. This gives the maximum limit of the charge.

Trucking companies exclusively receive three kinds of economic benefit out of five benefit categories in total. Those are;

a) Saving in fixed-costs of heavy truck,
b) Saving in waiting time, and
c) Saving in handling costs.

Total amount of three benefits are 104.6 million Baht at the year 2000.

This upper limit is almost 63% of the total revenue accruing to the Japanese charge system, in which monthly charge for berth is 134 Baht per sq. meter for a month, parking 75 Baht, lodging 352 Baht and so on.

2. Minimum criteria; break-even point

The break-even point is defined at which the annual revenue is equal to the annual expenditure. In this study, the minimum charges is set at which the annual revenue exceeds the annual operation and maintenance (O/M) cost.

The annual O/M cost is set 17.8 million Baht, equal to the five-year average after the commencement of terminal operation (1996-2000).

With this criterion, the monthly charge is set at 17% of the maximum level charge: 23 baht for berth per sq. meter per month, 13 for parking, 60 for lodging.

C. Setting of Charge Escalation Rate and Revision Interval

Revision of charge is necessary in the future because of a productivity improvement of trucking company in its cargo handling operation. This is equivalent to the amount of economic benefit that goes to the trucking company.

This study adopted three cases of increase rate, i.e., 0%, 3% and 6%, and are shown in Table 11.2.3. Reasons for each case are given below:

Table 11.2.3 Conditions of Charge Setting

Items	Charge Increase	Revision
Charge 1	0%	-
Charge 2	3%	5 year
Charge 3	6%	5 year

1. Charge escalation rate

Charge 1 keeps the charge constant and is used for comparison base.

Furthermore Charge 2 is set by the equal opportunity principle. In this criterion, both the trucking companies and the national economy are to receive the same increase rate of economic benefit. The former is about 6% per annum and the latter about 3%. Thus the truck companies should bear 3% (=6%-3%) increase of charge per annum. This guarantees equal opportunity to any entity for receiving the equal increase of their economic benefit.

Charge 3 sets the rate of charge revision as same as the increase rate of economic benefit of truck companies over the project life period (= approximately 6% per annum).

2. Revision interval

Longer interval period is much preferable since revision of charge faces a stubborn resistance as experienced in the case of bus charge.

However, it is not realistic to keep the charge constant for more than five years because a price increase at 6% per annum arrives at level as high as 1.33 times at the end of the fifth year. This period seems the limit to guarantee the revenue of the management company.

D. Impact Analysis of Truck Terminal Charge

This charge level is further evaluated in terms of two aspects:

1. Absorptive capacity of additional cost by trucking company;

Charges of the truck terminal are an additional cost for the trucking company. Absorptive capacity of additional cost for trucking company is thus the same as the negative benefit margin of the trucking company.

2. Price escalation effect;

Accurate impact should be analyzed on the macro-economic model. The institute of national economy planning agency is more right entity to conduct this matter. However, this has a significant impact to the whole commodities varying the wide range of field.

E. Determination of Model Charge

By considering the points above, the model charge level is set as shown in Table 11.2.4. Some explanations are shown below:

Table 11.2.4 Model Charge of the Public Truck Terminal

(unit: Baht/m2/month)

Unit Charge of Lease Contract	1992	1995	(1996)	2000	(2001)	2005	2010	2015	2020
Charge 2	3%								
1. Berth	49	54	61	77	100	147	250	493	1,128
2. Parking	27	30	34	43	56	82	140	276	631
3. Administration Building									
(a) Meeting Room	80	87	98	124	162	238	405	799	1,828
(b) Training Room	80	87	98	124	162	238	405	799	1,828
(c) Canteen	77	84	95	120	157	231	393	776	1,775
(d) Rest Room*1	99	108	122	155	202	297	506	999	2,286
4. Office	78	85	96	122	159	233	397	784	1,794
5. Warehouse	41	45	51	65	85	125	213	420	961
6. Lodging	97	106	92	117	153	225	383	756	1,730
7. Service Station									
(a) Gas Station*2	63,846	69,766	78,522	99,469	129,784	190,592	324,470	640,370	1,465,120
(b) Repair Shop*2	63,846	69,766	78,522	99,469	129,784	190,592	324,470	640,370	1,465,120
(c) Car Washing Shop									

(Note): *1 Averge of room area is 13 sq. meter per room.
*2 Unit of this charge is set per whole area of one factory.

1. Berth rental fee;

This setting is equivalent to 3,430 Baht per berth, and one trucking company is imposed to pay 3,430 Baht per month.

2. Related facilities' rental fee

These are determined by relative prices of Japanese price system and are justified by the review on the price level of similar facilities in Bangkok.

In 1992, model charge for lodge is set at 97 Baht per sq. meter for month. This is equivalent to 1,261 Baht per month per room (for two persons), cheaper than the average charge of similar facilities in Bangkok.

3. Tenants fee

This charge is for the whole territory of the factory per one month. This level is justified by the analysis on the similar facilities managed by the private sector.

11.2.3 Revenue Forecast

Revenue forecast is calculated by multiplying the model charge and the area of each facility for rent. First, the areas for rent are shown in Chapter 9, and the forecasts of total revenue are shown in Tables 11.2.5 through 11.2.7. This model charge is shifted up to the level high enough to guarantee the project viability.

11.3 Financial Cost by Case

11.3.1 Total Project Cost

Table 11.3.1 summarizes the financial cost of each case. Major differences lie in an introduction of land acquisition cost, and value added tax.

Table 11.2.5 Revenue accruing to the Truck Terminal (Case 1)

(unit: 1,000 Baht/year)

Items	1995	(1996)	2000	(2001)	2005	2010	2015	2020
1. Berth	32,414	35,721	40,352	72,765	94,500	138,915	236,250	465,885
2. Parking	10,643	11,826	13,403	21,440	27,922	40,885	69,804	137,614
3. Administration Building								
(a) Meeting Room	192	209	235	298	389	571	972	1,918
(b) Training Room	158	183	206	260	340	500	851	1,678
(c) Canteen	647	706	798	1,008	1,319	1,940	3,301	6,518
(d) Rest Room	642	700	791	1,004	1,309	1,925	3,279	6,474
4. Office	7,862	8,568	9,677	17,568	22,896	33,552	57,168	112,896
5. Warehouse	2,460	2,700	3,060	3,900	5,100	7,500	12,780	25,200
6. Lodging	1,937	2,117	1,837	2,336	3,055	4,493	7,648	15,096
7. Service Station								
(a) Gas Station	766	837	942	1,194	1,557	2,287	3,894	7,684
(b) Repair Shop	766	837	942	1,194	1,557	2,287	3,894	7,684
(c) Car Washing Shop	0	0	0	0	0	0	0	0
Total	58,497	64,403	72,242	122,967	159,944	234,855	399,840	788,647

Table 11.2.6 Revenue accruing to the Truck Terminal (Case 2-1)

(unit: 1,000 Baht/year)

Items	1995	(1996)	2000	(2001)	2005	2010	2015	2020
1. Berth	32,414	35,721	40,352	50,936	66,150	97,241	165,375	326,120
2. Parking	10,507	11,675	13,231	16,734	21,793	31,911	54,482	107,408
3. Administration Building								
(a) Meeting Room	154	167	188	238	311	457	778	1,534
(b) Training Room	96	104	118	149	194	286	486	959
(c) Canteen	462	504	570	720	942	1,386	2,358	4,656
(d) Rest Room	428	467	527	670	873	1,283	2,186	4,316
4. Office	7,862	8,568	9,677	12,298	16,027	23,486	40,018	79,027
5. Warehouse	1,476	1,620	1,836	2,340	3,060	4,500	7,668	15,120
6. Lodging	1,341	1,465	1,272	1,617	2,115	3,110	5,295	10,451
7. Service Station								
(a) Gas Station	766	837	942	1,194	1,557	2,287	3,894	7,684
(b) Repair Shop	766	837	942	1,194	1,557	2,287	3,894	7,684
(c) Car Washing Shop	0	0	0	0	0	0	0	0
Total	56,272	61,966	69,655	88,088	114,580	168,234	286,432	564,959

Tale 11.2.7 Revenue accruing to the Truck Terminal (Case 2-2)

(unit: 1,000 Baht/year)

Items	1995	(1996)	2000	(2001)	2005	2010	2015	2020
1. Berth	13,892	15,309	17,294	21,830	28,350	41,675	70,875	139,756
2. Parking	4,965	5,517	6,253	7,908	10,298	15,080	25,746	50,756
3. Administration Building								
(a) Meeting Room	77	84	94	119	156	228	389	767
(b) Training Room	250	271	306	387	505	743	1,264	2,493
(c) Canteen	333	363	410	518	678	998	1,698	3,352
(d) Rest Room	185	202	228	290	378	556	947	1,870
4. Office	3,370	3,672	4,147	5,270	6,869	10,066	17,150	33,869
5. Warehouse	984	1,080	1,224	1,560	2,040	3,000	5,112	10,080
6. Lodging	1,043	1,140	989	1,258	1,645	2,419	4,118	8,129
7. Service Station								
(a) Gas Station	766	837	942	1,194	1,557	2,287	3,894	7,684
(b) Repair Shop	766	837	942	1,194	1,557	2,287	3,894	7,684
(c) Car Washing Shop	0	0	0	0	0	0	0	0
Total	26,630	29,312	32,830	41,527	54,034	79,338	135,086	266,450

Table 11.3.1 Financial Cost

(unit: million Baht)

	Case 1	Case 2-1	Case 2-2
Project Cost with Land Acquisition Cost	912.3	696.5	318.4
Project Cost without Land Acquisition Cost	558.3	408.5	192.4

The Thai Government had introduced the value added tax (VAT) in January 1992. This VAT is included in the total cost of the project in this study.

Cost estimation does not include any compensation for the those who have to remove since no people have dwelling places and no other valuable properties such as trees can be seen in the planned sites.

11.3.2 Total Project Cost with the Government Participation

This study suggests that the government as well as the private sector finance some cost items according to the necessity in securing the financial feasibility of the project. The cost the government will fund is excluded from the project cost for the financial evaluation on the truck terminal management entity.
The possible cost items that the government may invest its fund are tabulated in Table 11.3.2.

Table 11.3.2 Project Cost Items of Truck Terminal Company and the Government

Items	Cost Items of Truck Terminal Company	Cost Item of the Government
Cost A.	All Items	Nothing
Cost B.	All items except items shown in the right cell	Land
Cost C.	All items except items shown in the right cell	Land Infrastructure 4. Drainage 10.1 Electricity Sub-station
Cost D.	All items except items shown in the right cell	Land Infrastructure 4. Drainage 10.1 Electricity Sub-station Intersection 6.2 Road 12 Intersection
Cost E.	All items except items shown in the right cell	Land Infrastructure 4. Drainage 10.1 Electricity Sub-station Intersection 6.2 Road 12 Intersection Terminal facilities 10.2 Other Facilities

Note; In cases of Cost B to E, land will be rented to Truck Terminal Company.

Therefore, various cases of project cost are set according to the degree of the government participation. Those are shown in Table 11.3.3.

Table 11.3.3 Project Cost Financed by Truck Terminal Company and Government

(unit: million Baht)

Case	Cost for Truck Terminal Company			Cost for the Government			
	Case 1	Case 2-1	Case 2-2		Case 1	Case 2-1	Case 2-2
Cost A	912.3 (100%)	696.5 (100%)	318.4 (100%)	All except Land	0	0	0
				Land	0	0	0
Cost B	558.3	408.5	192.4	All except Land	0	0	0
	(62%)	(59%)	(60%)	Land	354.0	288.0	126.0
Cost C	541.9	395.5	186.9	All except Land	16.4	373	5.5
	(59%)	(57%)	(59%)	Land	354.0	288.0	126.0
Cost D	493.4	355.1	167.3	All except Land	64.9	53.4	25.1
	(54%)	(51%)	(53%)	Land	354.0	288.0	126.0
Cost E	478.4	342.2	160.3	All except Land	79.9	66.3	32.1
	(52%)	(49%)	(50%)	Land	354.0	288.0	126.0

( ) indicates percentage share of the terminal company against the total financial cost shown in Row A.

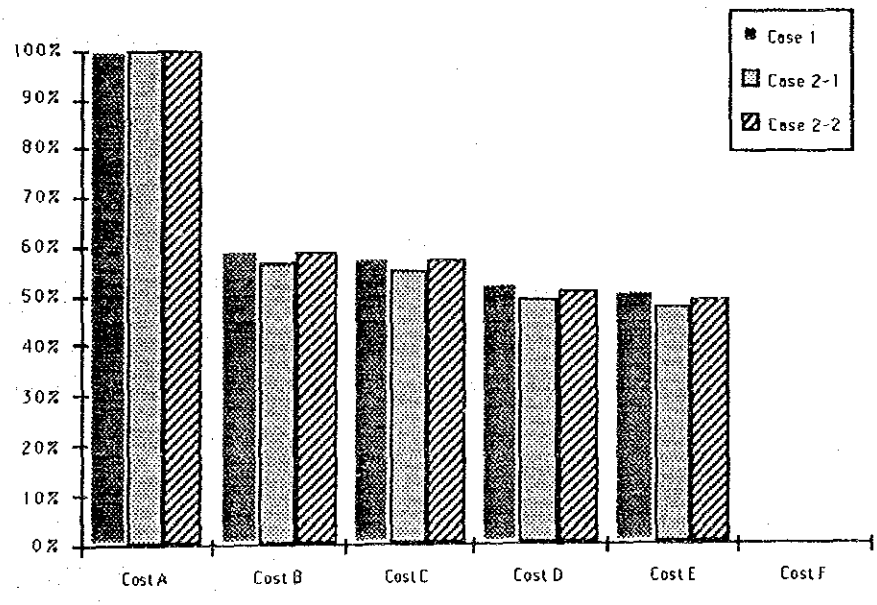


Fig. 11.3.1 Comparison of Cost Cases with the Government Participation

11.3.3 Land Acquisition Cost

Land acquisition cost was estimated on the market price base, regardless to who acquires and/or provides the land for the terminal. For this purpose, actual transaction prices at 1990 and 1991 were collected in cooperation with the Central Valuation Authority, Department of Land, in Thailand.

Unit prices for all the cases are set at 5,000 Baht/sq. wah (= 4 sq. meter) in this study. This is the highest level of the actual transaction prices at the expected terminal site, varying 3,000 - 5,000 Baht/sq. wah at the year 1990-1991. With the consideration of the latest escalation of land price, it is assumed that the higher level is appropriate for the present price in 1992.

Table 11.3.4 shows land acquisition cost by case.

Table 11.3.4 Land Acquisition Cost at the Market Price, 1990-1991

	Land Acquisition Cost (million Baht/site)	Unit Price (Baht/m^2)	Total Area (Rai)
Case 1	354	1,250	177
Case 2-1	288	1,250	144
Case 2-2	126	1,250	63

Note; 1,250 Baht/m^2 = 5,000 Baht/sq. wah.
1 rai = 400 sq. wah = 1,600 m^2.
(177 rai x 1,250 Baht/m^2 x 1,600m^2)

Price of the government land is set zero in this financial analysis if it is provided for the project. However, the terminal management entity has to pay the land rental charge to the government. In this study, the rental charge is calculated based on the depreciation period of one hundred (100) years: the most favorable condition for this public truck terminal.

In case that the government land assigned for the terminal will be rented to the truck terminal company, the land rental charge is the financial burden for the terminal management entity. Land rental charge is obtained by dividing the total amount of purchasing cost by the total depreciation period. In this study, the depreciation period is set to be one hundred (100) years.

Annual depreciation cost is reckoned to be 2.88 million Baht as shown in Table 11.3.5.

Table 11.3.5 Annual Rental Charge of Terminal Land

	Land Acquisition Cost (million Baht/site)	Depreciation Period (Years)	Annual Rental Charge (1,000 Baht/site)
Case 1	354	100	3,540
Case 2-1	288	100	2,880
Case 2-2	126	100	1,260

11.3.4 Operation and Maintenance Cost

This cost varies significantly year by year. However, its average figure gives the base to sight the magnitude of this item. It is at 17.8 million Baht per year during the first five year period after terminal's opening.

11.4 Financial Evaluation Indicators

11.4.1 Basic Conditions

Financial viability of the project is most sensitive to (1) project cost, (2) charge, and (3) gearing ratio. So these items are all set in various levels. Case for other less influential items is set unique for one item, and magnitude of change in these items are examined in the sensitivity analysis.

A. Cost:

Cost varies according to the degree of the government participation to the project. This study prepared six cases in section 11.3. Five (5) cost cases are previously defined in Table 11.3.2.

B. Charge:

Charge level is one of the determining elements of the project feasibility on the revenue side. Model charge system determined in section 11.2.2 are adopted in the analysis. Major settings are the following two:

1. Revision interval of charges; five (5) years
2. Charge increase rate: 3% per annum

Thus, the model charge level of berth per sq. meter is escalated upwards every five (5) years in a time horizon as follows;

1992-1995	;	49 Baht/m^2	(5 Years)
1996-2000	;	55 Baht/m^2	(5 Years)
2001-2004	;	64 Baht/m^2	(4 Years)
2005-2009	;	72 Baht/m^2	(5 Years)
2010-2014	;	83 Baht/m^2	(5 Years)
2015-2019	;	97 Baht/m^2	(5 Years)
2020-	;	112 Baht/m^2	(5 Years)

Whole model charge system above is also shifted upwards if this level cannot guarantee the viability of the project. And eight (8) cases of charge levels are prepared. In setting eight charge cases, the berth charge is raised by approximately ten (10) Baht up to the maximum level of the charge, which cannot exceed the economic benefit (=137 Baht/sq. meter). Other items are proportionally modified with the berth charge. Initial berth charges in various charge cases are set as follow;

Charge 1	;	60 Baht/sq. meter/month (for 1992-1995)
Charge 2	;	70 Baht/sq. meter/month (for 1992-1995).
Charge 3	;	80 Baht/sq. meter/month (for 1992-1995).
Charge 4	;	90 Baht/sq. meter/month (for 1992-1995).
Charge 5	;	100 Baht/sq. meter/month (for 1992-1995).
Charge 6	;	110 Baht/sq. meter/month (for 1992-1995).
Charge 7	;	120 Baht/sq. meter/month (for 1992-1995).
Charge 8	;	130 Baht/sq. meter/month (for 1992-1995).

C. Equity and Loan Amounts (Gearing Ratio):

It is set that all the project cost (excluding land acquisition cost) is financed by the equity and loan. And gearing ratio is defined as the composition ratio of equity and loan amount.

Setting of gearing ratios aims at determining how much amount of equity is appropriate for the project. This proper level is set at which the project turns feasible.

Ten (10) per cent of the investment amount for the public truck terminal (excluding land acquisition cost) is set as a minimum amount of equity. This is raised up to fifty (50) per cent by ten (10) per cent and five (5) cases of gearing ratio in total are set. Table 11.4.1 summarizes the necessary amounts of equity for each case below;

Table 11.4.1 Gearing Ratios and Necessary Equity Amount

(unit; million Baht)

Gearing Ratio (Equity:Loan)	Case 1	Case 2-1	Case 2-2
10:90	55.8	40.9	19.2
20:80	111.7	81.7	38.5
30:70	167.5	122.6	57.7
40:60	223.3	163.4	77.0
50:50	279.2	204.3	96.2

This gearing ratio affects, by its nature, the amount of interest payment of short-term loan in reckoning the internal rate of return (ROI), and its effect is not apparent if short-term loan is not necessary. In the latter case, ROI is constant regardless changes in the gearing ratio.

Furthermore, this study sets the equity shares of the government and the private investor: The government fiances forty-nine (49) per cent of the total equity and the private sector fifty-one (51) per cent. This is because

the Thai government had invested less than a half of the equity for the joint project with the private sector, usually forty-nine (49) per cent of the equity. It is judged these ratios are the most implementable one.

D. Long-term Loan:

Long-term loan is introduced to finance a portion of the investment cost that exceeds the capital. Conditions are shown in Table 11.4.2.

Table 11.4.2 Conditions of Long-term Loan

Items	Interest	Return period	Grace period	Interest Return
Long-term Loan	12%	20 years	5 years	next year
(Conditions for Sensitivity Analysis)				
Long-term Loan 1	4.25%	20 years	5 years	next year
Long-term Loan 2	7%	20 years	5 years	next year

Of the long-term loan, an interest is set at 12%, the same level as an ordinal long-term loan of the commercial banks in Thailand. Bank of Thailand reports in its "Quarterly Bulletin," September 1991 that interests of commercial bank deposit are set at about nine (9) percent to twelve (12) percent. The government loan also applies almost same rate of interest as the commercial loan for the semi-public investment. Thus 12% is judged suitable for analysis.

A loan interest generated during the construction period is to be paid within five (5) years after the completion of terminal.

Interest rates in the bottom two rows in Table 11.4.2 are quoted from the government financing institutions outside the Thailand and are applied in the sensitivity analysis.

E. Short-term Loan

This is necessary when the annual revenue can not generate profit and it offsets the annual deficit. Only one condition is set for analysis as shown below:

Table 11.4.3 Conditions of Short-term of Loan

Items	Interest	Return Period	Grace Period	Interest Return
Short-term Loan	12%	1 years	0	next year

Interest rate in the analysis is same as the prevailing level in Bangkok at the years 1991-92, i.e. 12 % per annum.

F. Depreciation:

Depreciation period of the following three items are set below;

1. Land ; 100 years
2. Building ; 20 years
3. Pre-construction expenditure; 5 years

Land is not actually depreciated in its true term. However depreciation period is necessary for setting the rental charge of land. Most favorable condition is introduced in this study in order (1) to guarantee the project feasibility and (2) to minimize the burden of the government in terms of capital participation, cost sharing in facility construction since the government has to share more initial investment burden if land rental charge were set high and depressed the repayment capacity of the truck terminal company.

G. Inflation:

This study stands on the no escalation base. Inflation has an effect to exaggerate the amount of revenue, and conceals other significant features or characteristics of the project. Thus, this effect is not incorporated in this analysis.

H. Tax:

Thirty-five (35) percent of the revenue is a subject of the business tax, and is incorporated in this analysis. However, it is assumed that no tax is imposed on the company suffered from the loss.

11.4.2 Case Setting for Financial Evaluation

Case 2-1 is used for analysis to determine the best levels of (1) charge, (2) cost and (3) gearing ratio. And the same conditions are applied to evaluate Case 1 and Case 2-2 to reckon the evaluation indicators.

Various combinations of factors described in the previous section are shown in Table 11.4.4, and on which Case 2-1 is evaluated. Three conditions encircled by double line in Table 11.4.4 are the most influential factors on the project. One case for each of these three factors together with an unique condition of "Other Factors" form the cases for the financial evaluation.

Table 11.4.4 Factors Involved in Financial Analysis and Cases

Cost	Charge	Gearing Ratio (Equity:Loan)	Other Factors
Cost A	Charge 1	10:90	1. Long-term Loan
Cost B	Charge 2	20:80	2. Short-term Loan
Cost C	Charge 3	30:70	3. Depreciation
Cost D	Charge 4	40:60	4. Inflation
Cost E	Charge 5	50:50	5. Tax
Cost F	Charge 6		

First procedure of the evaluation starts with reckoning the feasibility indicators for Cost A, which is the case with 100% private investment and with no government supports, based on the various charge levels and gearing ratios. This clarifies the necessity of the government participation to the project.

Then, analysis proceeds to further examination on the magnitude of each government support measures such as (1) provision of land, (2) provision of a part of construction cost such as infrastructure, intersection, and the terminal facility. This aims at determining what kinds of government support measures are necessary to the pubic truck terminal project.

Sensitivity analysis is conducted in relation with change in loan interests and additional cost of flyover.

11.4.3 Results of Evaluation

Financial internal rate of return (ROI) is used in determining the necessary measures of government support. Table 11.4.5 shows the results in case of Cost A, and the results of other cost cases are shown in Table 11.4.6.

Table 11.4.5 Project Evaluation Indicators (ROI) (without Government Support)

Cost	Charge	Gearing Ratio				
		10:90	2:80	30:70	40:60	50:50
Cost A	Charge 1	Nil	Nil	Nil	Nil	Nil
	Charge 2	Nil	Nil	Nil	Nil	0.36
	Charge 3	Nil	Nil	2.36	4.58	5.63
	Charge 4	4.48	6.30	7.28	7.85	8.22
	Charge 5	8.81	9.37	9.74	10.01	10.19
	Charge 6	11.09	11.37	11.57	11.70	11.72
	Charge 7	12.83	12.83	12.83	12.83	12.83
	Charge 8	14.38	14.38	14.38	14.38	14.38
	Charge 9	15.59	15.59	15.59	15.59	15.59

Note; Cells encircled by the double line indicate that net cash flow on this condition generates positive profit, and short-term loan for offsetting annual deficit is not necessary.