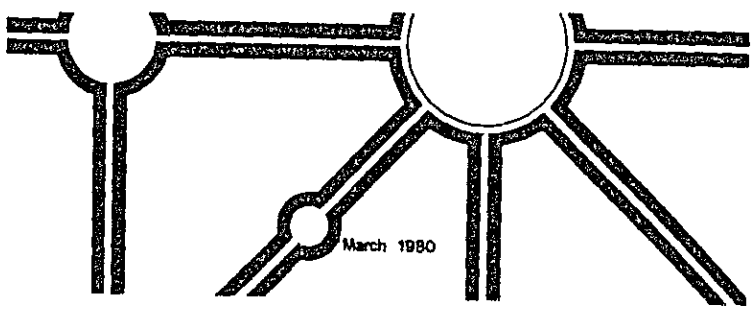
CHAPTER 5 TERMINAL FACILITIES DESIGN



Chapter 5 TERMINAL FACILITIES DESIGN

5.1 Alternatives for Facilities Design

Although two recommendations of terminal locations were made in the modified SEATAC study (Alt. 55) and the ETA study (Alt. 7), the most beneficial combinations of terminal locations was alternative 33 according to the benefit calculation results described in Chapter 4.

For the purpose of considering the terminal facilities design and calculating the construction cost, the following four alternatives were examined in detail:

Scale	Alternative No.	Terminals Included	Recommending Source
Full Scale	33	NEWC	This Study
	55	EWN'	Modified SEATAC Study
	7	C	E.T.A.
Optimum Scale	333	NEWC	Optimal variation of No.33

Alternative 55 is based on the recommended SEATAC study terminal locations (E, W and N) modified in accordance with the comments for this study made by the Thai authorities.

Based on the three alternatives (33, 55 and 7), the facilities design and the calculation of construction cost comparison were made. In all cases it was assumed that all of the truck terminal complex facilities were constructed using the maximum level of service (full scale of design). Based on the economic evaluation, alternative 33 was found to be most economically feasible, and therefore, further consideration was given to alternative 33 to determine the optimum scale of facilities. This was numbered as alternative 333. (See Section 5.7)

In the following sections a detailed description of the facilities design and the cost calculation for only alternative 33 is made. Alternatives 7 and 55 are only the summarized although the method of design and calculation is the same.

5.2 Facilities Planning for Alternative 33

5.2.1 General

The facilities in each truck terminal complex are planned and sectioned to meet four distinctly separate needs of the trucking industry in Bangkok as follows:

a) Truck Terminal facilities for the consolidation and transshipment of non-bulk mixed cargo between intra-city pick-up and delivery and inter-city line-haul truckers.

b) Warehouse facilities for bulk cargoes to enable expansion of warehousing outside the CBD to be served by truck transport.

c) Chartered truck center to rationalize the truck chartering business by providing garage and parking facilities for chartering companies who have been using public roads as business facilities and by centralizing the industry on the periphery of the urban area to avoid increasing urban congestion.

d) Public parking facilities for heavy trucks which must wait during restricted operating hours before being allowed to enter the GBA, etc.

In the following sub-sections, the elements of each of the four facilities is described along with the method for calculating the scale facilities required to meet the size of demand previously determined. Alternative-33 (i.e., single transfer system and construction of four terminals: North, East, West and Central) which was chosen as the best alternative in Chapter 4 is used as the example in describing the procedure for determination of the scale of the facilities.

5.2.2 Facility Elements

The elements of facilitiy planning in the truck terminal complex cover the four required trucking industry functions (namely, transshipment, bulk commodity warehousing, public truckers garage and heavy truck parking) as well as two support functions for the truck terminals (namely, administration and maintenance). The six elements and their components are listed below for reference.

(1) Truck Terminal Components

The main components of the truck terminal are the following.

- Cargo handling platforms for consolidation of cargoes into near truck-load lots and for transshipment between pickup and delivery and line-haul vehicles.

- Apron area adjoining the platform area.

- Branch or field office of the terminal operators.

- Parking area for pick-up and delivery and line-haul vehicles and roadway throughout and surrounding the platform areas.

(2) Warehousing Areas

The five kinds of warehouses which being considered inside the Terminal Complex are as follows:

- Warehousing for bulk agricultural products such as rice, sugar, etc.

- Warehousing for building materials such as steel piling.

- Warehousing for manufactured products such as household goods, textiles, food, furniture and industrial goods.

- Yard storage areas for bulk building materials such as bricks, gravel and sand.

- Silos for storing cement and maize.

The main components of each storage area are as follows:

- Warehouse

- Apron area adjoining the platform of the warehouse.

- Branch or field office for the warehouse operators.

- Roadway separating and providing access to each warehouse.

(3) Chartered Truck Center

The facilities listed below are planned for the truck chartering business:

- Garage and parking areas for chartered vehicles.

- Temporary Storage area.

- Office space, roadway, etc.

(4) Public Parking Area

- Parking space is planned both for heavy vehicles temporarily restricted from entering the GBA each day.as well as for the general public who arrive by taxi or private vehicle for business related to the functions of the truck terminal complex.

(5) Truck Terminal Administration Building

The following rooms were planned for inclusion in the truck terminal administration building:

- Administration offices for the complex as well as an office for an official from the DLT
- Clerical offices for terminal operators
- Conference room
- Training room
- Cafeteria with Kiosk
- Clinic
- Crew rest area
- Showers and toilets
- Public telephone facilities

(6) Truck Terminal Maintenance Area, etc.

- Shop for repair and inspection of vehicles
- Fuel station
- Trash disposal area
- Security checkpoint with weighing scale
- Employee parking area
- Green belt

5.2.3 Layout and Scale of Facilities for Alt. 33

The following paragraphs explain the method used to calculate the scale of facilities in the truck terminal complex.for the terminals of alternative-33 (namely, North, East, West and Central). Other alternative terminal scales are mentioned in Section 5.2.4.

The process of determining the scale of facilities is a two phase process. In the first phase the required functional areas are determined based on estimated facility demands. In the second phase, the areas are adjusted to make convenient rectangular shapes and to fix the spacing between facility components such as roadways, parking, green belts, etc. Since the second layout phase involves many special adjustments, the process is not described in detail, but only the results are presented herein.

(1) Scale of Truck Terminal Facilities

The determination of the scale of truck terminal facilities is primarily based on the projected volume of cargo to be handled. Cargo volumes are composed of inbound, outbound and transshipment volumes.

For the GBA, the total cargo volume for the year 2000 has been forecast at about 11,900 tons per day. This total cargo volume is divided between the terminals of alternative-33 in terms of their respective teritories covered. The resultant cargo volumes for each terminal (North, East, West and Central) are shown in Table 5-1.

Table 5-1 Cargo Capacity for Truck Terminals (Alternative-33)

(Unit: tons/day)

Type of Cargo / Truck Terminal	Outbound Cargo Volume	Inbound Cargo Volume	Transshipment Volume	Total Volume
North	1,211	750	38	1,999
East	1,370	462	24	1,856
West	1,087	672	34	1,793
Central	3,098	2,938	147	6,183
Total	6,766	4,822	243	11,831

Notes: 1. Computations are based on generated traffic volumes as shown Table 4-6.

2. Transshipment volumes were assumed to be 5% of inbound cargo volumes.

3. Outbound cargo volumes are considered to be equal to pick-up volumes.

4. Inbound cargo volumes as considered to be equal to delivery volumes.

The procedure for calculating the scale of truck terminal facilities is shown in Figure 5-1. Basically, the procedure involves the following elements.

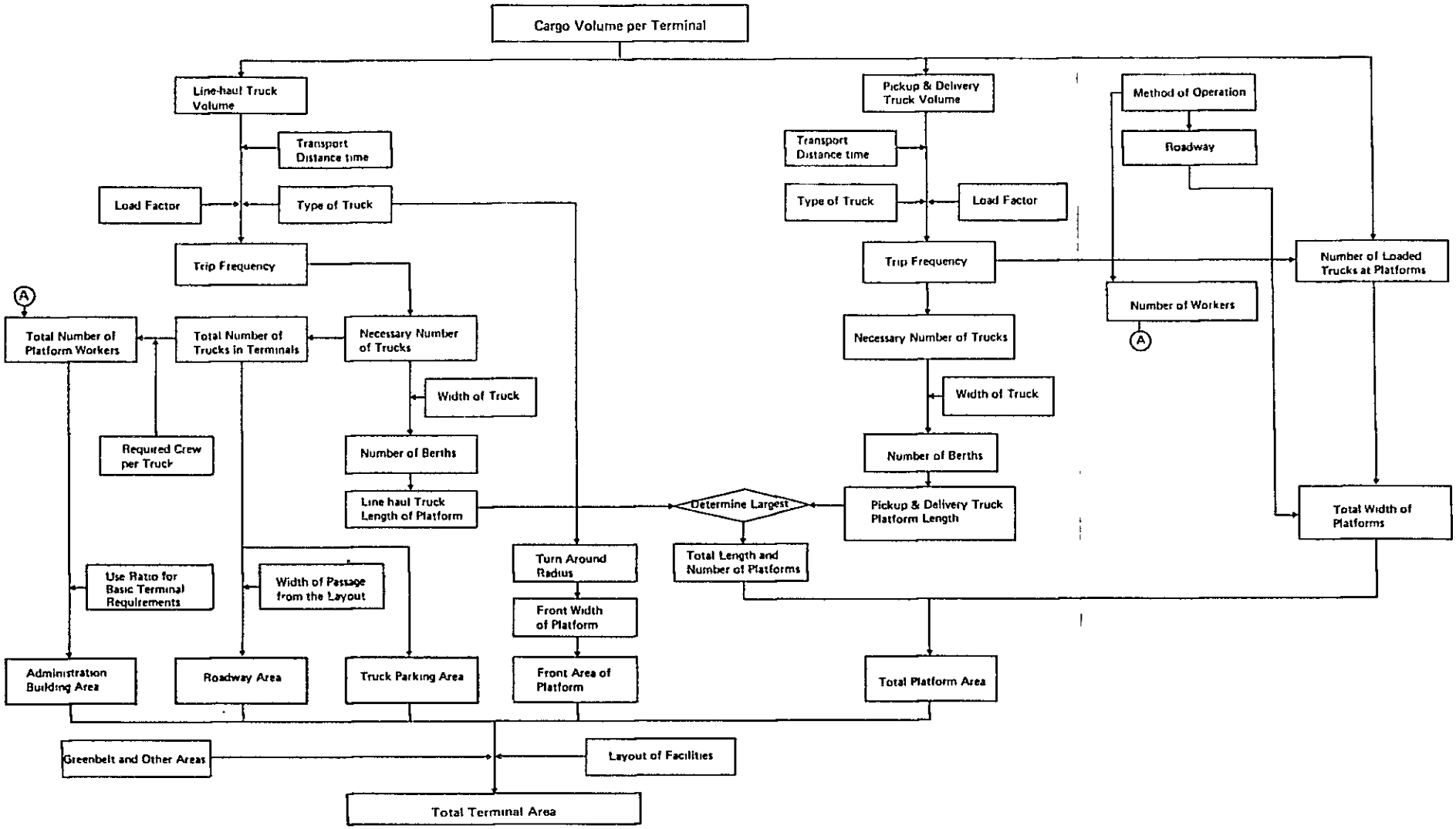
1. Total cargo volume to be handled in GBA: 11,830 tons/day

2. Average vehicle load (tons) for inbound and outbound cargo: 6 tons/truck

3. Average vehicle load (tons) for pick-up & delivery cargo: 1.91 tons/truck

Turn around time: 2.5 times per day

Fig. 5–1 DESIGN METHOD FOR TRUCK TERMINAL FACILITIES



4. Number of line-haul trucks x concentration ratio (25%)
   (Note: Distance between Terminal pillars was considered)

5. Number of berths x 3.5 m/truck
   Size of berth: 1 m^2/3.5 tons
   (Note: Distance between Terminal pillars was considered)

6. Employee determination:

Line-haul truck crews:	2 men/truck
Pick-up & delivery truck crews:	1.2 men/truck
Platform workers:	10 tons/man-day
Office staff:	20% of platform workers

7. Length x width x number of platforms

8. Side of line-haul trucks: length x 15 width
   Side of pick-up & delivery trucks: length x 10 m width

9. Office Unit Area: 10 m^2/office staff
   Crew Rest room: 2 m^2/man

10. Number of line-haul trucks: 25% of pickup & delivery trucks
    Unit Area for line-haul trucks: 48 m^2/truck
    Unit Area for pick-up & delivery trucks: 21 m^2/truck

11. Components determined from the layout chart:

    - Apron distance between line-haul trucks and platform: 15 m
    - Apron distance between pick-up & delivery trucks and platform: 10 m
    - Roadway widths ranging from 7 - 20 m

12. Car parking area, vehicle washing facilities, trash disposal area, green belt and guard box, etc.

The total area of the truck terminal in alternative-33(295,503 m^2) and the elements mentioned above are shown in Table 5-2.

(2) Scale of Warehouse facilities

Warehousing operations require space for vehicle parking, cargo handling and storage. In order to compute the scale of warehouses facilities, the following procedure was adopted.

The daily inbound and outbound cargo volumes for each peripheral terminal was computed based on the averaged volumes of

Table 5-2(A) Truck Terminal Facilities (Alternative-33)

Design Factor / Terminal	Cargo Volume (tons/day)	Number of Line-haul Trucks	Number of Pickup & Delivery Trucks	Number of Berths (Berths)	Area of Platform: LengthxWidth xNumber (m^2)	Employees Line-haul Distribution Platform + Office (Persons)	
North	1,999	398	493	102	7,140	1,676	796
							592
							240
					(119x20x3)		48
East	1,856	372	461	96	6,720	1,566	744
							554
							223
					(112x20x3)		45
West	1,793	359	443	90	6,300	1,510	718
							532
							216
					(105x20x10)		44
Central	6,183	1,237	1,518	320	22,400	5,188	2,474
							1,822
							743
					(112x20x10)		149
Total	11,831	2,366	2,915	608	42,560	9,940	4,732
							3,500
							1,422
							286

Table 5-2(B) Truck Terminal Facilities (Alternative-33)

Design Areas / Terminal	Platform Area (m^2)	Aprons (m^2)	Administration Building (m^2)	Parking Area (m^2)	Roadway (m^2)	Other Area (Parking, Greenbelts, Trash, Guard) (m^2)	Total Area (m^2)
North	7,140	8,925	1,800	7,500	19,800	3,998	49,163
East	6,720	8,400	1,800	6,400	19,100	5,266	47,686
West	6,300	7,875	1,800	6,400	18,700	5,134	46,209
Central	22,400	28,000	6,000	24,725	62,500	8,820	152,445
Total	42,560	53,200	11,400	45,025	120,100	23,218	295,503

each commodities to be handled in the year 2000. Terminal-C was excluded since existing warehouses in Bangkok are plentiful for the central area and land acquisition costs are prohibitive for a new warehouse venture. The warehouse storage volume was computed by multiplying the figure by the average stock days per year. And finally, the storage area required was computed based on the required area-per-ton volume.

Space requirements for vehicle operation, roadway and green belt, etc. were also determined as shown in the following work flow chart (Figure 5-2).

a) Daily inbound and outbound cargo volumes by warehouses (Table 5-3)

Table 5-3 Daily Inbound and Outbound Cargo Volumes

Commodity Group \ Terminal		Volume (ton) North	East	West	Total	Average Stock Days/Yr	Unit Storage Area
Agricultural Products	Rice	87	67	314	468	60 d	1.5 t/m^2
	Sugar	440	40	20	500	40	1.5
	Others	747	174	200	1,121	30	1.3
Building Materials	Cement	54	20	40	114	30	2.0
	Brick	34	12	24	68	50	2.0
	Piling	21	8	16	45	50	2.0
Manufactured Products		81	20	74	175	50	1.2
Total		1,462	341	688	2,491	-	-

Note: 1 Half of the total of inbound and outbound cargo volume shown constitute the average commodity volume.

b) Warehouse storage volumes

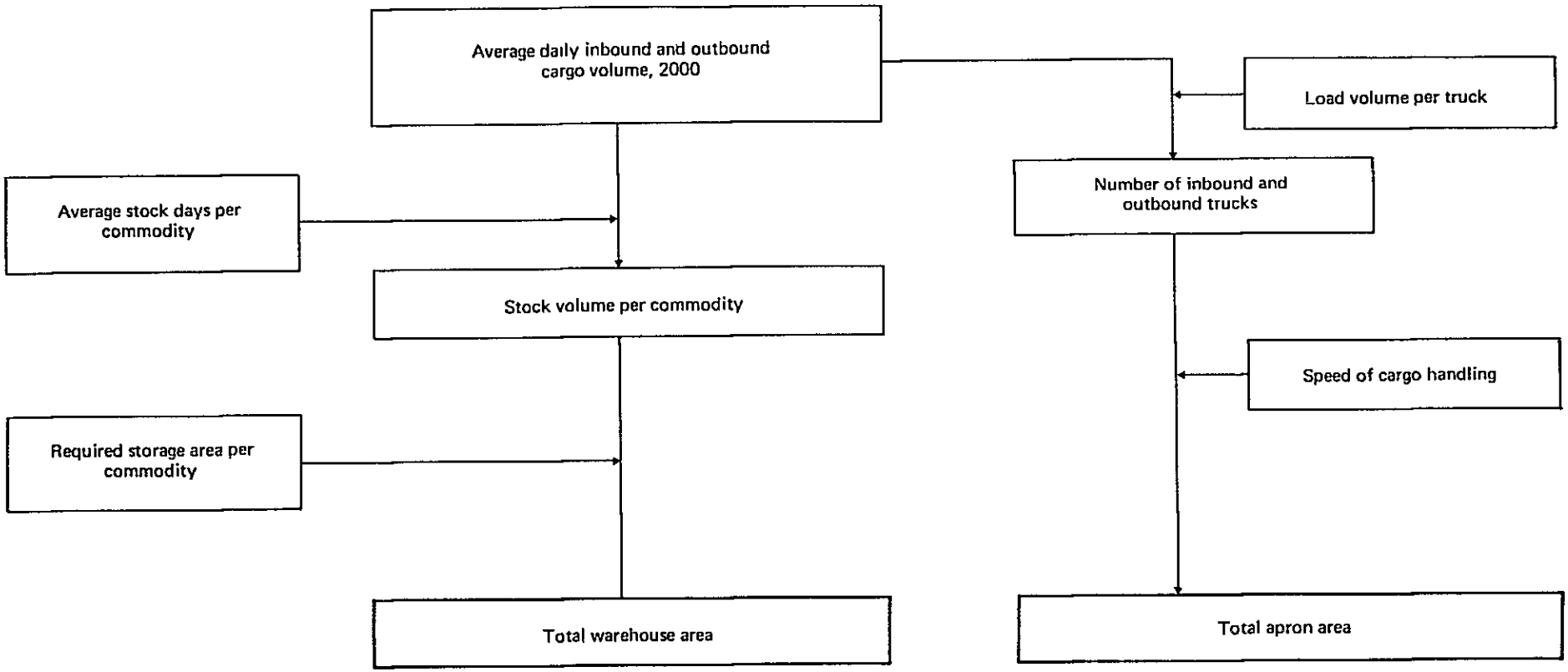
Warehouse storage volumes were computed by multiplying the average daily inbound and outbound cargo volumes by the average stock days. The results are shown in the following table (Table 5-4)

Table 5-4 Commodity Storage Volume (Alternative-33)

(unit: ton)

Commodity Group \ Terminal		Commodity Storage Volume North	East	West	Total
Agricultural Products	Rice	2,610	2,010	9,420	14,040
	Sugar	8,800	800	400	10,000
	Others	11,205	2,610	3,000	16,815
Building Materials	Cement	810	300	600	1,710
	Brick	800	300	600	1,700
	Piling	525	200	400	1,125
Manufactured Products		2,025	500	1,850	4,375
Total		26,775	6,720	16,270	49,765

Fig. 5–2 DESIGN METHOD FOR WAREHOUSE FACILITIES



c) Warehouse Storage Area

The required warehouse storage areas were computed by multiplying warehouses storage volume in item (b) above times the required basic area of storage. The results are shown in the following table (Table 5-5).

Table 5-5 Warehouse Storage Area by Commodity (Alt. 33)

(Unit: m^2)

Commodity Group \ Terminal		Required Warehouse Storage Area			
		North	East	West	Total
Agricultural Products	Rice	3,915	3,015	14,130	21,060
	Sugar	13,200	1,200	600	15,000
	Others	16,808	3,915	4,500	25,223
Building Materials	Cement	1,215	450	900	2,565
	Brick	1,200	450	900	2,550
	Piling	788	300	600	1,688
Manufactured Products		3,038	750	2,775	6,563
TOTAL		40,164	10,080	24,405	74,649

d) Warehouse Site Area

Based on the required storage area and consideration of the layout of the whole including aprons, the total site area was established for alternative-33 as shown in Table 5-6.

Table 5-6

(Unit: m^2)

Facility \ Terminal	North	East	West	Total
Warehouses	40,320	10,480	26,400	77,200
Apron	51,876	17,900	33,952	103,728
Total Site Area	92,196	28,380	60,352	180,928

e) Daily Number of inbound and outbound trucks

The number of inbound and outbound vehicles was computed, assuming that the loaded volume per truck is 4.5 tons, that the actual operating time per day is five hours and that the seasonal peak ratio is 30%. The results are shown in Table 5-7.

Table 5-7 Basic Warehousing Data

Item	North	East	West	Total	Remarks
Daily inbound and outbound cargo volume (ton)	1.462	341	688	2,491	
Daily number of inbound and outbound trucks (unit)	325	76	153	554	Actual unit: 277
Hourly number of inbound and outbound trucks (unit)	65	16	31	112	
Peak season hourly number of inbound and outbound trucks (unit)	85	21	41	147	

f) Terminal Employees

The unit number of employees required for each terminal is shown in Table 5-8 based on the following unit employee requirements:

1 clerk/30 ton
2 drivers/truck
and 1 labourer/15 ton

Table 5-8 Terminal Employee Requirements (Alternative-33)

(Unit: person)

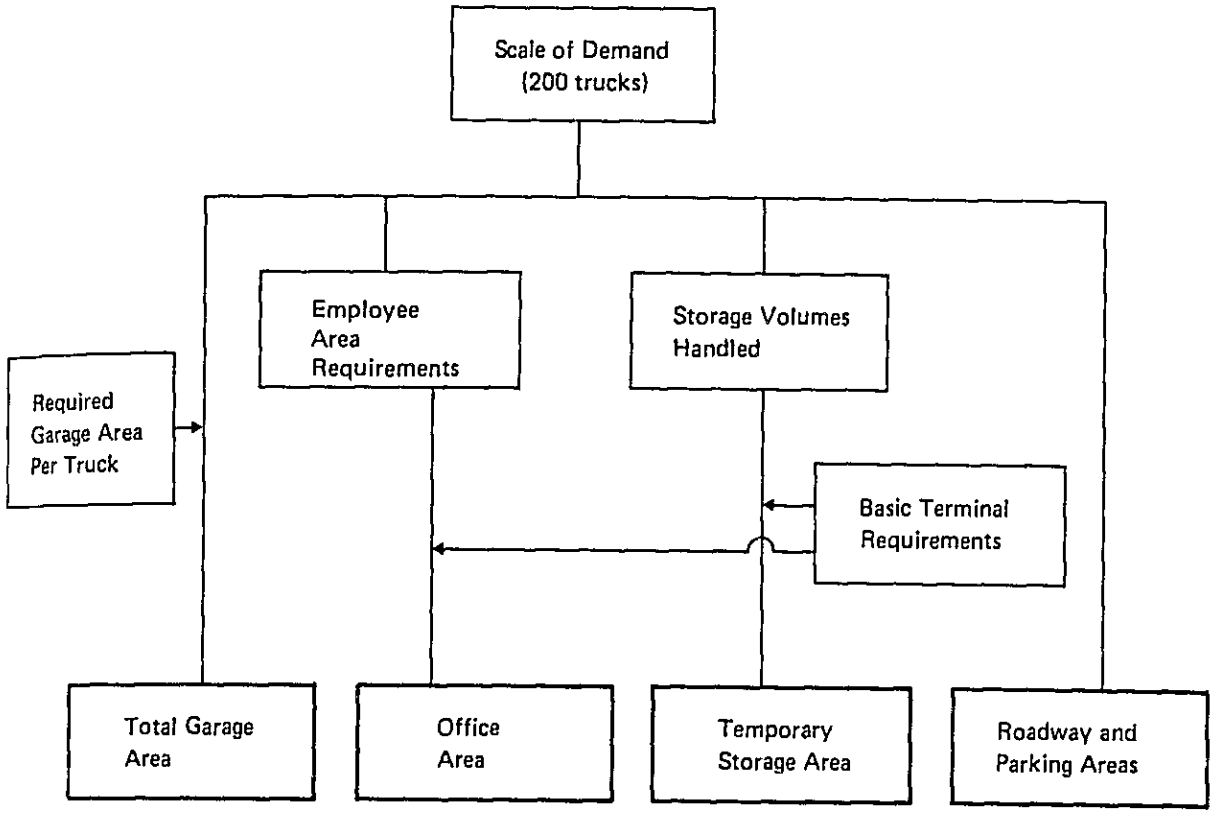
Employee \ Terminal	North	East	West	Total
Clerks	49	12	23	84
Drivers	325	76	153	554
Labourers	98	23	46	167
Total	472	111	222	805

(3) Scale of Facilities for the Chartered Truck Center

In order to encourage the centralization of truck enterprises and to keep trucks from parking on public roads, facilities were planned to accommodate 200 chartered trucks. The work flow for computing the scale of chartered truck center facilities is shown in Figure 5-3.

The chartered truck center facilities include garage, parking area, maintenance area and office. The scale of facilities planned will accommodate 200 trucks at each of the terminals in alternative-33: North, East, West and Central.

Fig. 5-3 DESIGN METHOD FOR CHARTERED TRUCK CENTER FACILITIES



a) Basic units for computation of facilities scale are as follows:

- Garage unit area per truck: 48 m^2 (12 m x 4 m)

- Office area requirements

  10 m^2/man and 1 clerk/10 trucks

  2 m^2/man and 1 driver 0.7 truck

  2 m^2/man and 1 labourer/5 trucks

- Temporary storage area

  1 m^2/2% of the handling volume (tons) per month for operators located in the terminals.

  (Example: 200 trucks x 10 ton/truck/day x 25 days x 0.02 x 1 ton/m^2 = 1000 m^2)

b) Based on the above-mentioned considerations, the total area requirement for 200 chartered trucks at each terminal is as follows:

- Garage area: 9,600 m^2

- Office area: 852 m^2

- Temporary storage area: 1000 m^2

- Roadway determined during the layout phase

(4) Scale of Public Parking Area

For heavy vehicles which are required to wait outside the boundary of the GBA by traffic control, public parking areas will be established in each of the peripheral terminals (ie. North, East and West). The parking areas will accommodate the estimated number of vehicles stopped at the respective GBA boundary location: namely 300 trucks at the North terminal and 200 trucks each at the East and West terminals.

- Unit parking area per truck: 48 m^2 (12 m x 4 m)

- Roadway and general parking area calculated during the layout phase.

(5) Scale of Truck Terminal Administration and Maintenance Facilities

The area for the Truck Terminal Administration building and maintenance area was computed based on the number of trucks and employees who will use the truck terminal, warehouse and chartered truck center (see Tables 5-9 and 5-10).

The work flow for this calculation is shown in Figure 5-4 and the results are shown in Table 5-11.

Table 5-9 Total Number of Trucks Using the Terminal Complex (Alternative-33)

(Unit: Veh./day)

Facility / Terminal	Truck Terminal		Warehouse	Chartered Truck Center	Public Parking Area	Total
	Line-Haul Trucks	Pickup & Delivery Truck				
North	398	493	163	200	300	1,554
East	372	461	38	200	200	1,271
West	359	443	77	200	200	1,279
Central	1,237	1,518	-	200	-	2,955
Total	2,366	2,915	278	800	700	7,059

Table 5-10 Total Number of Terminal Complex Employees (Alternative-33)

(Unit: person)

Employee Category / Terminal	Truck Terminal					Warehouses				Chartered Truck Center				Administration	
	Crew of Line-haul Tracks	Crew of Pickup & Delivery Trucks	Platform Workers	Office Clerks	Sub-Total	Truck Crews	Labourers	Office Clerks	Sub-Total	Truck Crews	Labourers	Office Clerks	Sub-Total	Staff	Total
North	796	592	240	48	1,676	325	98	49	472	286	40	20	346	15	2,509
East	744	554	223	45	1,566	76	23	12	111	286	40	20	346	13	2,036
West	718	532	216	44	1,510	153	46	23	222	286	40	20	346	13	2,091
Central	2,474	1,822	743	149	5,188	-	-	-	-	286	40	20	346	86	5,620
TOTAL	4,732	3,500	1,422	286	9,940	554	167	84	805	1,144	160	80	1,384	127	12,256

Note: "Crew" = Drivers and Assistants.

Table 5-11 Scale of Truck Terminal Administration and Maintenance Facilities (Alternative-33)

(Unit: m^2)

Terminal	Administration Building Area	Petrol Station Area	Maintenance Shop, and Inspection Facilities Area	Car Parking Area (w/o bus terminal, green belt, roadway at)
North	760	2,400	2,400	2,300
East	650	2,400	2,200	1,900
West	650	2,400	2,100	1,900
Central	2,200	4,800	6,000	5,100
TOTAL	4,260	12,000	12,700	11,200

(6) Terminal Layouts

As mentioned before, the layout procedure determined the final scale of each terminal component in order to maintain maximum separation of work mode and efficiency. The basic layouts for alternative-33 are shown in Figures 5-5 to 5-8.

Fig. 5–4 DESIGN METHOD FOR TRUCK TERMINAL SUPPORTING FACILITIES

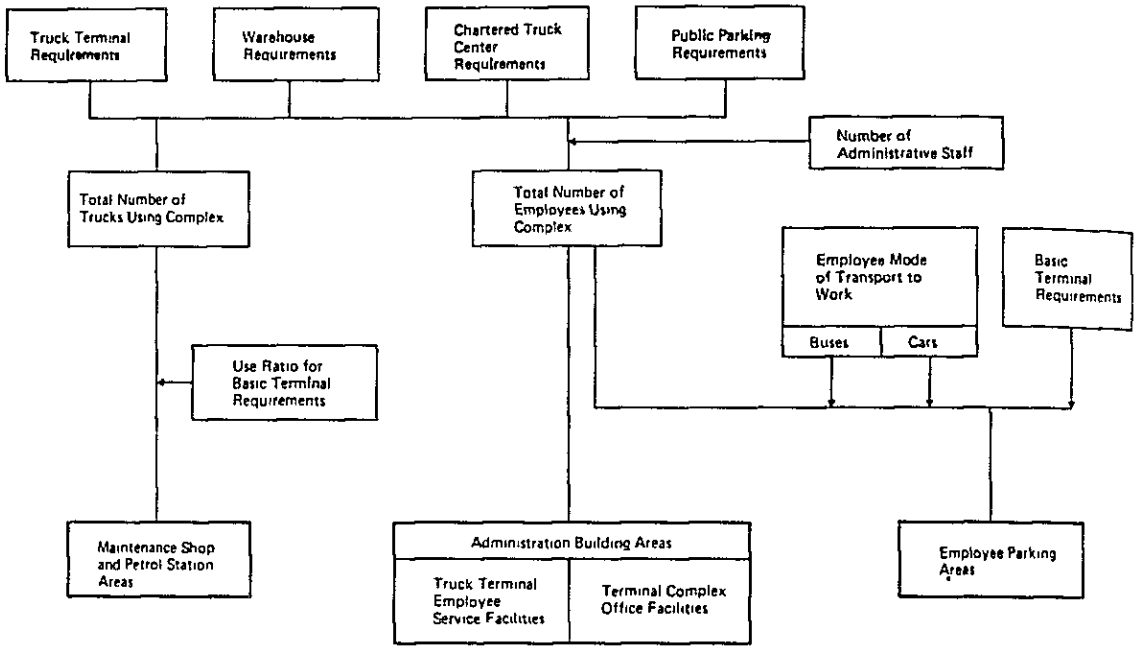


Table 5-12 Summary of Terminal Facilities (Alt. 33)

(Unit: m^2)

Facility	Component \ Terminal	North	East	West	Central	Total
Truck Terminal	° Platform	7,140	6,720	6,300	22,400	42,560
	° Apron	8,925	8,400	7,875	28,000	53,200
	° Offices	1,900	1,800	1,800	6,000	11,400
	° Parking Area	7,500	6,400	6,400	24,725	45,025
	° Roadway	19,800	19,100	18,700	62,500	120,100
	° Others	3,998	5,266	5,134	8,820	23,218
	Sub-Total	49,163	47,686	46,209	152,445	295,503
Warehouse	° Warehouse	40,320	10,480	26,400	-	77,200
	° Apron	51,876	17,900	33,952	-	103,728
	Sub-Total	92,196	28,380	60,352	-	180,928
Chartered Truck Center	° Garage	9,600	9,600	9,600	9,600	38,400
	° Offices	852	852	852	852	3,408
	° Temp. Storage Area	1,000	1,000	1,000	1,000	4,000
	° Roadway/others	11,622	10,626	6,725	7,828	36,801
	Sub-Total	23,074	22,078	18,177	19,280	82,609
Public Parking Area	° Parking Area	14,400	11,040	9,600	-	35,040
	° Roadway	13,400	11,148	6,606	-	31,154
	Sub-Total	27,800	22,188	16,206	-	66,194
Truck Terminal Administration and Maintenance Facilities	° Administration Bldg.	760	650	650	2,200	4,260
	° Petrol Station	2,400	2,400	2,400	4,800	12,000
	° Repair Shop	2,400	2,200	2,100	6,000	12,700
	° Parking Area	3,935	3,190	3,290	7,650	18,065
	Sub-Total	9,495	8,440	8,440	20,650	47,025
Interior Roads (Including Access Road)		61,680	51,168	61,560	49,280	223,688
Total Site Area		263,408	179,940	210,944	241,655	895,947
Total Site Dimensions (meters)		577 x 454	523 x 354	508 x 428	535 x 465	

Fig. 5-5 TERMINAL-N LAYOUT (ALTERNATIVE-33)

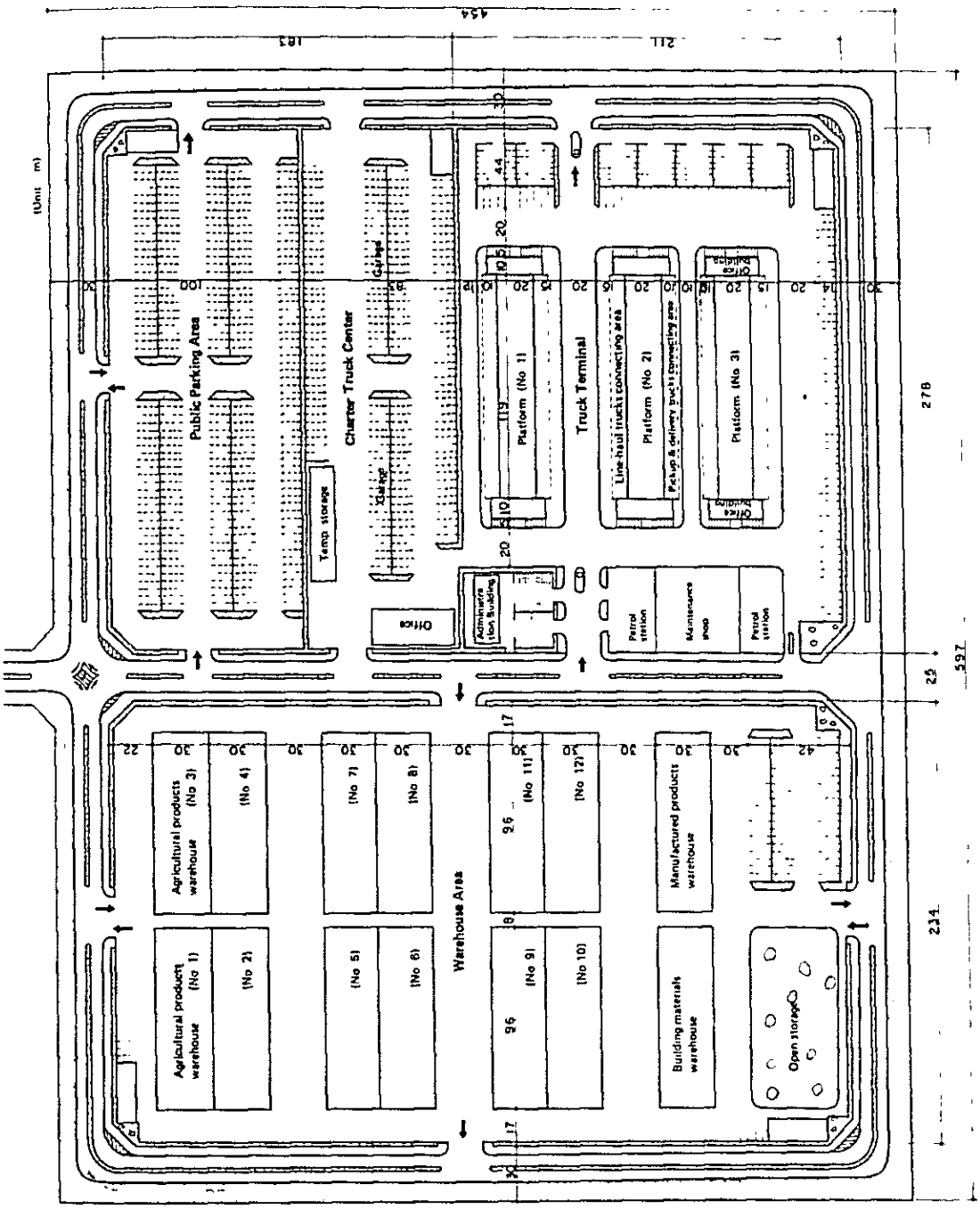


Fig. 5–6 TERMINAL–E LAYOUT (ALTERNATIVE–33)

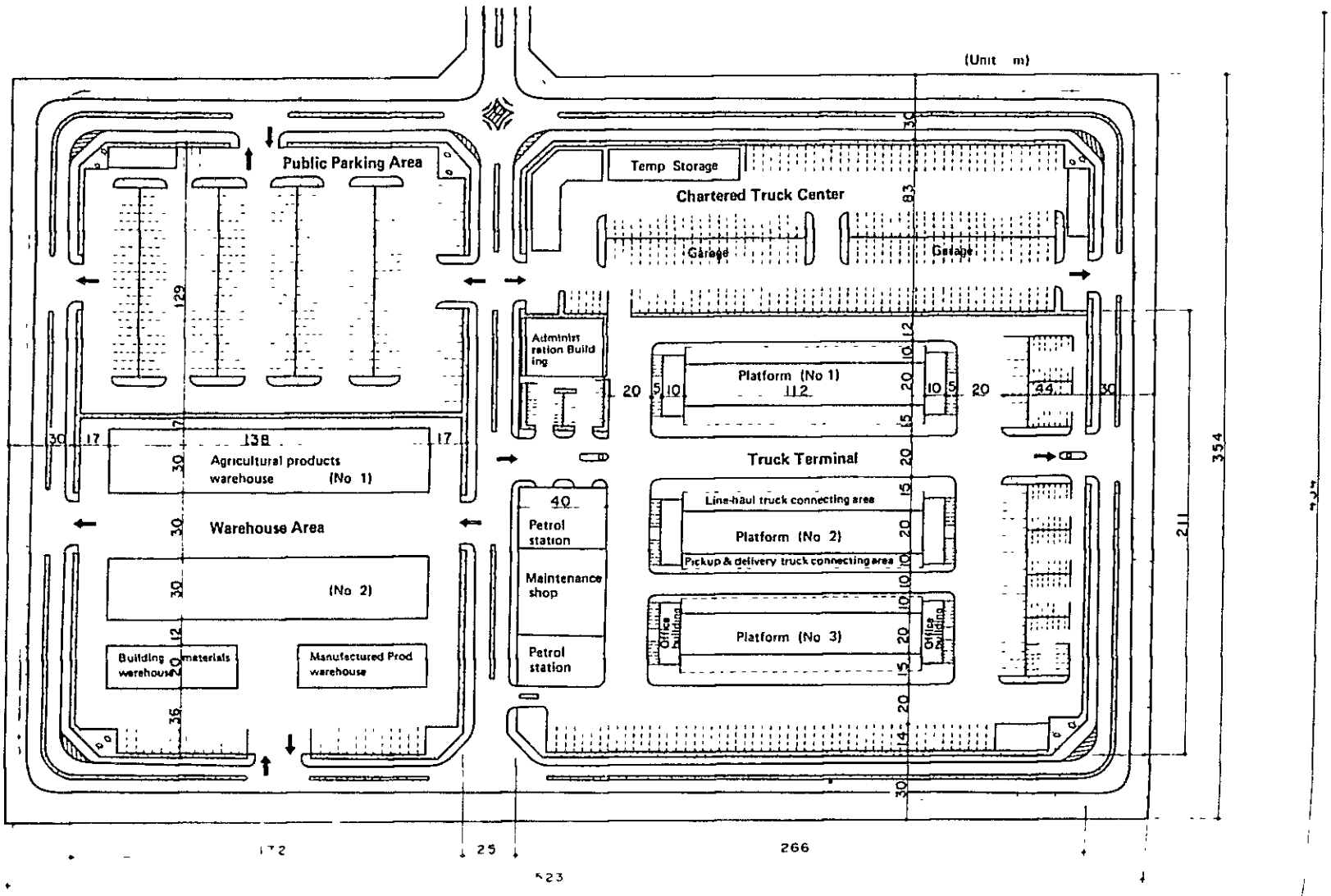


Fig. 5-7 TERMINAL-W LAYOUT (ALTERNATIVE-33)

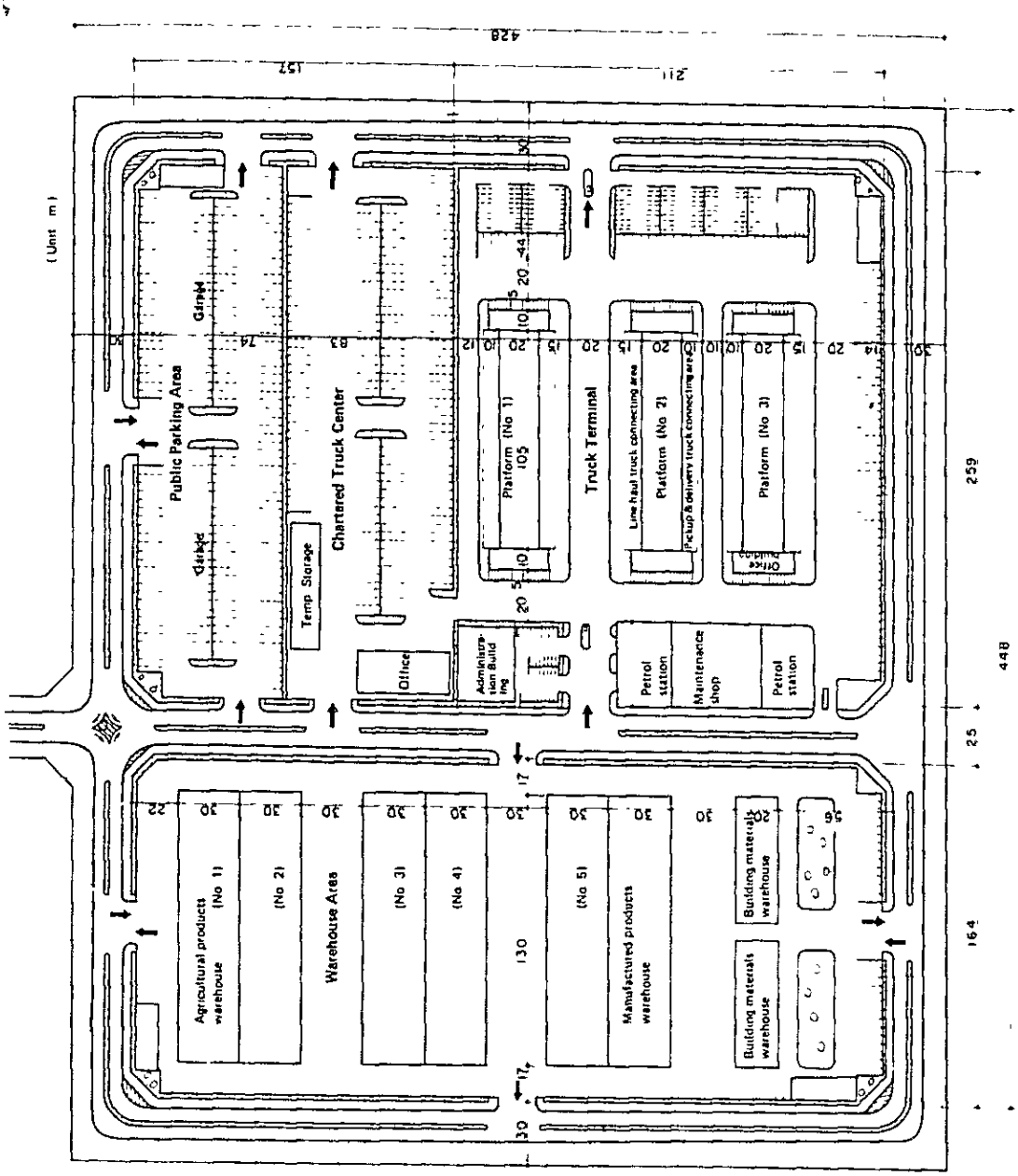
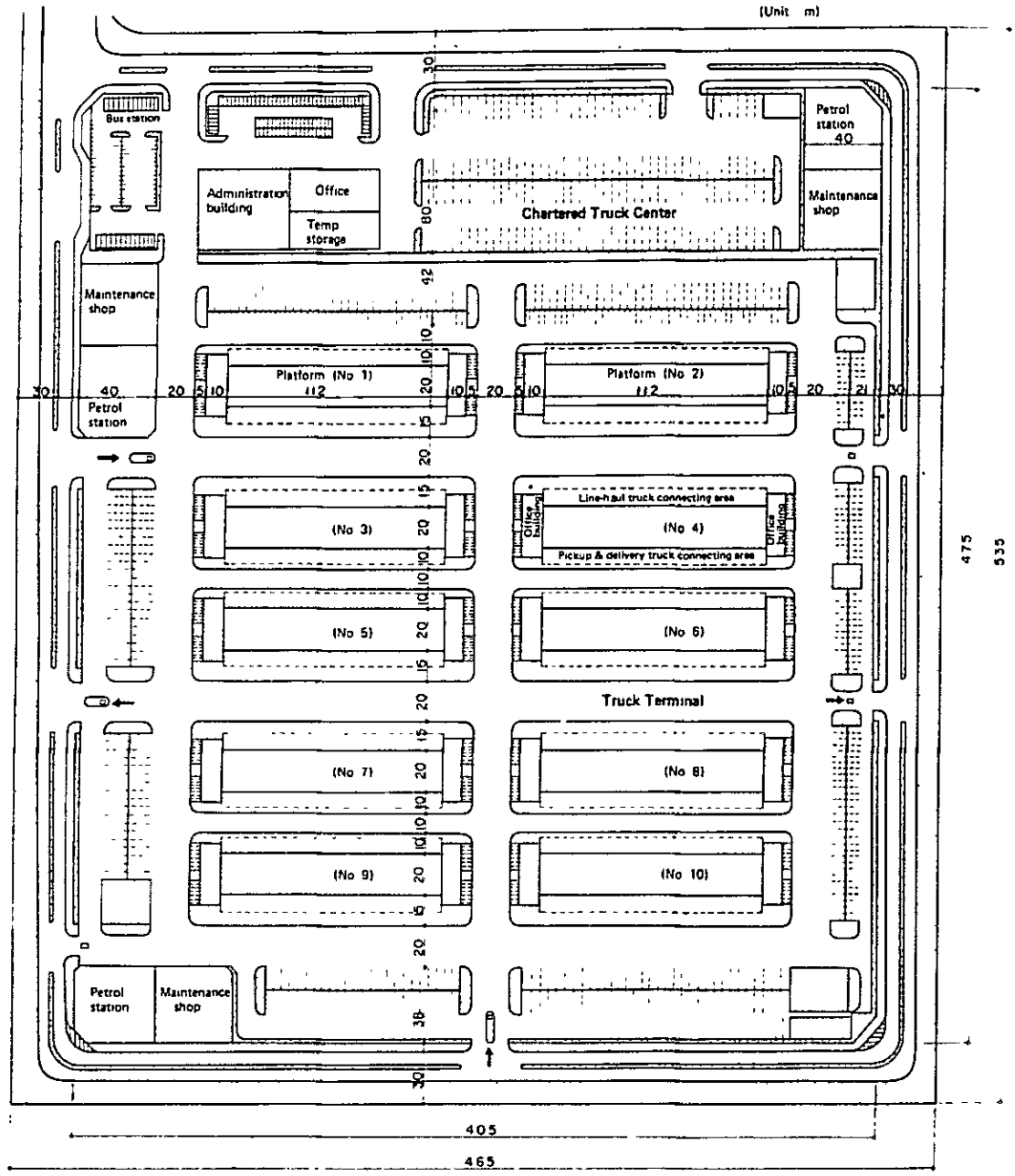


Fig. 5–8 TERMINAL–C LAYOUT (ALTERNATIVE–33)



5.3 Facilities Planning for Alternatives 55 and 7

Alternatives 55 and 7 are two patterns of terminal locations previously proposed by the SEATAC Study and E.T.A. respectively. For alternative-55 the construction of only 3 peripheral terminals is considered: east, west and alternate-north. For Alternative-7, only one terminal (a central terminal) is constructed. Although these alternatives were not judged by this study to offer as large savings as the combination of facilities in alternative-33, the layout and design of the facilities for these alternatives are briefly considered in this section for the purpose of making a financial comparison later on.

The procedure for calculating the scale of facilities is exactly the same as presented in Section 5.2.3 and is based on the standard control volume of 11,831 tons per day. The cargo capacity for each of the terminals in these alternatives is shown below in Table 5-13.

Table 5-13 Cargo Capacity for Truck Terminals

1. (Alternative-55) (Unit: ton/day)

Territory	Volume of Cargo to be Handled			Total
	Inbound	Outbound	Transshipped	
East	1,370	462	24	1,856
West	1,087	672	34	1,793
Alt. North	4,309	3,688	185	8,182
Total Alt.-55	6,766	4,822	243	11,831

2. (Alternative-7)

Total Alt.-7 (Central)	6,766	4,822	243	11,831

In alternative-55, the scale of east and west terminals is exactly the same as in alt.-33. In addition, the Alternate-north Terminal of alternative-55 is approximately equivalent to the sum of the north and central terminals in alternative-33. For alternative-7, the facilities are approximately equal to the total facilities in both other alternatives. The number of trucks and employees using the facilities in the two alternatives considered here are as shown in Tables 5-14 and 5-15. The summary of the area of all terminal facilities is shown in Table 5-16.

The layouts for these alternatives are shown in separate sheets as appendix.

Table 5-14 Total Number of Trucks Using Terminal Complex

1. (Alternative-55)

(Unit: Veh)

Terminal	Truck Terminal		Warehouses	Chartered Truck Center	Public Parking Area	Total
	Line-haul Trucks	Pickup and Delivery Trucks				
East	372	461	38	200	200	1,271
West	359	443	77	200	200	1,279
Alt. North	1,635	2,011	163	200	300	4,309
Total Alt.-55	2,366	2,915	278	600	700	6,859

2. (Alternative-7)

Total Alt.-7 (Central)	2,367	3,569	278	800	700	7,714

Table 5-15 Total Number of Terminal Complex Employees

1. (Alternative-55)

(Unit: person)

Employee Category / Terminal	Truck Terminals					Warehouses				Chartered Truck Center				Administration	Total
	Crew of Line-haul Trucks	Crew of Pickup & Delivery Trucks	Platform Workers	Office Clerks	Sub-Total	Truck Crews	Laborers	Office Clerks	Sub-Total	Truck Crews	Laborers	Office Clerks	Sub-Total	Staff	
East	744	554	223	45	1,566	76	23	12	111	286	40	20	346	13	2,036
West	718	532	216	44	1,510	153	46	23	222	286	40	20	346	13	2,091
Alt. North	3,270	2,414	983	197	6,864	325	98	49	472	286	40	20	346	101	7,789
Total Alt.55	4,732	3,500	1,422	286	9,940	554	167	84	805	858	120	60	1,038	127	11,910

2 (Alternative-7)

Total Alt 7 (Central)	4,734	4,283	1,420	294	10,731	554	167	84	805	1,144	160	80	1,384	86	12,996

Note "Crew" = Drivers and Assistants

Table 5-16 Summary of Terminal Facilities

1. (Alternative-55)

(Unit; m^2)

Facility	Terminal Component	East	West	Alternate North	Total
Truck Terminal	° Platform	6,720	6,300	30,240	43,260
	° Apron	8,400	7,875	37,800	54,075
	° Admin. Offices	1,800	1,800	7,200	10,800
	° Parking Area	6,900	6,700	30,243	43,843
	° Roadway	19,100	18,700	80,600	118,400
	° Others	4,766	4,834	17,113	26,713
	Sub-Total	47,696	46,209	203,196	297,091
Warehouse	° Warehouse	10,480	26,400	41,400	78,280
	° Apron	17,900	33,952	52,340	104,192
	Sub-Total	28,380	60,352	93,740	182,472
Chartered Truck Center	° Garage	9,600	9,600	9,600	28,800
	° Offices	852	852	852	2,556
	° Temp. Storage Area	1,000	1,000	1,000	3,000
	° Roadway/others	10,626	10,045	11,148	31,819
	Sub-Total	22,078	21,497	22,600	66,175
Public Parking Area	° Parking Area	11,040	9,600	14,400	35,040
	° Roadway	11,148	9,566	11,830	32,544
	Sub-Total	22,188	19,166	26,230	67,584
Truck Terminal Administration & Facilities	° Administration Bldg.	650	650	2,860	4,160
	° Petrol Station	2,400	2,400	7,200	12,000
	° Repair Shop	2,200	2,100	8,200	12,500
	° Parking Area	3,190	3,290	13,740	20,220
	Sub-Total	8,440	8,440	32,000	48,880
Interior Roads (Including Access Roads)		56,370	61,760	93,150	211,280
Total Site Area		185,142	217,424	470,916	873,482
Total Site Dimensions (meters)		523x354	508x428	762x618	—

2. (Alternative-7)

Central
42,840
53,550
10,800
50,907
111,387
22,110
291,594
76,950
101,990
178,940
38,400
3,408
4,000
46,872
92,680
33,600
28,660
62,260
4,100
13,200
12,900
11,850
42,050
122,710
790,234
943x838m

5.4 Estimated Construction and Maintenance Costs

5.4.1 General

A unit price was established for each construction item using basic cost elements such as labour, materials, equipment, overhead, profit, etc. The unit prices were computed in accordance with the following criteria.

(1) The estimates are made on the assumption that all construction works will be contracted to general contractors by international tender.

(2) The unit prices were computed under the economic conditions prevailing in September, 1979.

(3) The cost was estimated for all alternatives and was classified into foreign currency (indicated in Baht) and local currency (indicated in Baht) portions.

Foreign currency and local currency components of each unit price were computed based on the following classification of basic cost elements.

The foreign currency component consists of the costs of:

- Imported equipment, materials and supplies;
- Domestic materials of which the country is a net importer;
- Wages of expatriate personnel; and
- Overhead and profit of foreign firms.

The local currency component includes the cost of:

- Domestic materials and supplies of which the country is a net exporter;
- Wages of local personnel;
- Overhead and profit of local firms; and
- Taxes.

(4) The unit price of each work item is obtained by accumulating the labour cost, equipment cost, material cost, etc. for the item, and the result was checked against recent actual figures for construction works in Thailand.

(5) Major materials costs are classified under the following 8 items: fuel, reinforcing bars, structural steel, fine aggregate, coarse aggregate, cement and asphalt.

(6) Land acquisition costs are based on the unit cost data obtained from Land Transport Department.

(7) For all unit prices a constant allowance of 30% for overhead and profit was added to the direct unit prices.

(8) Contingency was assumed to be 15% of the total of construction cost, land acquisition and compensation costs, final engineering, supervision fees and administration cost.

(9) The final engineering, supervision fees and administration cost, etc. were assumed to be 10% of the total of construction cost, and the breakdowns are as follows:

- Final Engineering: 3%

- Supervision, Administration and others: 7%

5.4.2 Unit Prices

(1) Unit Costs of Materials

The unit cost data of material was collected. The imported and and local materials are based on market prices in Bangkok. The unit costs of the major material items are as shown in Table 5-17.

Table 5-17 Unit Cost of Major Materials

Major Material	Unit	Unit Cost (฿)	
		Foreign Cost Component	Local Cost Component
Fuel (Diesel Oil)	LIT	4.88	-
Fuel (Gasoline)	"	7.84	-
Reinforcing bar	TON	7,800	-
Structural steel	TON	15,000	-
Fine aggregate	CU.M.	-	140
Coarse aggregate	CU.M.	-	155
Cement	TON	3,200	1,150
Asphalt	TON	3,200	-

(2) Unit Costs of Labor

The unit labor cost is based on the actual cost prevailing in Bangkok. The following are the costs for major classes of labor.

(3) Local labor

Foreman, General	23 ฿/hr.
Plant Operator	15 ฿/hr.
Driver	12 ฿/hr.
Mechanic	10 ฿/hr.
Carpenter	12 ฿/hr.
Skilled Labor	12 ฿/hr.

Heavy Labor	6 ฿/hr.
Common Labor	6 ฿/hr.

The estimated labor rates include social benefits, insurances, travel costs, sick leave, etc. and are based on the rates given by ETA (Expressway and Rapid Transit Authority of Thailand).

(3) Equipment Costs

An assessment of equipment hourly costs was made for the plant that would probably be used in the construction of the project. Main equipment rates are shown in Table 5-18.

That is, the estimated hourly owning costs are calculated based on the estimated market prices at Bangkok and the operation costs (fuel, lubricant and other expenses) are based on the market prices in Bangkok.

Table 5-18 Equipment Direct Cost Per Hour

Unit: ฿/hr.

No.	Equipment	Direct Hourly Costs	
		Foreign Cost	Local Cost
1.	Bulldozer 17 ton (D6C), 140 H/P	751	177
2.	Motor Grader (LG2-H), 120 H/P	548	152
3.	Excavator 0.53 - 0.6 m^3 (MS 160), 125 H/P	605	173
4.	Macadam Road Roller 10 t (WN102), 60 H/P	279	86
5.	Tire Roller 10 t (MR20)	348	105
6.	Dump Truck 3 CU.M	163	40
7.	Asphalt Distributor 4,000 l (DS-36-Date), W = 66 ton	631	201
8.	Flat Bed Truck 4.5 t (FK-102F), 130 H/P	181	45
9.	Asphalt Plant 100 t/hr. (NAP-1, 600AZW)	5,462	1,706
10.	Aggregate Spreader (NS45B)	992	307

5.4.3 Unit Cost by Work Items

The unit cost by work item is calculated from the material cost, labor cost, equipment cost etc. taking into consideration the local conditions in Bangkok. The results of the unit costs by items are as listed in Table 5-19.

Table 5-19 Unit Cost by Work Item

Description	Unit	L.C. in ฿	F.C. in ฿
Clearing and Grubbing	m^2	1.0	3.0
Embankment with Borrow Material	m^3	76.0	143.1
R.C. Pipe Culvert D = 40 cm	m	659.0	61.0
R.C. Pipe Culvert D = 100 cm	m	2170.0	282.0
D-Ditch 0.3 x 0.5	m	540.0	135.0
U-Ditch 1.0 x	m	2103.0	430.0
Cement Concrete Pavement	m^2	373.0	154.0
Asphaltic Concrete Pavement	m^2	221.0	427.0
Transshipment Platform	m^2	2115.0	2115.0
Docking Yard	m^2	373.0	154.0
Control and Business Offices	m^2	3630.0	3630.0
Parking Yard	m^2	373.0	154.0
Warehouse	m^2	1440.0	1440.0
Carage	m^2	1440.0	1440.0
Control Offices	m^2	3630.0	3630.0
Petrol Station	m^2	2907.0	2907.0
Maintenance Shop	m^2	2115.0	2115.0

5.4.4 Land Acquisition Costs for Alternatives 33, 55 and 7

The land acquisition costs for each terminal proposed were calculated according to the highest data on district land prices obtained from the Department of Land Transport. Final unit land acquisition costs per square meter shown below include a 10% allowance.

Table 5-20 Land Acquisition Cost

Terminal Location	Land Acquisition Cost ฿/m^2	Land Acquisition Cost ฿/rai	Index Based on Central Area
North	550	880,000	23
East	206	329,600	9
West	138	220,800	6
Central	2,416	3,865,600	100
Alt.-North	1,208	1,932,800	50

Source: Market prices for land as determined by the Department of Land Transport at the places and on the dates mentioned below.

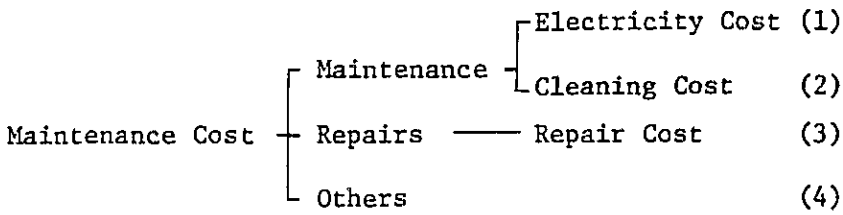
Tambol	Amphoe	Date of Assessment
Prachatipat	Tanyaburi	18 Dec., 1978
Klong 1	Klong Luang	"
(Various)	Bang Plee/	"
(")	Bang Bo	"
(")	Bang Kunthien/	23 Nov., 1978
	Phasi Charoen/	"
	Khong Kham	"

5.4.5 Preliminary Construction Cost Estimates in 1979 Prices

The preliminary construction cost estimates were calculated for the 3 cases illustrated in Tables 5-24 to 5-26 by computer based on the quantities estimated in the preliminary design and on the unit prices by work items. The cost is split into foreign currency and local currency components.

5.4.6 Maintenance Cost

The maintenance has been defined as "the preserving and keeping of each type of roadway, terminal platform houses, and facility as nearly as possible in its original condition as constructed or as subsequently improved." The maintenance cost is estimated for the following items.



(1) Electricity Cost

This includes the cost of electricity for lighting and other facilities and services.

(2) Cleaning Cost

This includes the cost of cleaning road surfaces, drainage facilities, etc.

(3) Repair Cost

This includes the cost of road surface repairs, overlays, painting of facilities and inspection of terminal facilities.

(4) Indirect Cost

This assumed at 10% of the total of items 1) to 3).

5.5 Staged Construction

5.5.1 Construction Plan

(1) Construction Period

According to the overall construction plan of the Truck Terminal Construction Project, the maximum possible construction period for each stage of construction is 2 years for each terminal. Considering this condition, the following assumptions are made for the construction works.

(2) Working Day

The existing situation in Thailand is that the usual working day is 7 hours. However, at construction sites the average actual working time is found to range from 7 to 10 hours.

(a) Number of working days in a month

According to the rainfall data, shown in Table 5-22. the number of working days in a month is assumed as follows:

Table 5-21 Number of Working Days in A Month

Month	Dry Season 11-3 (5 months)	Rainy Season 4-10 (7 months)
Average number of rainy days in a month	3 days	17 days
Working efficiency on a rainy day	65%	35%
Number of holidays	5 days	5 days
Number of actual working days in a month	24 days	14 days
Working efficiency in a month	80% (24/30)	47%(14/30)

Therefore, the working efficiency throughout the year is assumed as follows:

$$\frac{223 \text{ days}}{365} = 61\%$$

Table 5-22 Rainfall Record in the Project Area (1973-1974)

Month	Rainfall(in millimeters) Total		Max. in 24 hours		Days of rain		Percentage humidity Monthly mean (8 hours)		Min. daily range	
	1973	1974	1973	1974	1973	1974	1973	1974	1973	1974
	Phra Nakhon Lat. 13°44' N Long. 100°30' E									
January	0	0.7	-	0.7	-	1	74.0	74.8	43.4	40.2
February	0	0	-	-	-	-	74.9	73.9	42.0	38.4
March	102.6	10.2	52.8	4.3	9	4	78.7	75.9	31.9	36.5
April	5.6	130.2	4.9	27.8	2	13	76.3	79.8	35.2	32.5
May	157.5	179.3	36.8	47.7	18	17	79.6	80.5	32.8	29.2
June	131.9	82.3	48.0	23.4	16	13	78.6	75.9	29.5	26.6
July	68.5	129.9	26.3	39.0	14	18	77.2	78.3	28.9	29.8
August	97.3	160.9	30.5	29.9	20	22	78.6	81.0	29.4	29.4
September	364.7	219.7	64.4	70.8	25	19	81.2	80.9	27.2	31.1
October	113.8	471.2	30.9	109.4	15	23	80.7	86.2	32.3	25.8
November	36.8	134.8	14.6	63.0	5	9	76.3	81.1	33.3	31.2
December	11.2	0	11.2	-	1	-	70.4	75.1	39.9	36.4

Note: Data from Statistical Yearbook Thailand, National Statistical Office, Office of the Prime Minister.

(3) Staged Construction

The construction of the truck terminals requires a very large investment due to the size of facility requirements. For this reason and to obtain maximum economic benefit, it is desirable to study different patterns of staged construction to meet the demand levels at various stages instead of completing all elements of the terminals or all the terminals from the initial stage.

In the following paragraphs a description is made of each of the staged alternatives considered.

(a) Delayed Construction of some terminals

Three construction combinations of terminals have been selected as the main project alternatives; they are listed as follows:

- Alternative 33 : Construct Terminal N, E, W and C
- Alternative 55 : Construct Terminal E, W and Alt.-N
- Alternative 7 : Construct Terminal C

The staged construction orders for terminals in alternatives 33 and 55 were decided according to traffic demand described in Chapter 3 as shown below.

- Alternative 33

  First priority - Terminal C
  Second priority - Terminal N, E and W

- Alternative 55

  First priority - Terminal Alt.N
  Second priority - Terminal E and W

(b) Stage Construction of Terminal Elements

As described in Chapter 4, the planned terminal elements in each terminal are not constructed at the same time. Instead, it has been recommended that three or four stages of construction for the various truck terminal elements be executed according to traffic demand as shown in Figs. 5-9 to 5-14.

After careful study of the data collected during the field investigations and of the construction cost estimates of each link, it is recommended that each terminal be sub-divided into various stages with regard to the scale of work as mentioned above.

5.5.2 Construction Schedule

Before beginning construction, it will be necessary to carry out pre-construction preparatory works such as topographical survey, soils investigation, detailed design, land acquisition, and procurement of finance.

The period required for such preparatory procedures is estimated to be about 24 months.

The detailed design will take about twelve months and assuming that at the same time, negotiations and financial procurement are successful, land acquisition can begin.

During the period required for land acquisition to be completed, the contract for construction can be approved and awarded. Mobilization for construction can begin after the contract is awarded.

The construction schedule outlined above is shown in Figs. 5-15 to 5-20.

5.6 Cost Estimate

In view of the desire to arrive at the most economically feasible proposal for the truck terminals, cost estimates were made for each of the alternatives being evaluated in terms of three configurations of project elements:

- Total Complex (Truck Terminal, Warehouses, Chartered Truck Center and Public Parking Area)
- Truck Terminal and Warehouses only
- Truck Terminal only

The results of cost estimation are shown in Appendix Table AP5-1 through 5-14 results are summarized in Table 5-23 which indicates the following:

1. In terms of total cost, alternatives 55 and 7 are respectively 10% less costly and 30% more costly than alternative 33. The main reason for alternative 7's high cost is the high cost of land in the central area. Even in alternative 33, the terminal in the central area is 73% of the total alternative 33, land acquisition cost.

2. By considering different configurations of project elements, total project cost can be reduced 17-21% in the case of truck terminal and warehouse only or 36-49% in the case of constructing only the truck terminal elements.

Table 5-23 Financial Cost Summary

(Unit : 1000 Baht)

(1) TOTAL PROJECT COST	Alt. 33	Alt. 55	Alt. 7
Total Complex	3,398,850 (100)	3,044,251 (90)	4,422,417 (130)
T.T. + Warehouses	2,843,550 (84)	2,520,022 (74)	3,479,710 (102)
T.T. Only	2,181,089 (64)	1,686,878 (50)	2,272,139 (67)

(2) FACILITY COSTS	Alt. 33	Alt. 55	Alt. 7
Total Complex	1,857,110 (100)	1,764,042 (95)	1,715,355 (92)
T.T. + Warehouses	1,552,237 (84)	1,465,016 (79)	1,383,238 (74)
T.T. Only	1,111,864 (60)	963,318 (52)	918,308 (49)

(3) LAND ACQUISITION COSTS	Alt. 33	Alt. 55	Alt. 7
Total Complex	912,695 (100)	706,727 (77)	1,958,689 (215)
T.T. + Warehouses	765,188 (84)	579,805 (64)	1,504,273 (165)
T.T. Only	671,823 (74)	405,478 (44)	965,634 (106)

N.B. T.T. - Truck Terminal

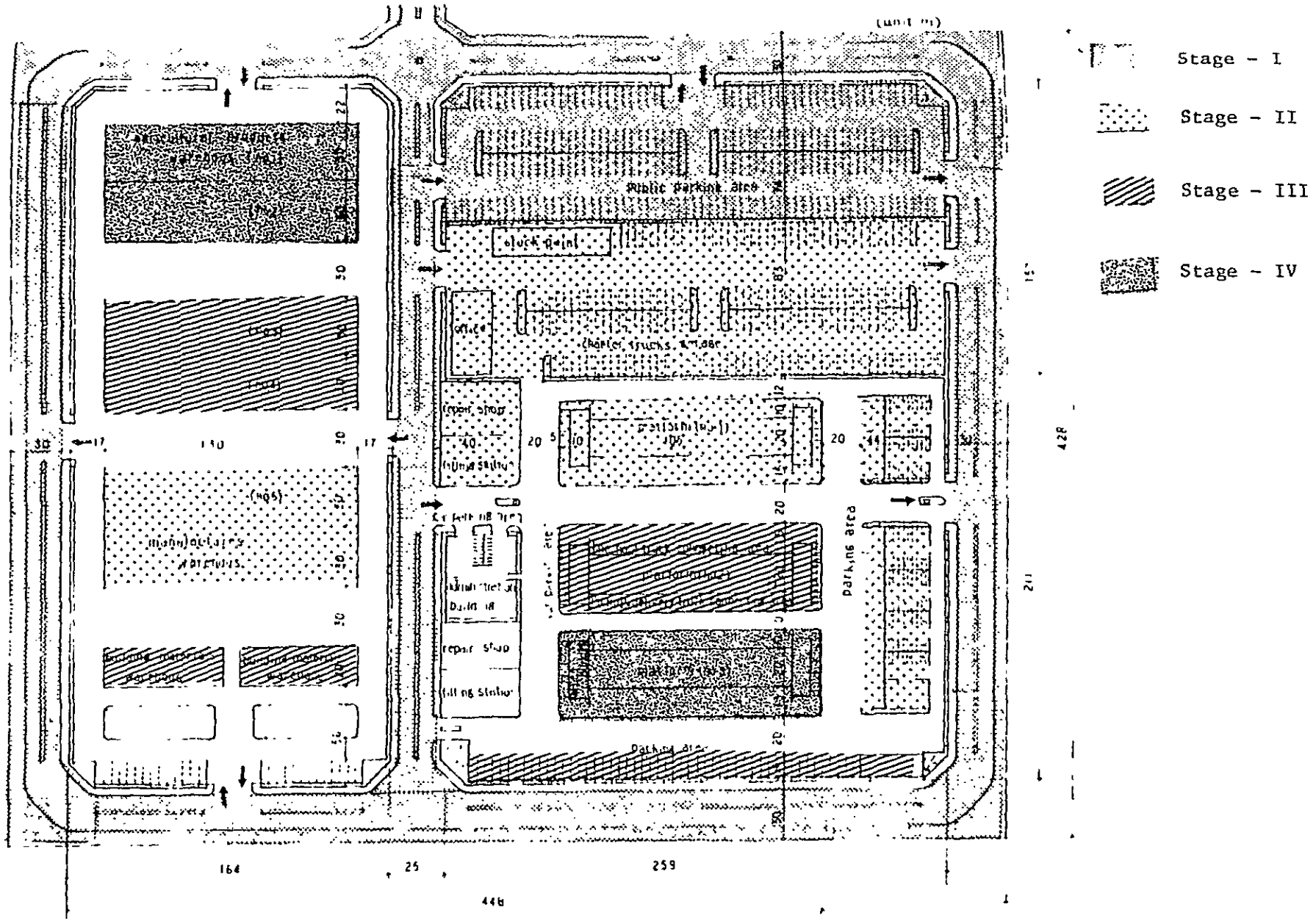

Stage - I
Stage - II
Stage - III
Stage - IV
Public parking area
Block Paint
Office
Repair shop
Filling Station
Parking area
164
25
259
448

Fig. 5–10 CONSTRUCTION STAGES FOR TERMINAL–E (ALTERNATIVE–33)

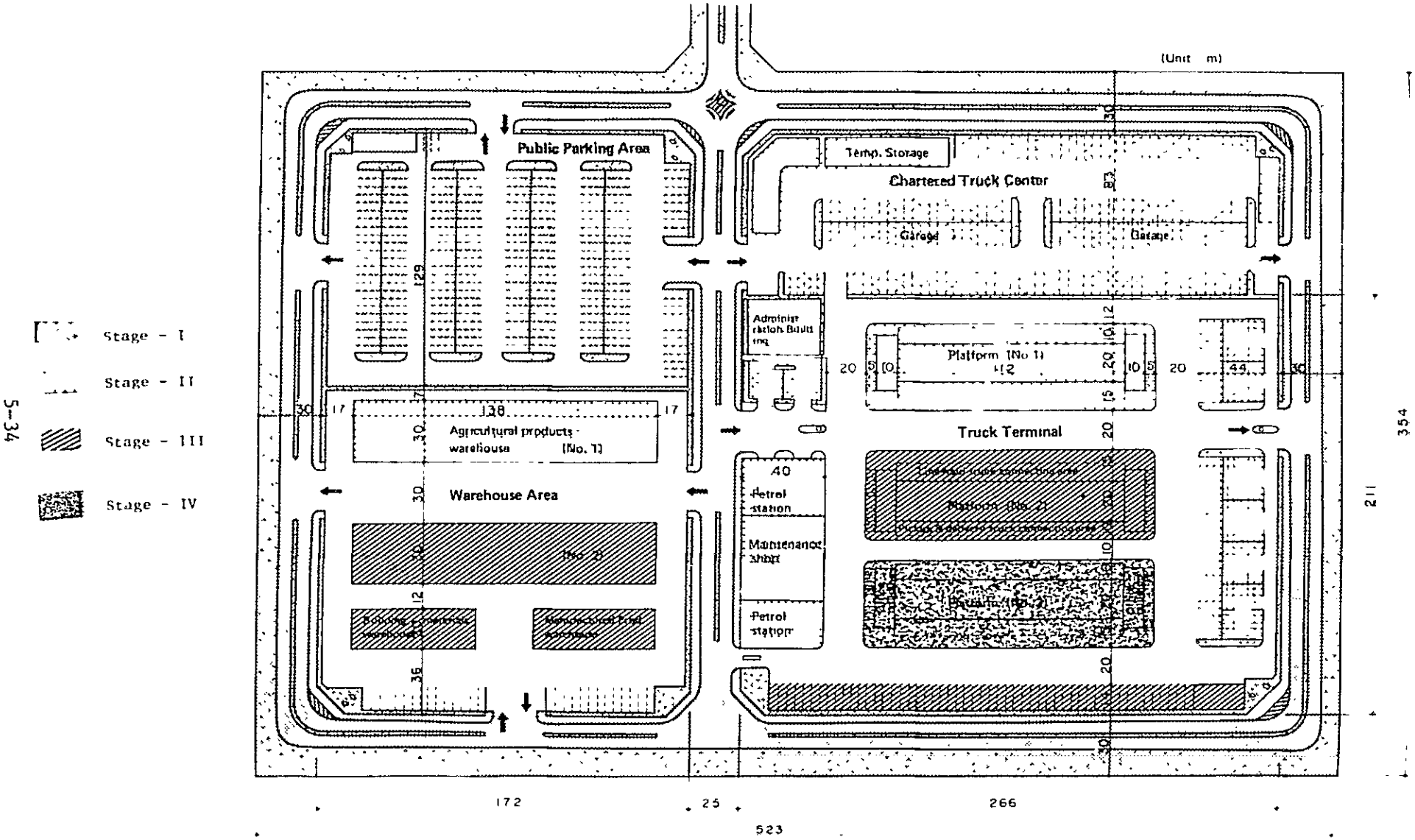
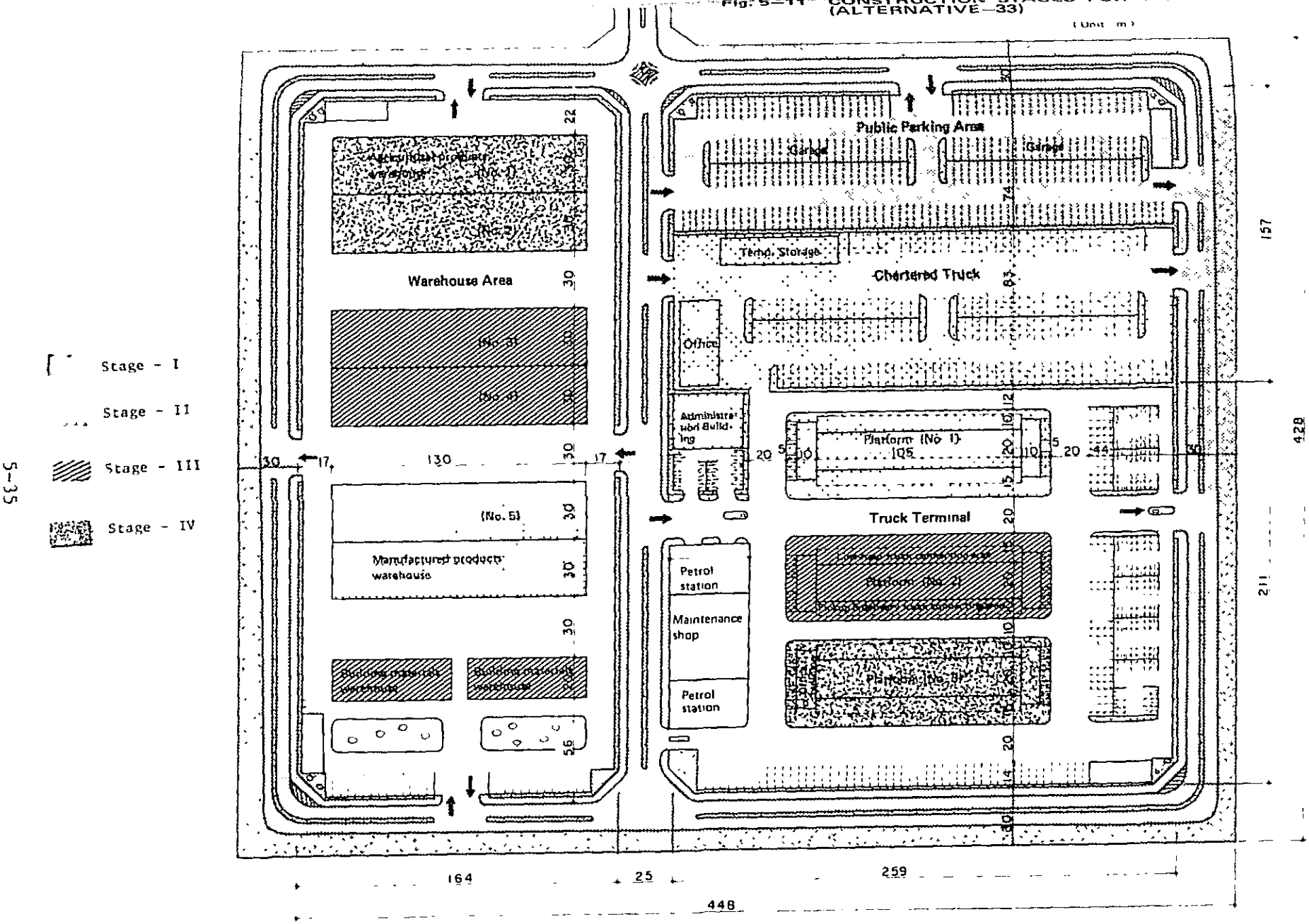
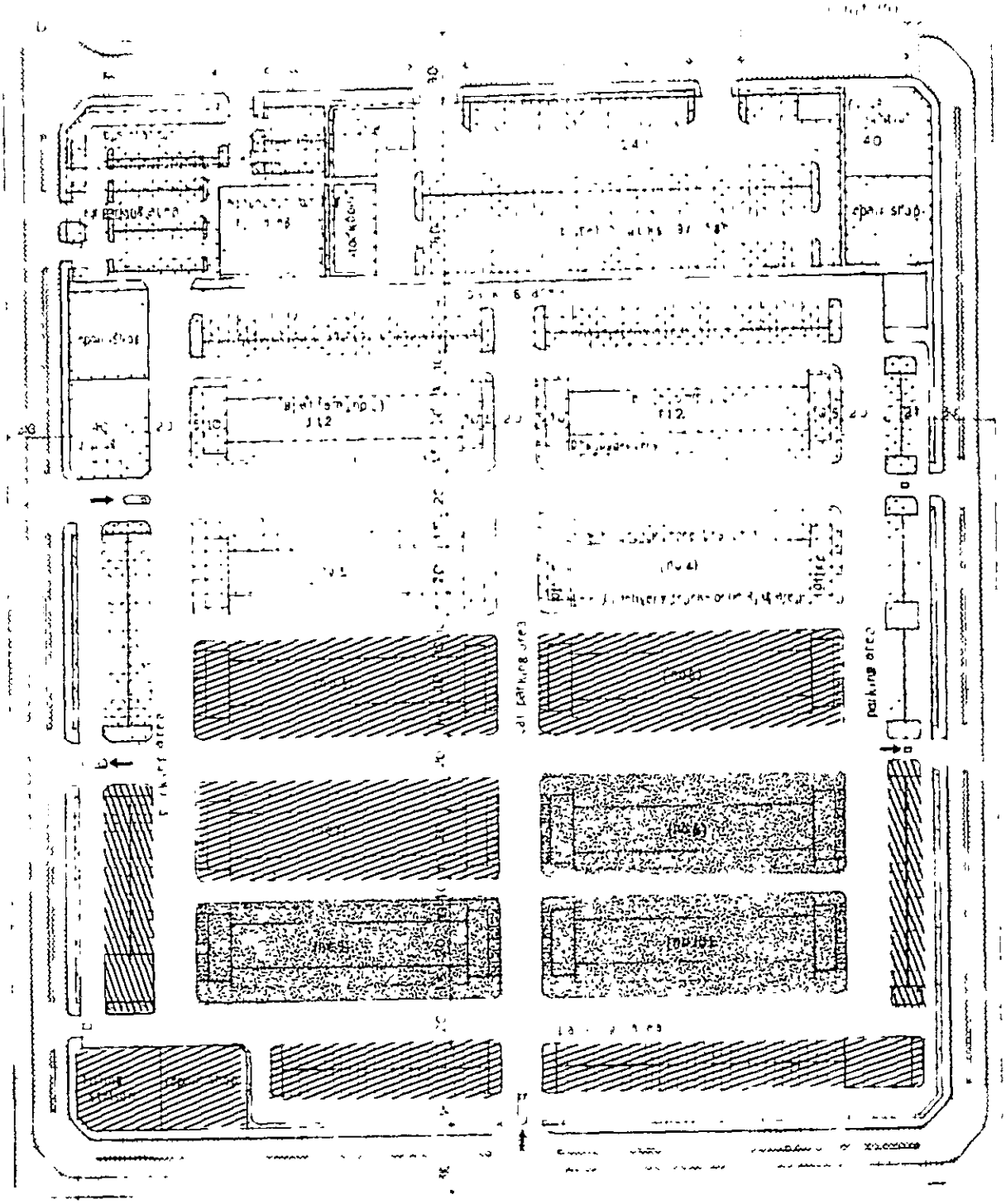


Fig: 5-11 CONSTRUCTION STAGES FOR TERMINAL-W (ALTERNATIVE-33)





Stage - I

Stage - II

Stage - III

Stage - IV

Fig. 5–12 CONSTRUCTION STAGES FOR TERMINAL–C (Alt. 33)

Fig 5 13 CONSTRUCTION STAGES FOR TERMINAL N (Alt 55)

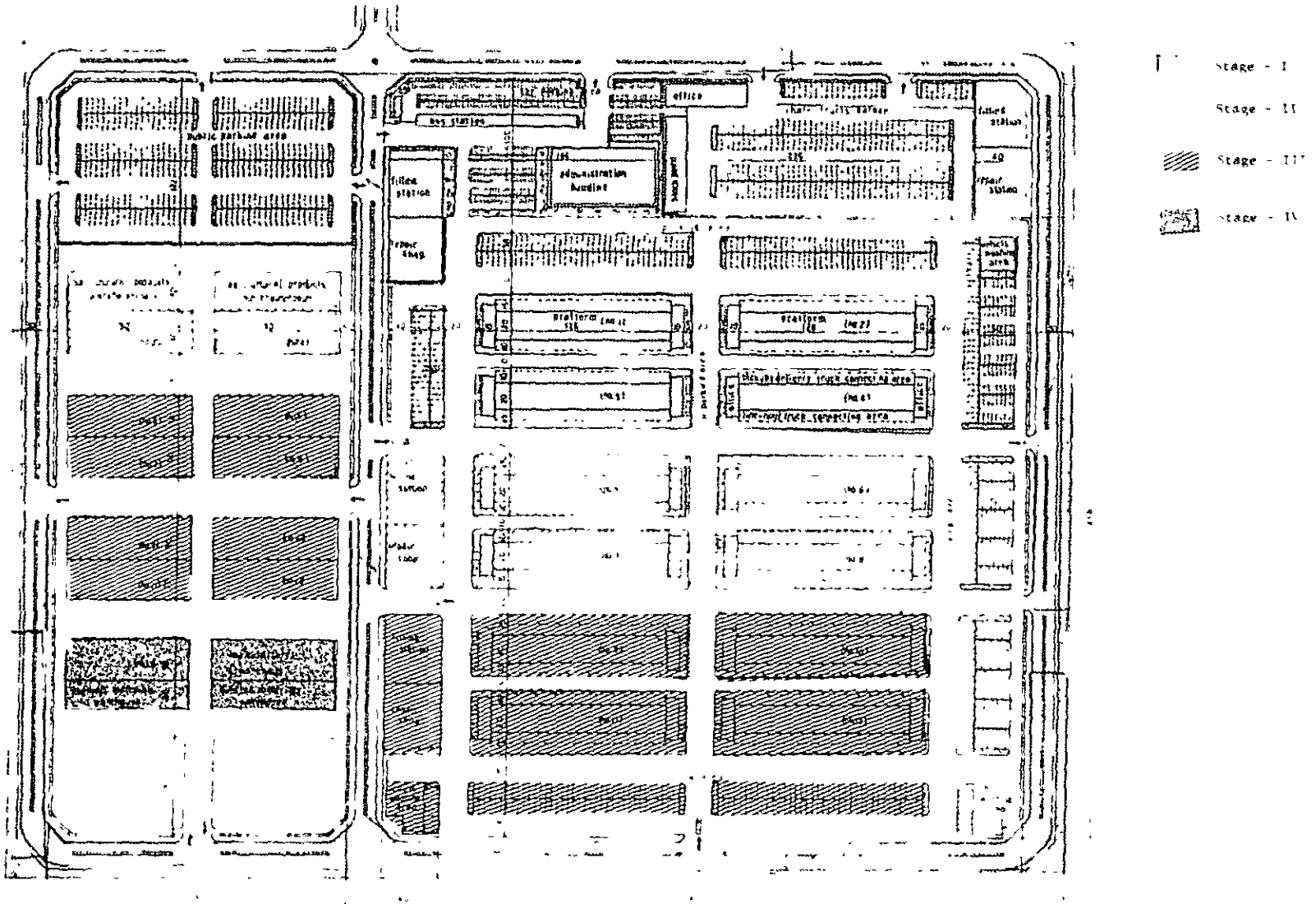


Fig. 5–14 CONSTRUCTION STAGES FOR TERMINAL–C (Alt. 7)

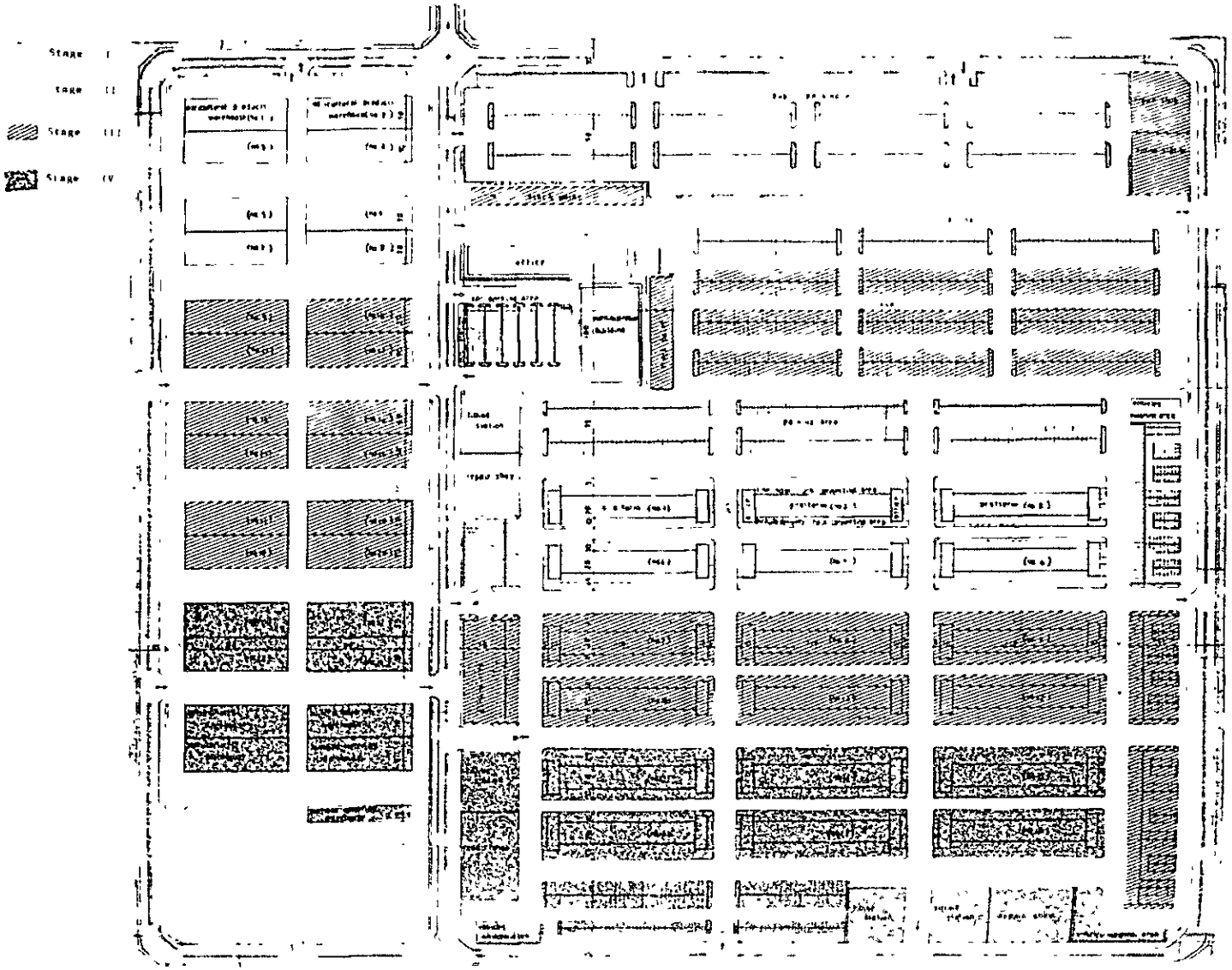


Fig 5-15 CONSTRUCTION SCHEDULE FOR TRUCK TERMINAL-N (ALTERNATIVE-33)

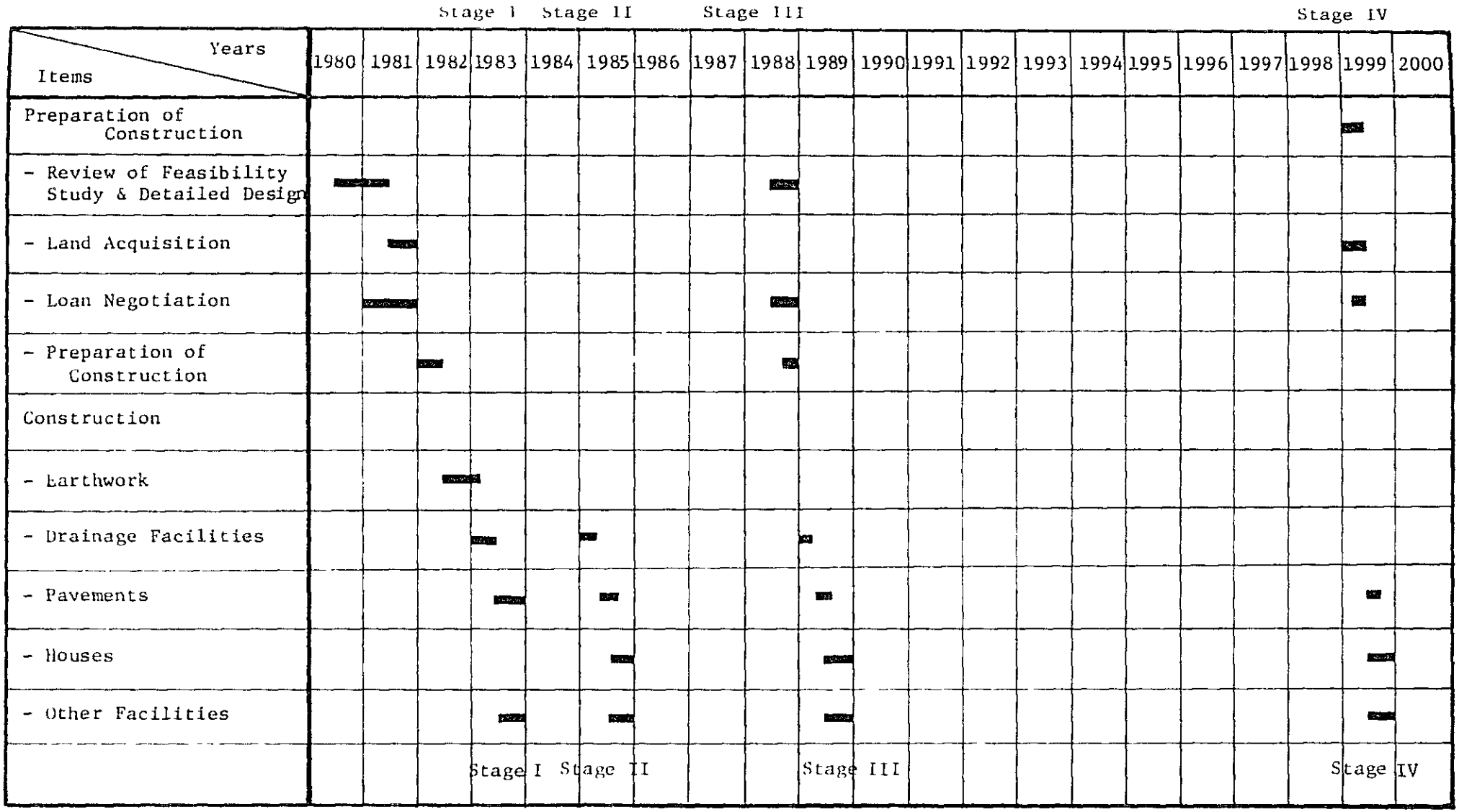


Fig. 5–16 CONSTRUCTION SCHEDULE FOR TRUCK TERMINAL–E (ALTERNATIVE–33)

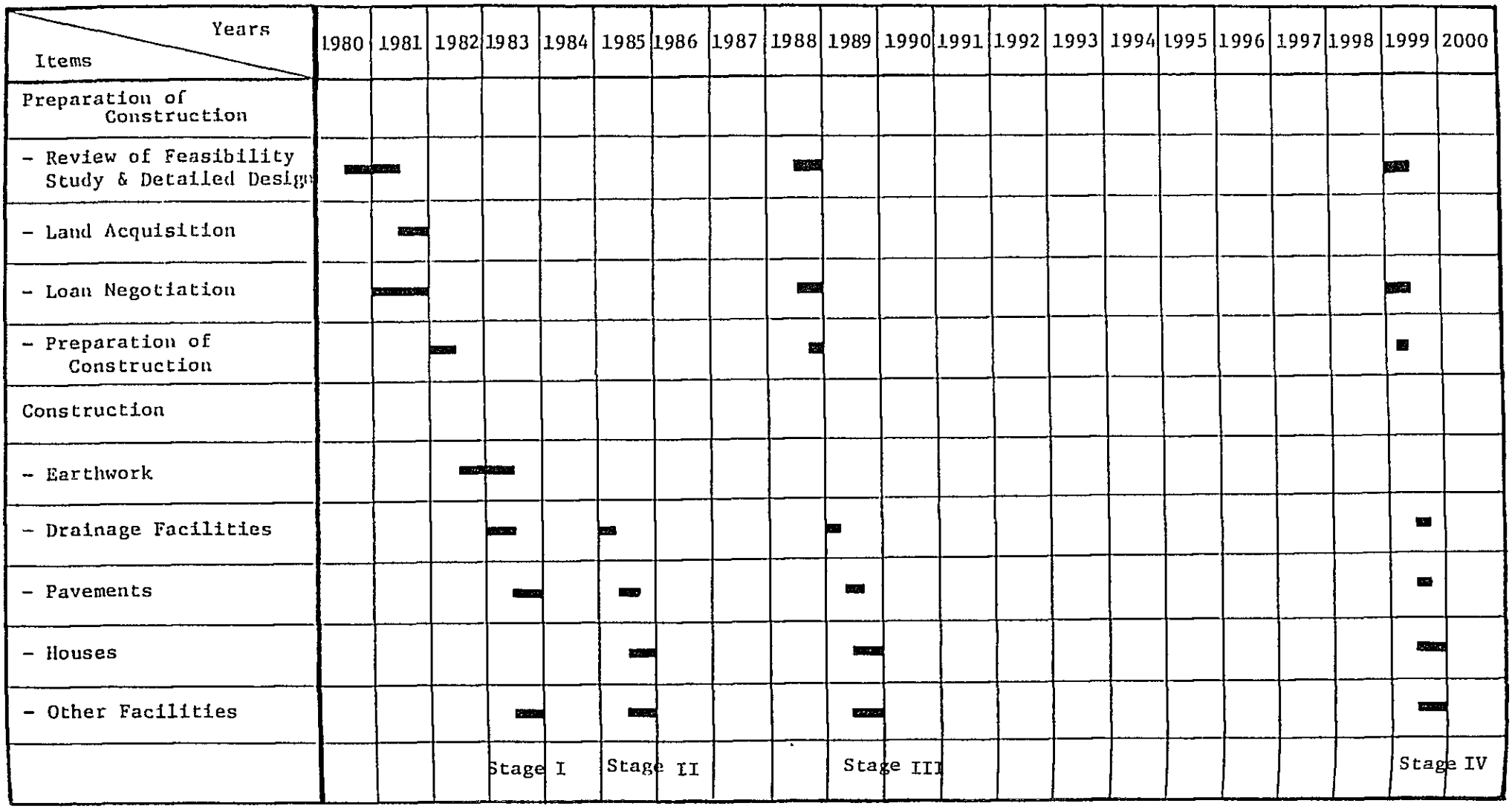


Fig. 5—17 CONSTRUCTION SCHEDULE FOR TRUCK TERMINAL—W (ALTERNATIVE—33)

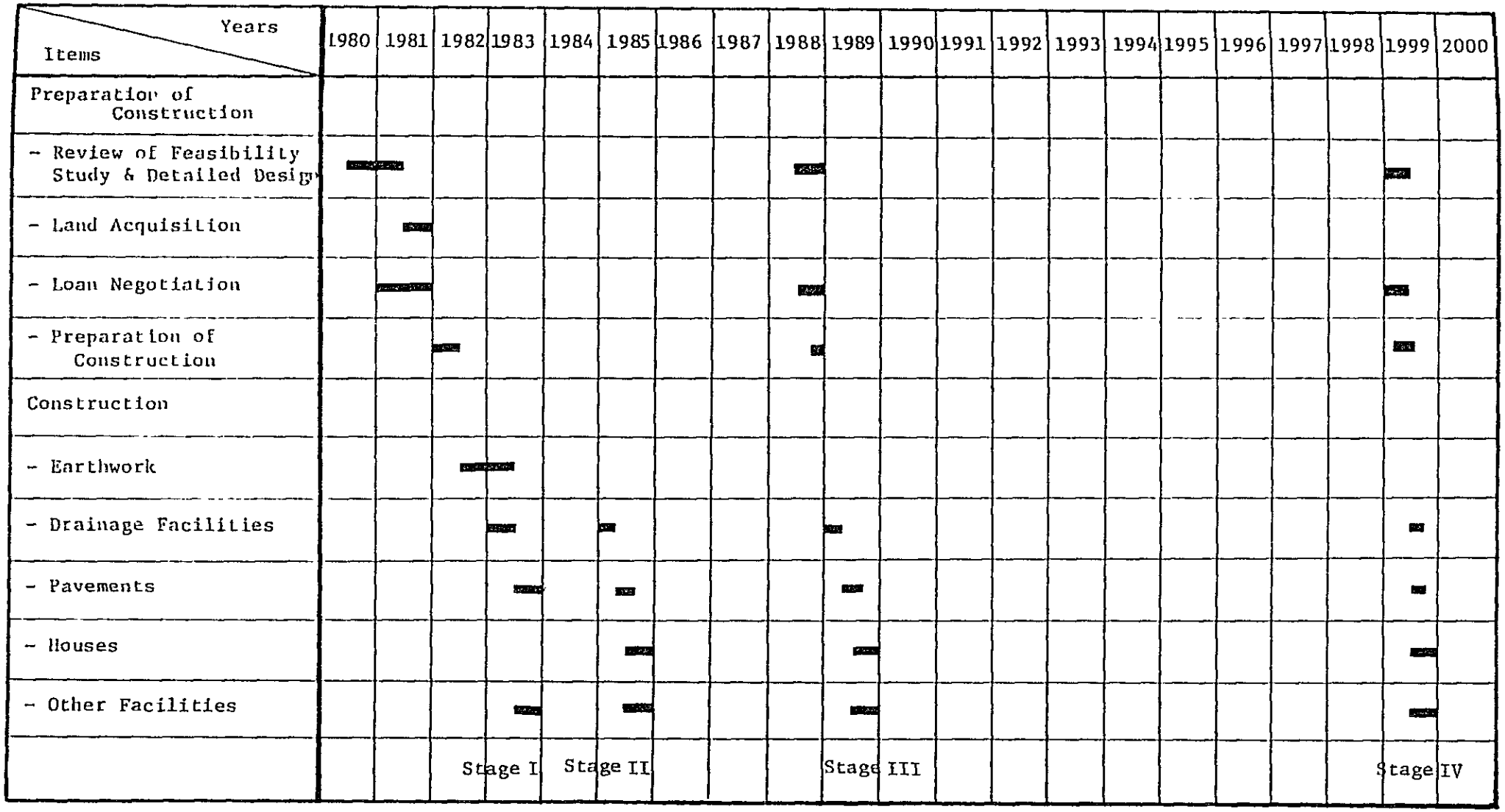


Fig. 5–18 CONSTRUCTION SCHEDULE FOR TRUCK TERMINAL–C (ALTERNATIVE–33)

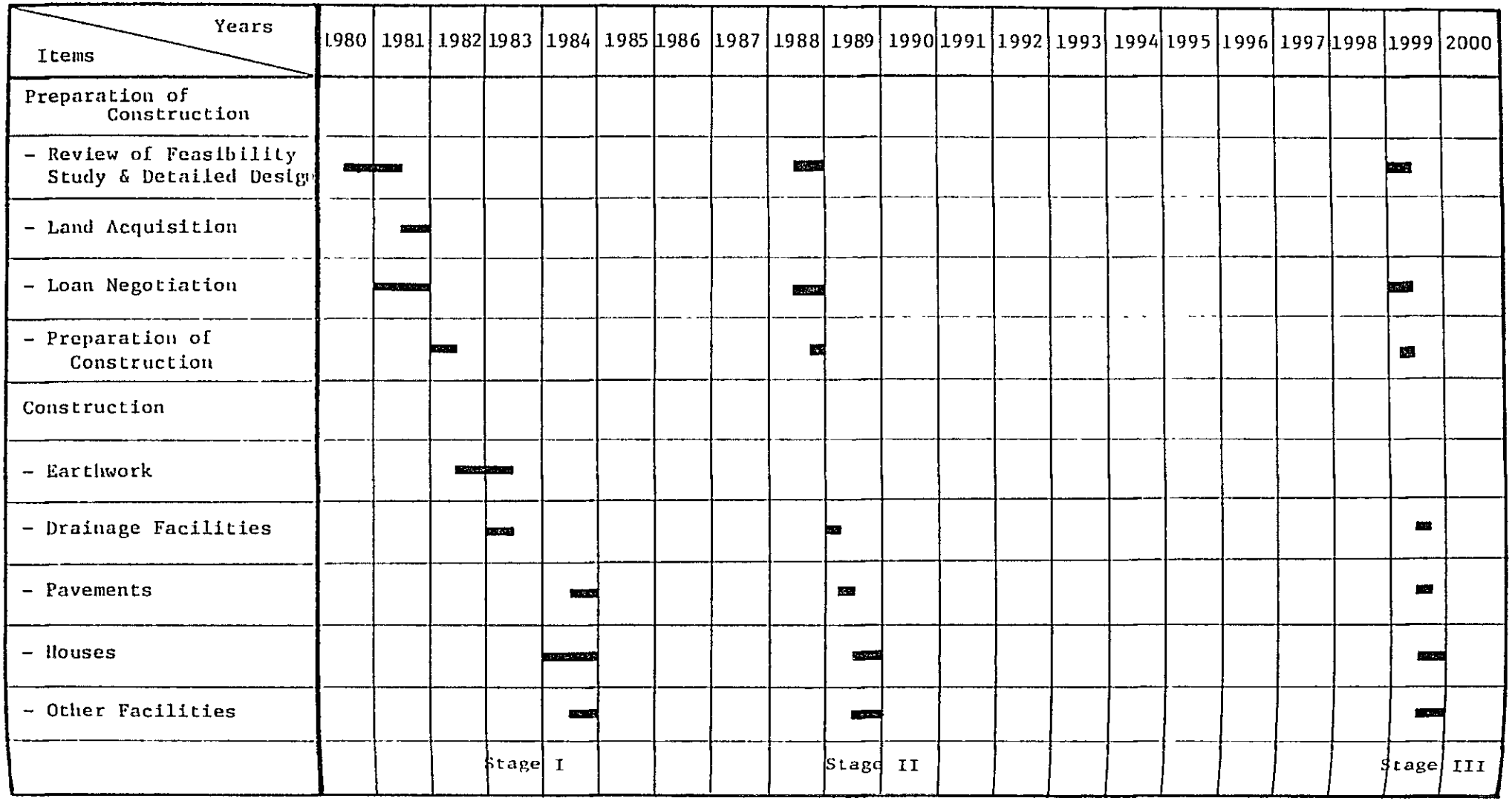


Fig. 5—19 CONSTRUCTION SCHEDULE FOR TRUCK TERMINAL—N' (ALTERNATIVE—55)

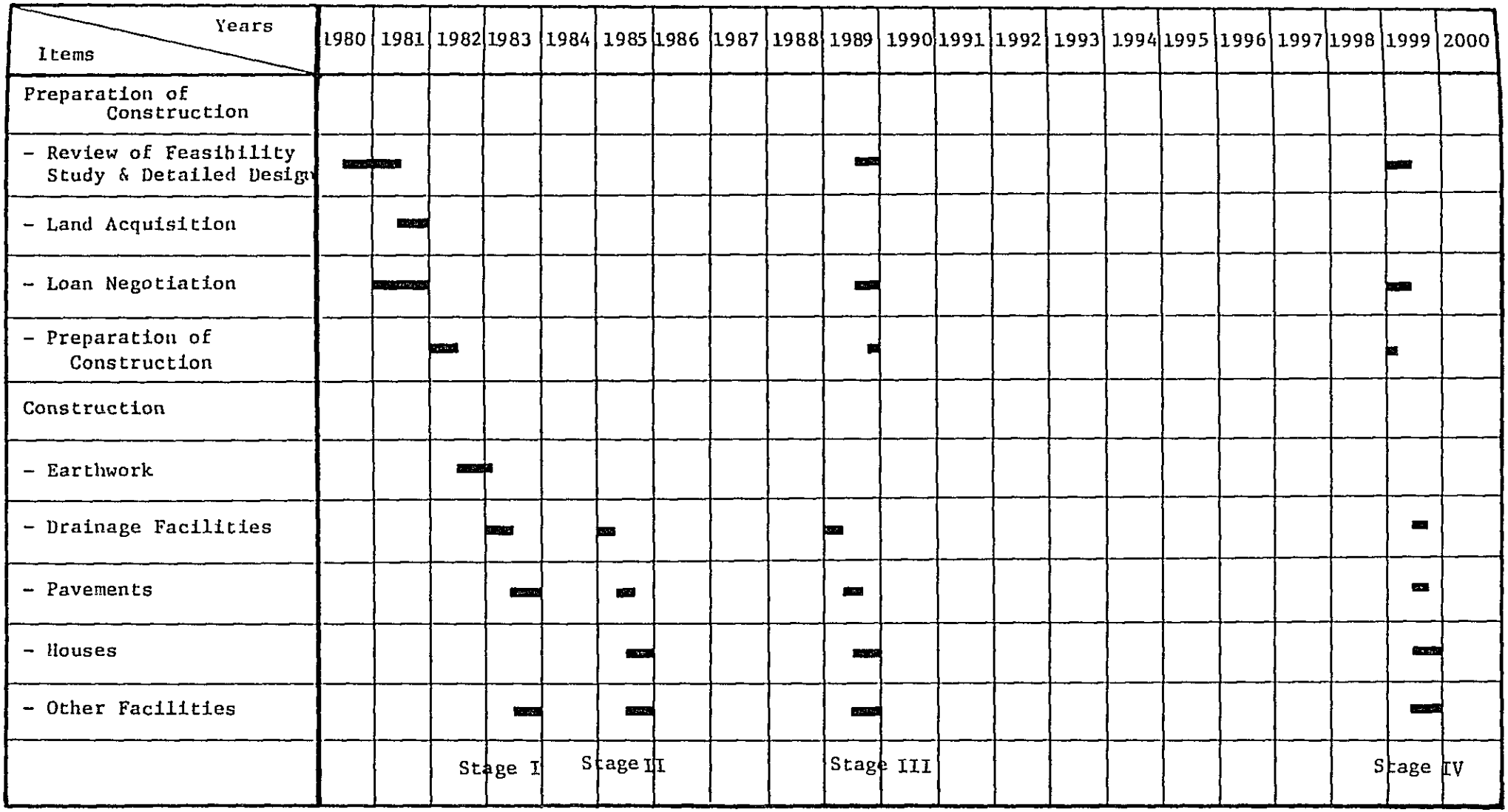
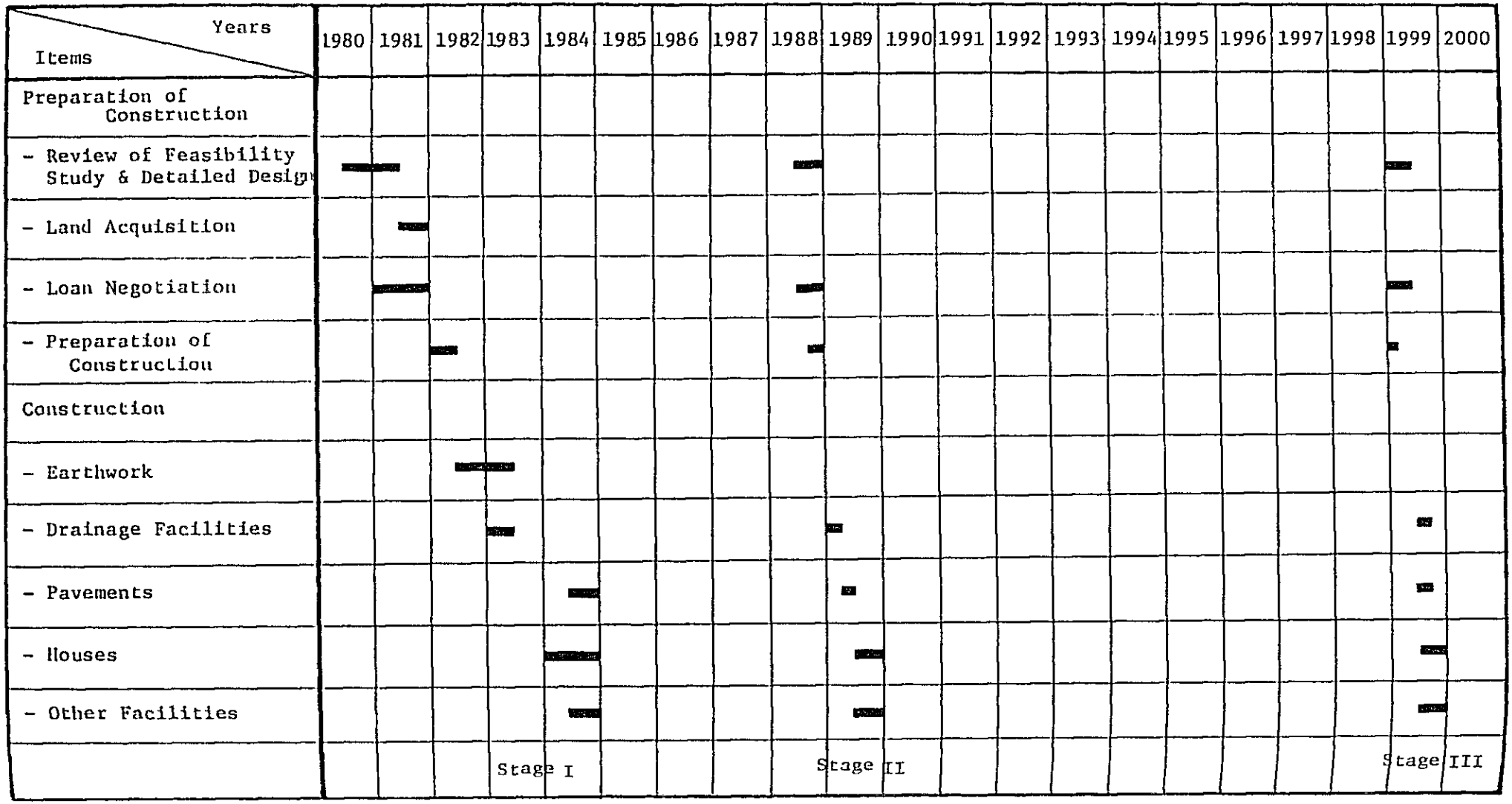


Fig. 5-20 CONSTRUCTION SCHEDULE FOR TRUCK TERMINAL-C (ALTERNATIVE-7)



5.7 Facility Planning and Cost Calculations for Alternative 333

In accordance with the benefit and cost analysis comparison between the three alternatives numbered-33, 55 and 7, it was determined that alternative-33 is the most feasible one. However, the economic viability of this alternative-33 is not sufficient since alternative-33 involved the planning of high cost facilities. For the purpose of optimizing the scale of the truck terminal from both view points of technical and economic feasibility, a further case was considered and numbered as alternative-333. The main fundamental items of difference between alternative-33 and-333 are summarized as follows:

5.7.1 Unit Costs

There are no differences in the unit costs of earth work, pavement, pipe culvents and U-ditches between alternatives-33 and-333. However, the unit costs of other facilities for alternative-333 have been reduced in price to 90% of alternative-33 which is the absolute minimum cost without any allowances for unknown factors, though phisical contingency is taken into consideration as 10% of all cost items. For land acquisition costs of alternative-333, values based on district land price data obtained from the DLT as mentioned above were re-examined.

The resulting unit land acquisition costs per square meter are shown below, which are the double prices of the DLT's original values of the selected lands. This is because the DLT's values are prepared to impose a land tax on the owners.

Table 5-24 Land Acquisition Costs for Alternative-333

(Unit: B/m^2)

Terminal	N	E	W	C
Cost	500	375	650	1,610

5.7.2 Scale of Facilities

For the purpose of minimizing of the construction cost, the reduction of scale of facilities was made according to the following concepts.

(1) reduce the peak ratio from 25% to 15%

(2) maintain the utilization ratio at the minimum value for the supporting facilities

(3) minimize the area of the access road within the truck terminal complex area.

(4) limit the supporting facilities to anly the truck terminal proper

(5) reduce the average embankment height from 2.0m to 1.2m as a minimum flood level allowance

The following table (Table 5-25) is a summary of the planned terminal areas for alternative-333. Tables 5-26 to 5-30 compare the differences in detail between alternatives 33 and 333, terminal by terminal.

Table 5-25 Summary of Terminal Facilities (Alt.-333)

(Unit: m^2)

Project Elements				Terminal / Facilities	North	East	West	Central	Total
Truck Terminal Facilities	Main elements		1	Platform	4,200	3,920	3,920	13,440	25,480
			2	Apron	5,250	4,900	4,900	16,800	31,850
			3	Roadway	10,808	10,500	10,500	32,391	64,199
			4	Administration Bldg.	110	95	95	467	767
			5	Green belt & others	1,552	1,524	1,524	2,822	7,422
				Sub-total	21,920	20,939	20,939	65,920	129,718
	Supporting elements	Main	6	Platform office	600	600	600	1,800	3,600
			7	Truck parking	3,288	3,120	3,120	11,271	20,799
			8	Platform car park	600	600	600	1,800	3,600
				Sub-total	4,488	4,320	4,320	14,871	27,999
		Other	9	Employee facilities	344	321	308	1,100	2,073
			10	Petrol station	800	800	800	1,600	4,000
			11	Maintenance shop	810	780	720	2,430	4,740
			12	Car park	925	925	925	3,035	5,810
			13	Other	845	913	986	1,696	4,440
				Sub-total	3,724	3,739	3,739	9,861	21,063
Related Facilities	Warehouse area		14	Warehouse	12,800	3,200	7,625	-	23,625
			15	Apron & roadway	18,592	4,208	8,090	-	30,890
			16	Other	12,712	4,192	5,229	-	22,133
				Sub-total	44,104	11,600	20,944	-	76,648
	Chartered truck center		17	Garage	9,600	9,600	9,600	9,600	38,400
			18	Office	852	852	852	852	3,408
			19	Petrol Station	600	600	600	600	2,400
			20	Roadway	8,604	7,848	7,848	7,524	31,824
			21	Other	804	790	790	812	3,196
				Sub-total	20,460	19,690	19,690	19,388	79,228
	Public parking		22	Public parking	14,400	9,600	9,600	-	33,600
			23	Petrol Station	600	600	600	-	1,800
			24	Roadway	13,204	8,836	9,900	-	31,940
			25	Other	1,348	916	844	-	3,108
				Sub-total	29,552	19,952	20,944	-	70,448
Others			26	Access roads	12,255	9,755	9,755	13,455	45,220
			27	Main Drainage	10,255	8,309	8,841	9,919	37,324
G. Total					146,758	98,304	109,172	133,414	487,648

Table 5-26 Comparison of Terminal Areas (Terminal N)

(Unit: m^2)

	Alternative 33 (A)	Alternative 333 (B)	Amt. of Change 1-((B)/(A)) %
Truck Terminal Facilities			
Platform	7,140	4,200	41.2
Apron	8,925	5,250	41.2
Others	33,098	20,682	37.5
Warehouse Area			
Warehouse	40,320	12,800	68.3
Others	51,876	31,304	39.7
Chartered Truck Center			
Garage	9,600	9,600	0
Office	852	852	0
Others	12,622	10,008	20.7
Public Parking			
Public parking	14,400	14,400	0
Others	13,400	15,152	-13.1
Other Facilities and Access Road	71,175	22,510	68.4
Total	263,408	146,758	44.3

Table 5-27 Comparison of Terminal Areas (Terminal E)

(Unit: m^2)

	Alternative 33 (A)	Alternative 333 (B)	Amt. of Change 1-((B)/(A)) %
Truck Terminal Facilities			
Platform	6,720	3,920	41.7
Apron	8,400	4,900	41.7
Others	32,566	20,178	38.0
Warehouse Area			
Warehouse	10,480	3,200	69.5
Others	17,900	8,400	53.1
Chartered Truck Center			
Garage	9,600	9,600	0
Office	852	852	0
Others	11,626	9,238	20.5
Public Parking			
Public parking	11,040	9,600	13.0
Others	11,148	10,352	7.1
Other Facilities and Access Road	59,608	18,064	69.7
Total	179,940	98,304	45.4

Table 5-28 Comparison of TErminal Areas (Terminal W)

(Unit: m^2)

	Alternative 33 (A)	Alternative 333 (B)	Amt. of Change 1-((B)/(A)) %
Truck Terminal Facilities			
Platform	6,300	3,920	37.8
Apron	7,875	4,900	37.8
Others	32,034	20,178	37.0
Warehouse Area			
Warehouse	26,400	7,625	71.1
Others	33,952	13,319	60.8
Chartered Truck Center			
Garage	9,600	9,600	0
Office	852	852	0
Others	7,725	9,238	-19.6
Public Parking			
Public parking	9,600	9,600	0
Others	6,606	11,344	-71.7
Other Facilities and Access Road	70,000	18,596	73.3
Total	210,944	109,172	48.2

Table 5-29 Comparison of Terminal Areas (Terminal C)

(Unit: m^2)

	Alternative 33 (A)	Alternative 333 (B)	Amt. of Change 1-((B)/(A)) %
Truck Terminal Facilities			
Platform	22,400	13,440	40.0
Apron	28,000	16,800	40.0
Others	102,045	60,412	39.8
Warehouse Area			
Warehouse	-	-	-
Others	-	-	-
Chartered Truck Center			
Garage	9,600	9,600	0
Office	852	852	0
Others	8,828	8,936	-1.2
Public Parking			
Public parking	-	-	-
Others	-	-	-
Other Facilities and Access Road	69,930	23,374	66.6
Total	241,655	133,414	44.8

Table 5-30 Comparison of Terminal Areas (Total All Terminals)

(Unit: m^2)

	Alternative 33 (A)	Alternative 333 (B)	Amt. of Change 1-((B)/(A)) %
Truck Terminal Facilities			
Platform	42,560	25,480	40.1
Apton	53,200	31,850	40.1
Others	199,743	121,450	.39.2
Warehouse Area			
Warehouse	77,200	23,625	69.4
Others	103,728	53,023	48.9
Chartered Truck Center			
Garage	38,400	38,400	0
Office	3,408	3,408	0
Others	40,801	37,420	8.3
Public Parking			
Public parking	35,040	33,600	4.1
Others	31,154	36,848	-18.3
Other Facilities and Access	262,373	82,544	.68.5
Road			
Total	887,607	487,648	45.1

Based on the design methods presented in Fig. 5-1 and 5-2. Design factors and areas of the truck terminals and warehouses are calculated for the alternative-333 as shown in Table 5-31 through 5-36. Consequently, the layout plan of each terminal is designed as presented in Fig. 5-21 through 5-24.

5.7.3 Truck Terminal Facilities for Alternative-333

Table 5-31 Truck Terminal Design Factors (Alternative-333)

Design Factor / Terminal	Cargo Volume (tons/day)	Number of Line-haul Trucks	Number of Pickup & Delivery Trucks	Number of Berths (Berths)	Area of Platform: Length x Width x Number (m^2)	Employees Line-haul Distribution Platform Office (Persons)	
North	1,999	398	493	66	4,200 (105x20x2)	1,580	796 592 160 32
East	1,856	372	461	56	3,920 (98x20x2)	1,477	744 554 149 30
West	1,793	359	443	56	3,920 (98x20x2)	1,423	718 532 144 29
Central	6,183	1,237	1,518	192	13,440 (112x20x6)	4,890	2,474 1,822 495 99
Total	11,831	2,366	2,915	370	25,480	9,370	4,732 3,500 948 190

Table 5-32 Truck Terminal Facilities (Alternative-333)

(Unit: m^2)

Design Areas / Terminal	Platform Area	Aprons	Administration Building	Parking Area	Roadway	Other Area (Parking, Greenbelts, Trash, Guard)	Total Area
North	4,200	5,250	1,200	3,888	10,808	1,552	26,298
East	3,920	4,900	1,200	3,720	10,500	1,524	25,164
West	3,920	4,900	1,200	3,720	10,500	1,524	25,164
Central	13,440	16,800	3,600	13,071	32,391	2,822	80,324
Total	25,480	31,850	7,200	24,399	64,199	7,422	156,950

Table 5-33 Commodity Storage Volume (Alternative-333)

(Unit: ton/day)

Commodity Group / Terminal		Commodity Storage Volume			
		North	East	West	Total
Agricultural Products	Rice	1,740	1,340	6,280	9,360
	Sugar	5,500	500	250	6,250
	Others	7,470	1,740	2,000	11,210
Building Materials	Cement	540	200	400	1,140
	Brick	560	210	420	1,190
	Piling	368	140	280	788
Manufactured Products		1,418	350	1,295	3,063
Total		17,596	4,480	10,925	33,001

Table 5-34 Warehouse Storage Area by Commodity (Alternative-333)

(Unit: m^2)

Commodity Group \ Terminal		Commodity Storage Volume			
		North	East	West	Total
Agricultural Products	Rice	1,160	894	4,187	6,241
	Sugar	3,667	334	167	4,168
	Others	5,741	1,339	1,539	8,625
Building Materials	Cement	270	100	200	570
	Brick	280	105	210	595
	Piling	184	70	140	394
Manufactured Products		1,182	292	1,080	2,554
Total		12,490	3,134	7,523	23,147

Table 5-35 Warehouse Site Areas (Alternative-333)

(Unit: m^2)

Facility \ Terminal	North	East	West	Total
Warehouses	12,800	3,200	7,625	23,625
Apron, Others	31,304	8,400	13,319	53,023
Total Site Area	44,104	11,600	29,944	76,648

Table 5-36 Scale of Truck Terminal Administration and Maintenance Facilities (Alternative-333)

(Unit: m^2)

Terminal	Administration Building Area	Petrol Station Area	Maintenance Shop, and Inspection Facilities Area	Car Parking Area (w/o bus terminal, green belt, roadway etc.)
North	454	800	810	925
East	416	800	780	925
West	403	800	720	925
Central	1,567	1,600	2,430	3,035
Total	2,840	4,000	4,740	5,810

Fig. 5–21 TERMINAL - N LAYOUT (Alt. 333)

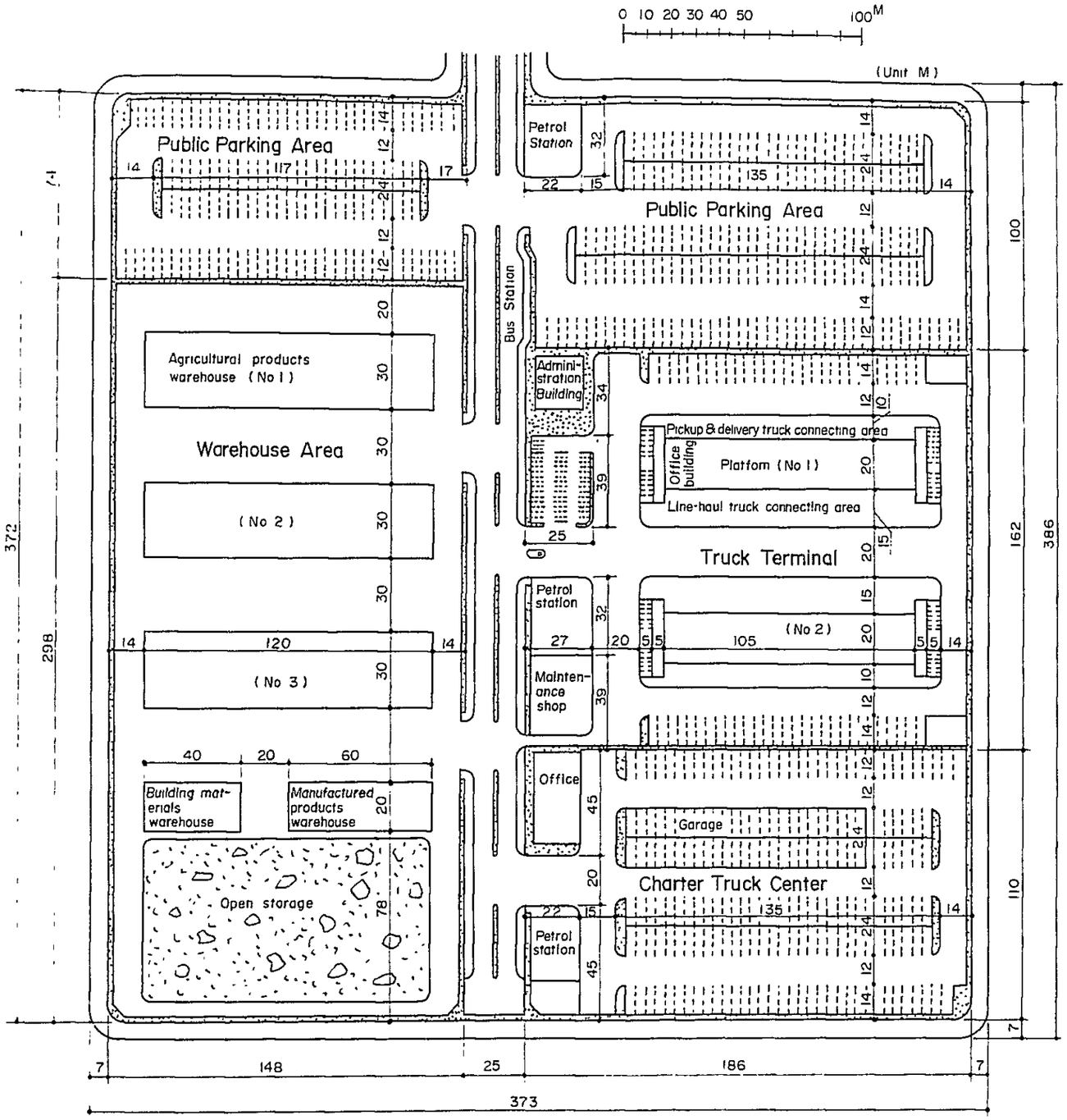


Fig. 5–22 TERMINAL - E LAYOUT (Alt. 333)

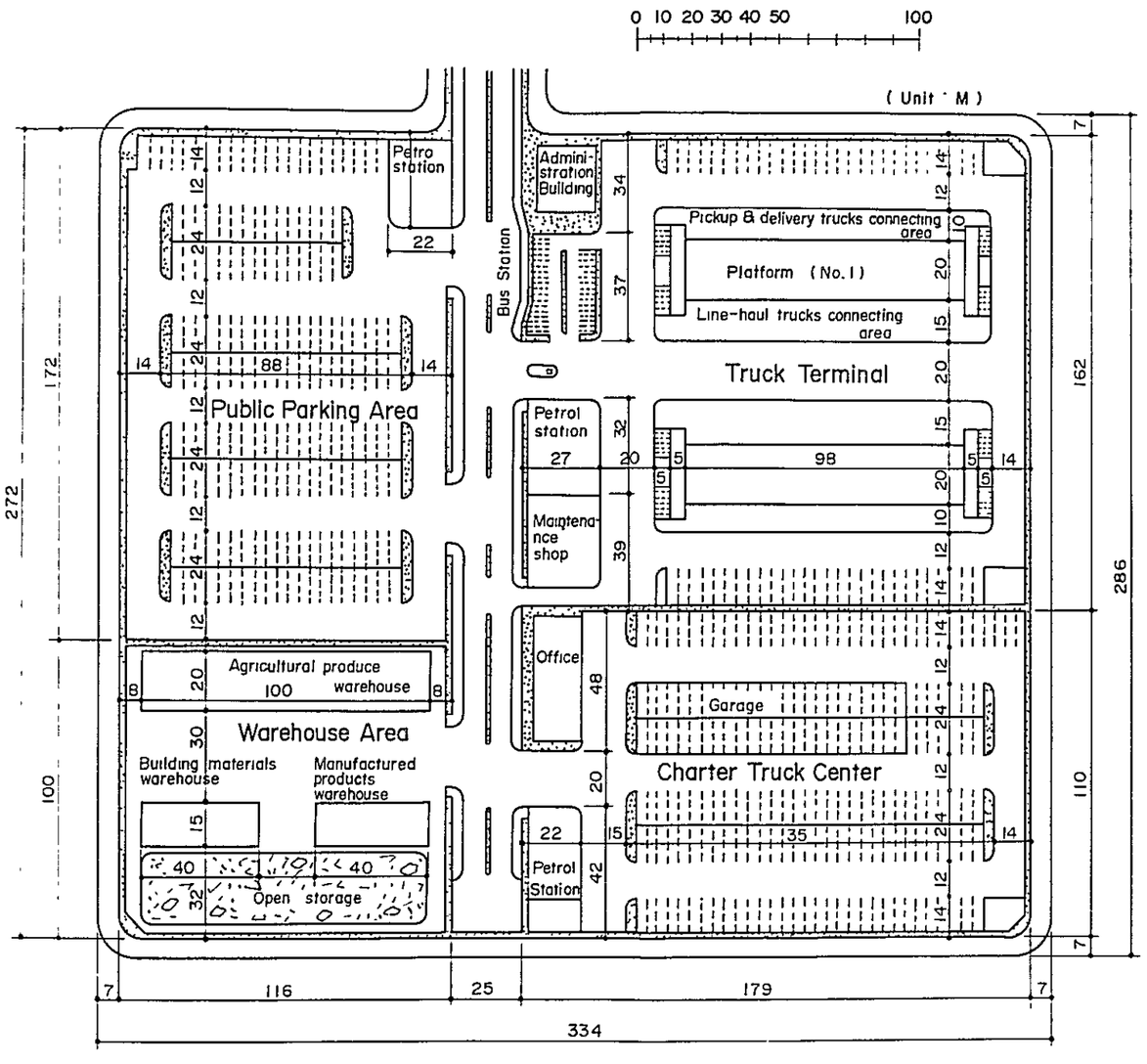


Fig. 5–23 TERMINAL – W LAYOUT (Alt. 333)

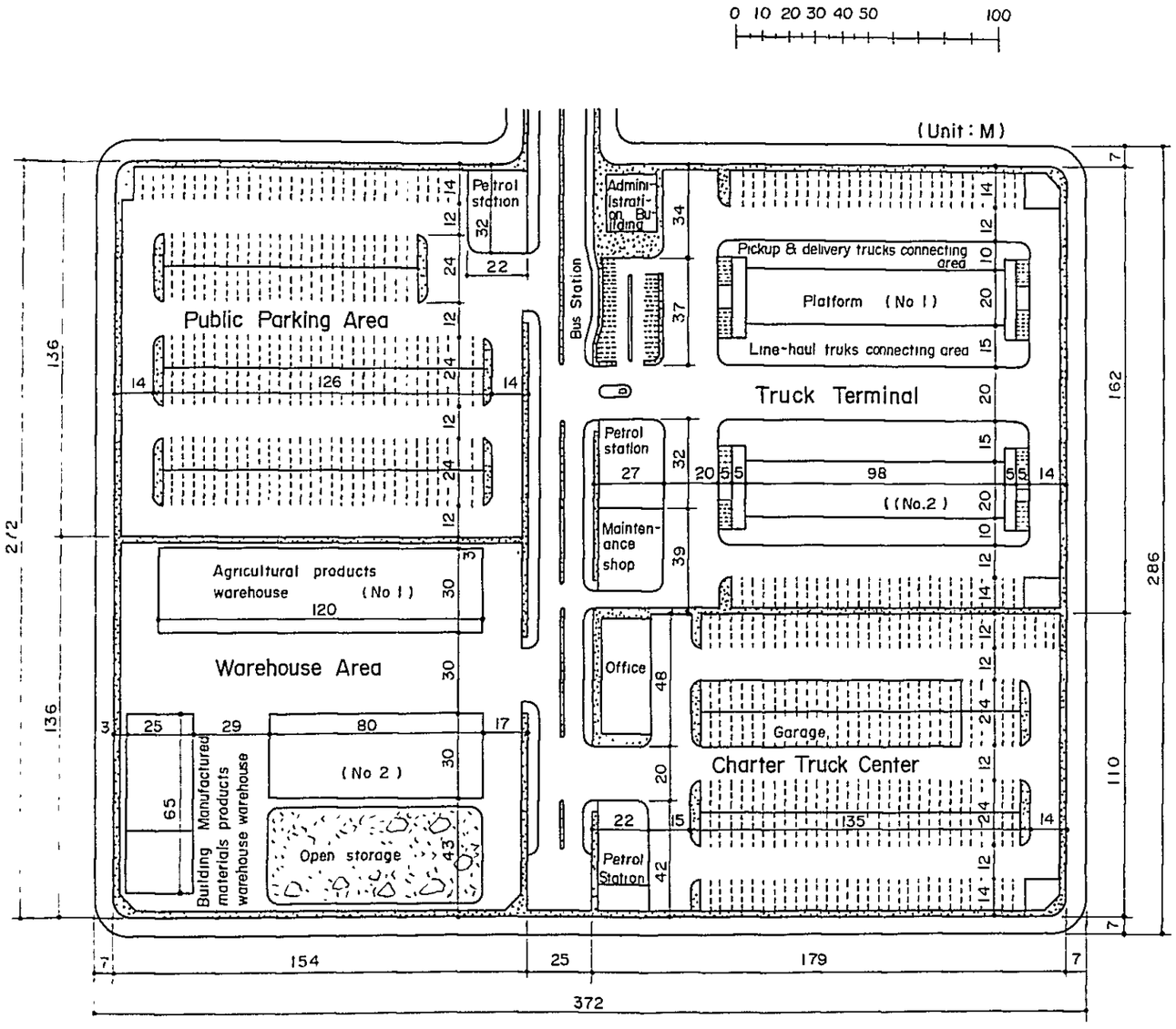
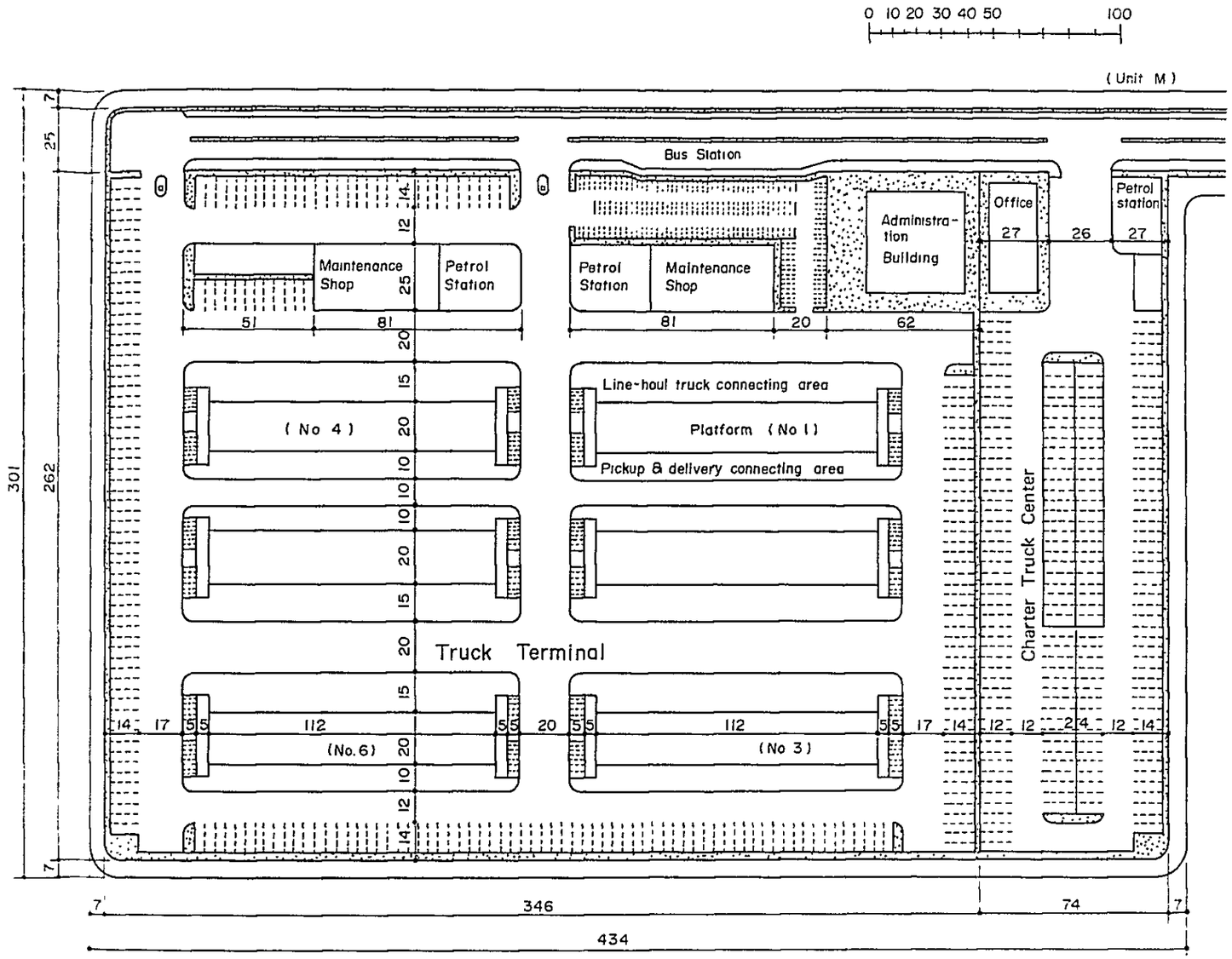


Fig. 5–24 TERMINAL – C LAYOUT (Alt. 333)



5.7.3 Estimated Construction Cost and Construction Schedule for Alternative-333

The construction cost estimates and construction plan were carried out according to same method as with the other alternatives. The results of cost estimates for alternative-333 are summarized in Table 5-37.

The construction schedules for each terminal of alternative-333 are shown in Figs. 5-25 to 5-30.

Table 5-37 Summary of Terminal Construction Costs (Alternative-333)

(Unit: 1000 Baht)

Facility \ Terminal			N	E	W	C	Total	%
Truck Terminal	Main Elements		76,826	69,563	75,897	321,180	543,466	36.4
	Supporting Elements:	Main	18,092	17,199	18,506	74,919	128,716	8.6
		Other	17,594	16,742	17,452	58,475	110,263	7.4
	Sub-total		112,512	103,504	111,855	454,574	782,445	52.3
Related Facilities	Warehouse Area		61,690	14,196	32,280	0	108,166	7.2
	Chartered Truck Center		73,763	69,703	75,660	95,537	314,663	21.1
	Public Parking		55,215	35,780	43,780	0	134,775	9.0
	Other		33,655	24,555	32,539	63,936	154,685	10.3
	Sub-total		224,323	144,234	184,259	159,473	712,289	47.7
G. Total			336,835	247,738	296,114	614,047	1,494,734	100.0
%			22.5	16.6	19.8	41.1	100.0	-

Note: Main Elements consist of: Platform, apron, roadway and administration building.

Main Supporting Elements: Platform office, truck parking, platform car park.

Other Supporting Elements: Employee facilities, petrol station, maintenance shop and other elements inside the terminal.

Warehouse Area: Land prepared for warehouse, apron roadway and others.

Chartered Truck Center: Garage, office, petrol station, roadway and others.

Other: Access roads and main drainage around the terminal complex.

For further reference, refer to Appendix Table AP5-15 through 5-20 which shows the breakdown of financial costs of each major item for each terminal.

Fig. 5–25 CONSTRUCTION SCHEDULE FOR TRUCK TERMINALS N, E & W
(ALTERNATIVE–333)

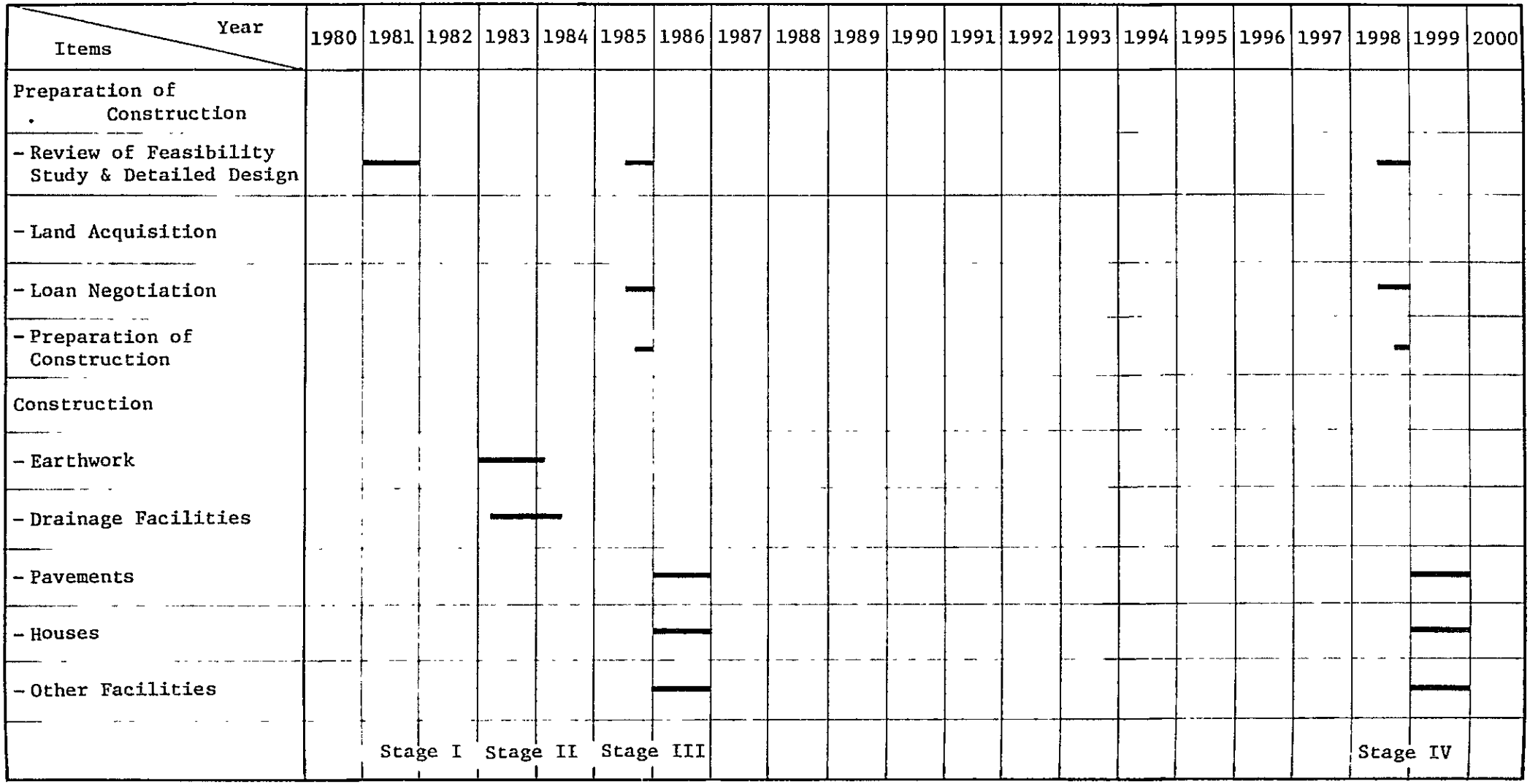
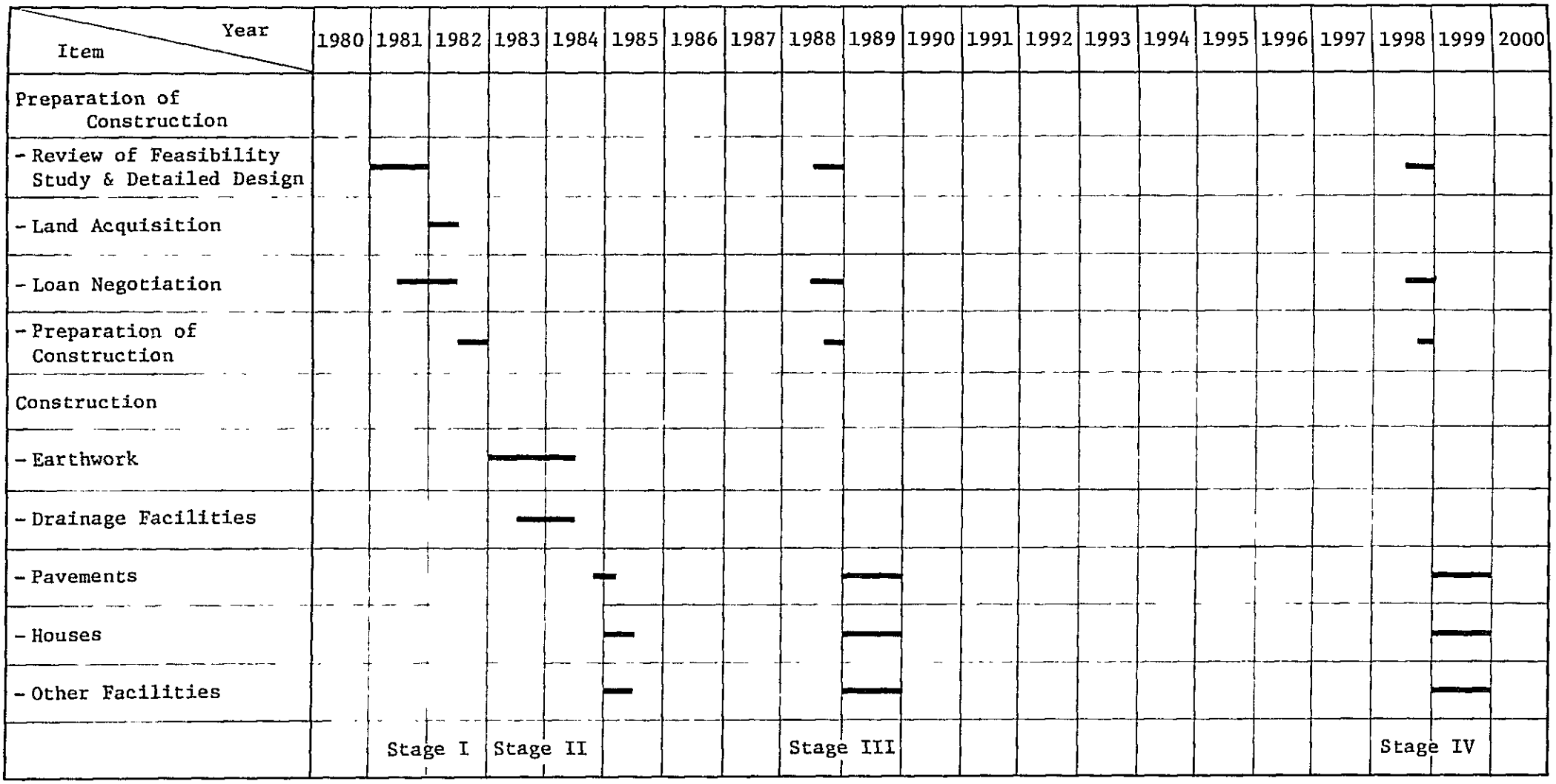


Fig. 5–26 CONSTRUCTION SCHEDULE FOR TRUCK TERMINAL–C (ALTERNATIVE–333)



5.8 Container Yard at Terminal–E

5.8.1 Function and Role

The container terminal now located in the port area is a node of ocean and land transport. The terminal has facilities for loading and unloading of ships, storage of cargo, receipt and delivery of container cargo and other equipment.

Since the newly, planned container terminal at Sattahip is far from Bangkok, it will be desireable to locate an inland depot or terminal, to link the container port with scheduled transport service and performs the functions of customs clearance, pickup & delivery, collection of empty containers, temporary storage, checking, repairing, vanning and devanning of containers and transship LCL cargoes (less than container load). There are two types of inland depots: an inland port type and a cargo collection and distribution center. They differ in terms of their respective functions as described below:

The inland port type has all the facilities, which are separable from port area, at another place. Accordingly it functions to link the port area directly and at a convenient place for collection and distribution of containers.

The other type, for cargo collection and distribution center which is located outside the port area at a place especially convenient for container cargo is called a "Container Freight Station (CFS).

In the case of Bangkok, the planned depot at a rail base is a type of inland and cargo collection and distribution center.

On the other hand, the depot which is planned to be establish at Truck Terminal-E is a type of cargo collection and distribution center.

CL (Container Loads)

In the case of import cargo, direct transfer is made to the bonded warehouse (or general warehouse) of the consignee and delivered, it is not handled via CFS.

LCL (Less-than-container loads)

Although a container is the unit lot of cargo, LCL is a container filled by two lots or more of small-sized cargoes (a consolidated container load). Since the container terminal for LCL are planned to be establish at Truck Terminal-E, study of its scale as a CFS is described in the following paragraphs.

5.8.2 Traffic Forecast of Number of Containers

Although a detailed estimate of the future container volume to be handled at Sattahip port is not available; a rough estimation was made in this study for the purpose of examining the scale of container yard using the method described below.

(1) Present Traffic Volume

According to the statistical data issued by the Port Authority of Thailand, the number of containers handled at Bangkok port are summarized as follows:

Table 5-38 Summary of Inbound and Outbound Containers at Bangkok Port, 1976-8[1/]

Direction	Year	Number of Containers					Cargo
		20'	35'	40'	Total	Total (TEU)[2/]	(Tons)
Inbound	1976	8,674	5,480	4,815	18,969	27,896	204,456
	1977	13,788	5,605	7,140	26,533	37,878	354,427
	1978	28,448	7,601	10,989	46,498	62,785	581,179
Av. Annual Growth Rate		81.1	17.8	51.1	56.6	50.0	68.6
Outbound	1976	7,920	5,487	4,271	17,678	26,065	172,414
	1977	11,275	5,605	6,956	23,856	34,996	223,195
	1978	23,764	7,020	10,667	41,451	57,384	467,884
Av. Annual Growth Rate		73.2	13.1	58.0	53.1	48.4	64.7

Note: 1/ TEU Number of Containers in "twenty-foot equivalent units". Based on the following number of vessels:

Year	Container Vessels	General Vessels
1976	160	316
1977	184	346
1978	316	527
Av. Anual Growth Rate	40.5	29.1

Source: Port Authority of Thailand, 1976-8.

(2) Forecast of Future Number of Containers

The forecasting of the number of containers to be handled at Bangkok port is estimated by reference to economic indicators. In this study, the future growth rate of Gross National Products (GNP) was used as the basis for determining the growth rate of container volume. According to the examination of GNP in chapter 3 of this report, the future growth rate of GNP will be as follows:

1978∿1980	7% per annum
1981∿1990	6% per annum
1991∿	5% per annum

Using this growth rate, the estimated potential container volumes to be handled at Bangkok port were estimated and are summarized as Table 5-39.

Table 5-39 Potential Inbound and Outbound Container Volumes at Bangkok Port by Key Years

(Unit: TEU/Year)

	Inbound	Outbound	Total
1978	62,785	57,384	120,169
1980	71,883	65,699	137,582
1990	128,732	117,657	246,389
2000	209,691	191,651	401,342

(3) The Port Diversion Ratio

According to the information from Ministry of Communications (MOC), there is a plan to establish two additional Container Freight Station (CFS) at Bangkok port and three CFS at Bang Sue railway terminal based on the container flow from the Sattahip deep sea port. The detailed cargo volumes to be handled at Sattahip port are not available in this time, although, according to the information by Port Authority of Thailand, the main function of the port is for the export of cassava; in the future in will also have the function as an alternative to the port of Bangkok. Although the cargo volume handled at Bangkok port seems already to have nearly reached the capacity of the port, information from the MOC indicates that after the two additional CFS are established, the handling capacity of Bangkok port will increase to twice its present capacity.

Consequently, the container volume to be handled at Bangkok port is calculated as follows and based on this, the container volume of Sattahip port also is calculated.

		Inbound	Outbound	Total
The potential container volume to be handled at BKK port	(TEU/Yr.)	209,691	191,651	401,342
Actual container volume handled at BKK port	(TEU/Yr.)	125,570	114,768	240,338
Yearly container volume to be handled at Sattahip port	(TEU/Yr.)	84,121	76,883	161,004
Monthly average container volume to be handled at Sattahip port	(TEU/Mo.)	7,010	6,407	13,417

Note: TEU = "20-foot equivalent units"

(4) Type of Commodity

Among the import cargo volumes, the ratio of mixed cargo in containers using the truck terminals is examined. According to the data from Committee on Foreign Trade Statistics, mixed cargo is approximately 20 percent of imports, therefore this ratio is applied for estimation.

(5) Modal Split of Container Transport

In this paragraph, the modal split of railway transport and road transport from Sattahip port to Bangkok is examined. Further study is required to decide the modal split for this cargo movement accurately since the information concerning this matter is not available at this time. A rough estimation was made that 50 percent of the containers from Sattahip will be carried by railway and rest of 50 percent will be carried by truck to Bangkok.

(6) Estimated Container Volume handled at Truck Terminal-E

The estimation of number of containers using the truck terminal-E was made using the following formula.

$$Y = X \times \alpha \times \beta \times \gamma$$

where, Y : Estimated number of inbound containers at Terminal-E (Containers/Mon.)

X : Estimated number of containers handled at Sattahip sea port

α : The ratio of containers which have a Bangkok destination

β : Modal split ratio for truck

γ : Ratio of mixed cargo

In this study, the ratio of mixed cargo (γ) for each mode of transport was settled as follows:

	Bulk Cargo	Mixed Cargo
Railway	90%	10%
Truck	70%	30%

Consequently, the ratio of mixed cargo for all modes was calculated at 20 percent as shown below.

Railway	Bulk	0.5 x 0.9 = 0.45	
	Mixed	0.5 x 0.1 = 0.05	20%
Truck	Bulk	0.5 x 0.7 = 0.35	
	Mixed	0.5 x 0.3 = 0.15	
	Total	1.00	

The number of containers handled per month is as follows:

$$Y = X \times \alpha \times \beta \times \gamma = 7,010 \times 0.9 \times 0.5 \times 0.3$$
$$= 947 \text{ containers/month}$$

5.8.3 Scale of Facilities

The handling volume of LCL cargo of container terminal in Truck Terminal-E is estimated to be 1,326 units of containers (in 20-foot container equivalents)/day (i.e., 13,260 tons/month)

Volume of imports: 947 unit/average month (9,470 ton/month)

Volume of exports: 379 unit/average month (3,790 ton/month or 40% of imports)

The scale of the facilities was estimated based on the assumption that 26 container ships will enter the port per month (the average performance of 1978 in the port of Bangkok).

- Handling volume of CFS (average export & import volume)

  1,326 unit ÷ 26 = 51 unit/time (510 ton/time)

- Cargo storage area of CFS

  510 ton ÷ 0.5 ton/m^2 = 1,020 m^2

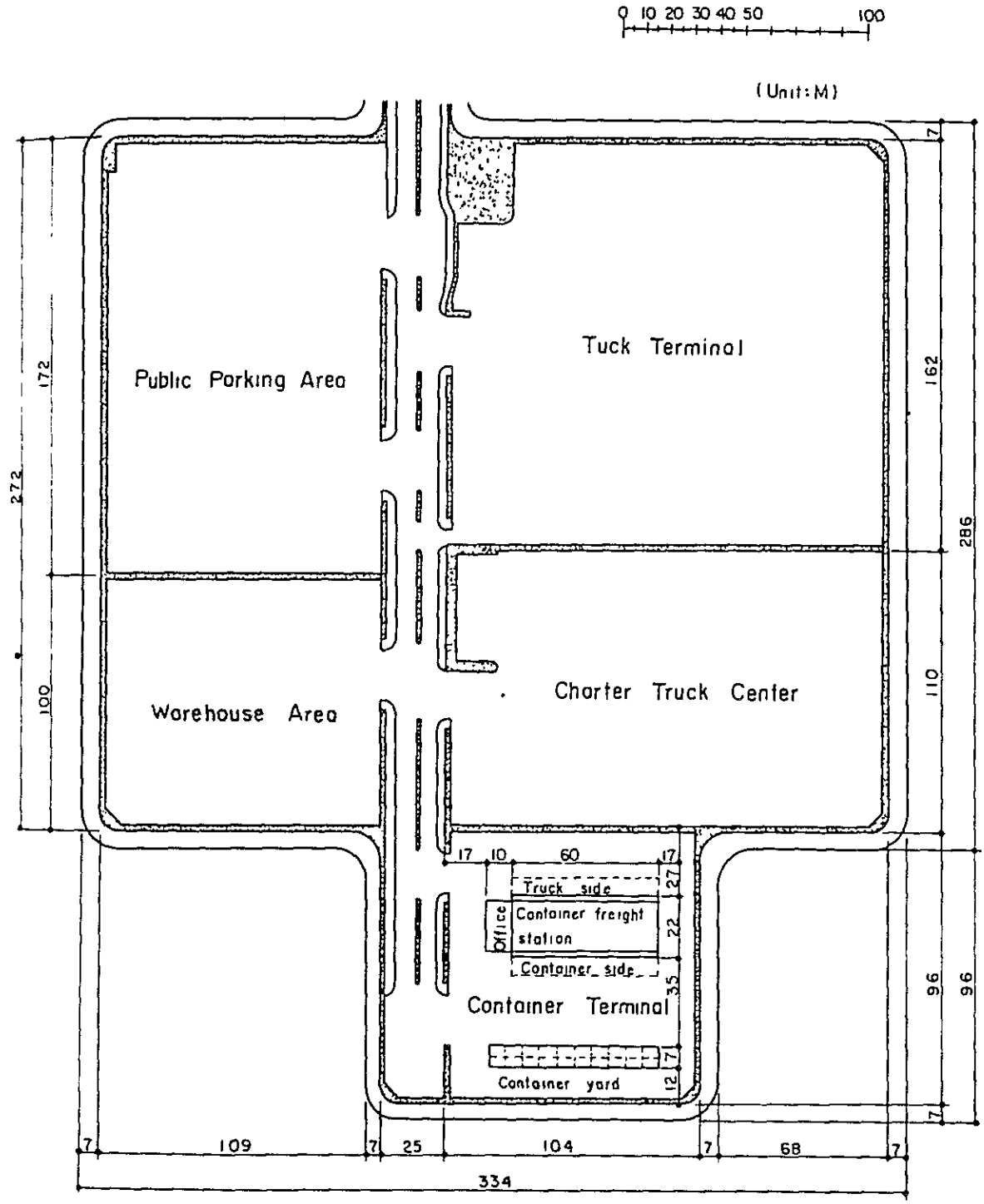
The structure of the CFS will have a high floor, with a width of 20 m and length of 60 m. An Apron of 2 m width is allocated on each side of the CFS. The planned length of 60 m is equal to 15 berths.

A container yard, to accommodate 40 units of container is also to be established. Vehicle marshalling yard outside the CFS, office and auxiliary facilities are included in the layout (see Figure 5-27).

Table 5- 40 Summary of Container Yard Facilities at Terminal-E

Facilities		Area	Remarks
Container Yard	Storage Area for CFS	1,440 (m^2)	20m x 60m = 1,200 m^2 2m x 60m x 2 = 240 m^2
	Yard	455	7m x 65m = 455 m^2
	Office	200	10m x 20m = 200 m^2
	Roadway	7,289	
	Others	600	
	Total	9,984	96m x 104m
Access Road		2,400	25m x 96m
Main Drainage		1,344	96m x 7m x 2
Total		13,728	96m x 143

Fig. 5–27 CONTAINER YARD LAYOUT FOR TERMINAL–E
(Alternative 333)



5.8.4 Construction Cost Estimates for Container Terminal

The construction cost estimates for the container terminal were carried out according to the general layout of the container terminal and estimated quantities (see Fig.5-27). The same unit prices established for Alternative 333 were used for each construction item of the container terminal.

The total construction cost and its breakdown are presented in Table 5-41. The additional cost to terminal E by the construction of the container terminal is approximately 10 percent of the truck terminal complex cost described follows:

(Unit: 1,000 Baht)

a)	Truck Terminal-E Construction Cost	247,738
b)	Container and Construction Cost	24,039
b)/a)	Additional cost increment	9.7%

Table 5-41 Container Yard Facilities

(Unit: 1,000 Baht)

Item No	Description	Quantity	Unit	Local		Foreign		Total
				Unit Price	Amount	Unit Price	Amount	
1	Clearing Grubbing	13,728	m^2	0.001	14	0 003	41	55
2	Embankment	13.728	"	0.083	1,139	0 156	2,142	3,281
3	RC-Pipe Culvert D=0.4m	13,728	"	0 0056	77	0 0005	7	84
4	RC-Pipe Culvert D=1.0m	13,728	"	0.1781	2,445	0.0023	32	2,477
5	U-Ditch 0.3x0 5m	13,728	"	0.0019	26	0 0005	7	33
6	U-Ditch 1.0x	13,728	"	0.0211	290	0.0048	66	356
7	Storage Area for CFS	1,440	"	0.373	537	0.154	222	759
8	Container Yard	455	"	0.373	170	0.154	70	240
9	Office	200	"	3.300	660	3.300	660	1,320
10	Roadway	7,289	"	0.373	2,719	0 154	1,226	3.945
11	Access Road	2,400	"	0.373	895	0.154	370	1,265
12	Others				897		484	1,381
	Sub Total				9,869		5,327	15,196
13	Land Acquisition and Compensation	13,728	m^2	0.375	5,148			5,148
14	Final Engineering, Supervision, Administration & Others				987		523	1,510
15	Contingencies				1,600		585	2,185
	Grand Total				17,604		6,435	24,039

5.9 Intermodal Transportation

For the facilities planning of the truck terminal complex intermodal distribution was considered.

The possible volume of cargo suitable for truck terminals arising between road and water transport is not large because the type of cargoes transported by the water are usually bulk cargoes.

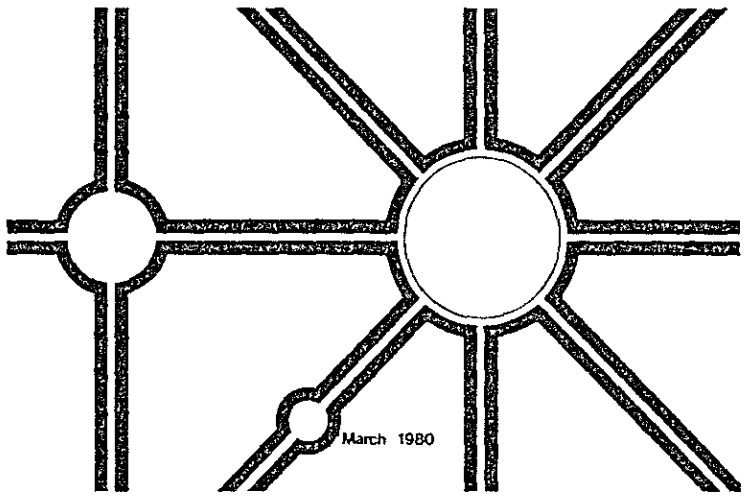
In the case of the road-railway transport interface, the statistical data from SRT indicates that the composition ratios of manufactured goods and other goods in terms of tons carried by railway in 1972 which would be suitable for transfer at the truck terminal, was 11.9 percent and 14.9 percent respectively. This percentage is expectably low since the large potion of cargoes carried by railway are bulk cargo which can be transported directly from originating cargo station to the destination without any sorting at a truck terminal.

No special truck terminal facilities are needed for the purpose of utilizing terminals since it is possible to convert some of the designed public parking space into railway freight container yards. The use of railway freight containers is recommended and there is a possibility to use the truck terminal for railway freight containers, especially the proposed truck terminals E and N. In the case of Japanese truck terminals, only 7 public terminals out of 47 have a railway freight container facility and the container facilities occupy an area of about 2.7 percent of the total terminal area.

There is a possibility on some occasions for utilizing the railroad as the long distance line-haul element in the truck transport network.

CHAPTER 6

ORGANIZATION AND IMPLEMENTATION PROGRAM



Chapter 6 ORGANIZATION AND IMPLEMENTATION PROGRAM

6.1 Organizational Participants and Administrative System

6.1.1 General Considerations of Types of Organizational Participants by Phase of Involvement

This section deals with the general consideration of alternative organizational participants who are suitable for the development and operation of truck terminal facilities as a public project.

The area of involvement considered here covers the following five development phases, classified by function for the total process of facility construction.

Main Functions for the Process of Facility Construction
1. Promotion
2. Investment
3. Ownership
4. Administration
5. Tenancy

The suitability of the following types of organizational participants is also considered.

Classification	Organizational Participants	Neumonic Label
Public Sector	- Central Government	(G)
	- Metropolitan Administration	(g)
	- Joint Venture between Central Government and Metropolitan Administration	(G')
Private Sector	- Non-Transport related Firm	(N)
	- Transport related Firm	(T)
	- Private Truck Terminal Operation Company	(P)
	- Truck Terminal User Cooperative	(U)
Joint Venture	- Public sector with multi-industry participation based in the private sector	(J)
	- Public sector between transport related industries in private sector	(j)

In the paragraphs which follow, consideration is given to the suitability of each of the participants who could be involved for each of the five implementation functions listed above. For brevity, each party has been given a neumonic identifying label ("G" for central government, "T" for transport related firm, etc. as shown in the table above) and the organization functions have been numbered 1-5 (also as shown above). The symbol, "G_1", for example, refers to the case of Government as the promoter since promotion is organizational function No. 1; and so on.

(1) Promotion Function: Pros and Cons

a) Case G_1 : Promotion by Central Government

The central government is in the best position to promote the truck terminal development program with a broad perspective for the public interest, and can coordinate such a program with other public programs for transportation such as traffic, social, urban and regional developments. It can also provide the necessary supports in the legislative, legal and administrative aspects. Easier access through the central government to cooperation with all governmental bodies for such an undertaking will also be a valuable asset and will be an expedience for the program development.

The need of creating a considerable and large organization within the administration setup and the temporary nature of the need for such an organization are considerable disadvantages for the central to be the sole promoter of the program.

b) Case g_1 : Promotion by Metropolitan Administration

The metropolitan administration is not in as good a position as the central government, having generally much less authority than the latter, and also in view of the fact that the need for a truck terminal development program is more of a national interest than of local interest.

c) Case G'_1 : Promotion by a Joint Venture Between the Central Government and Metropolitan Administration

A joint venture between the central government and the metropolitan administration, has the merit of combining the administrative expediences at both the national and local levels. This factor alone is, however, insufficient in the long run to counter-balance the cost of expanding the administrative setup which is even greater than the case where the central government is the sole promoter. It also will require more paperwork and other administrative activities.

d) Case N_1, T_1, P_1: Private Business Enterprise

The private sector should be encouraged to develop their own truck terminals as long as they comply with the public regulations and requirements such as locating facilities outside the CBD in assigned zones of landuse. Any such endeavour will contribute to the decentralization of the commodity distribution industry from central Bangkok, and therefore should satisfy the public interest. However, no consideration in any detail will be made here regarding private business enterprises in truck terminal establishment since the role of the government in such a case would be strictly limited to that of legal administration. The private enterprise would in principle be free to conduct its own business program at its own discretion within the limitations of the legal framework.

e) Case U_1 : User Cooperative Enterprise

The statements in Case N_1, T_1 & P_1 apply to this case, which is also a form of private organization. In reality however, cooperatives of related industries are presently non-existent in Bangkok and it would be impractical to consider creating any cooperative to promote a truck terminal development program.

f) Case J_1 : Joint Venture between the Central Government and the private sector, including organizations of transport operators and agents, traders, warehousing industry, banks and other types of financial organizations or institutions.

With competent representatives of the public sector and qualified personnel from the private sector holding suitable key posts, this system can maintain the advantages of cases G and G' without having their shortcomings; it also has other merits such as the following:

i) Business incentives of the private sector can be exploited for the development program.

ii) Talented enterprising personnel from the private sector can be selected in order to utilize their capabilities to satisfy the high standards of personnel requirements needed at the implementation stage.

iii) Implementation of the facility development program can be more easily checked from the public interest point of view with the presence of public personnel within the management.

iv) Involvement of financial organization and leading personalities of various relevant industries in the private sector will facilitate close cooperation and support from their respective social groups which are important factor in the success of the program.

g) Case j_1 : Joint Venture Between the Public Sector and Transport Related Industry

Limitation of the joint venture partners to parties from transport related industries is not as desirable as case J_1, as it unnecessarily narrows the base of public support for the undertaking.

(2) Investment Function: Pros and Cons

a) Case G_{2_i} : Investment by the Central Government

Investment of the central government is justified by the public benefits which can be derived from the development of truck terminals.

b) Case g_2 : Investment by the Metropolitan Administration

Investment of the Metropolitan Administration alone can not be justified, based on considerations of the nature of the project and its relatively small financial resources.

c) Case G'_2 : Joint Venture Investment by the Central Government and the Metropolitan Administration

A Joint Venture between the Central Government and the Metropolitan Administration is in theory possible, but it does not have substantial merit to justify its acceptance.

d) Case N_2, T_2, P_2, U_2 : Private Investment

Private investment in truck terminal development projects should be encouraged, but detailed consideration of such enterprises will not be done here as stated in the consideration of private promotion.

e) Case J_2 : Joint Venture Investment between Public Sector and Multi-Industry based Private Sector

Introduction of investment by private parties having the intention to participate in facility administration injects not only capital into the program, but also profit incentives which are necessary for the success of the operation, and is therefore desirable wherever it is practical to do so.

f) Case j_2 : Joint Venture investment between public sector and private sector participated in exclusively by transport related industries.

The exclusion of other industries in the private sector from such investment is undesirable not only for the reasons stated in Case j_1 above, but also because of the negative aspects of unnecessarily limiting the sources of funds.

Based on the foregoing evaluations, consideration hereafter will be narrowed to the following cases:

i) Facilities established (planned and invested) by the central government (G_1 - G_2)

ii) Facilities established (planned and invested) by a Joint Venture Organization between public and private sectors (J_1 - J_2)

(3) Ownership Function: Pros and Cons

Truck terminal facilities after completion can either remain under the ownership of the investor and leased out for the use of qualified tenants, or sold in lots to qualified applicants, limited to operators of the relevant industries for whose use the facilities are intended. The buyer in this case can either be existing firms and individuals, or truck terminal operation agencies or

cooperatives of users, should any such organizations be formed in the future.

In the leasing case, administration of the facilities can be accomplished by several alternative types of organizations as discussed below, while in the case of sale, the entire area of responsibility should be transferred to the relevant local authority to be administered as an ordinary developed area under its control, with the parcelled properties registered as individual real estate to be maintained by the ultimate user.

(4) Administration Function: Pros and Cons

Alternative types of organizations for the administration of leased facilities in general include the following:

i) Public agency
ii) Entrusted private business firm
iii) Entrusted private truck terminal operating corporation
iv) Entrusted truck terminal users cooperative
v) Joint venture of truck terminal corporation between public and private sectors

i) Public Agency: Direct administration in general is known to have the disadvantage of providing a burden on the public workers for the clerical work load along different lines of speciality from their normal field of endeavor. They are also unresponsive to user needs and often get bogged down in paperwork or "red tape". On the other hand, this type of organization does not have any substantial benefit which cannot be obtained otherwise.

ii) Entrusted Private Business Firm: Entrusting of administration of public facilities to a private firm is acceptable where no other practical alternative exists, but such is not the situation in the case of the truck terminal facilities under consideration.

iii) Entrusted Private Truck Terminal Corporation: Entrusting the administration to a private truck terminal corporation established mainly by the facility users under the administrative guidance of the public agency is a realistic and practicable solution.

However, inherent negative aspects also exist in this system such as:

1. Difficulty in practice tends to occur wherever the question of authority for public property management is involved.

2. The dual structure of administration tends to entail excessively high cost for the facility user.

iv) Entrusted Truck Terminal Users Cooperative:
This system is practicable in theory, but involves basic problems in the operation system and procedures especially those related to security of freight handling, route and trip assignment and operations etc. all of which require extensive study in order to arrive at realistic and practical solutions. Therefore, it will not be taken as an alternative for further consideration.

v) Joint Venture Corporation between Public and Private Sectors:
This system is realistic and practical if either the corporation itself or the government owns the property. With a suitable number of competent public personnel in the management, coordination with the administration authorities and authority of the public property management will not be a problem, and with qualified personnel from the private sector holding responsible positions for field operations, efficient and business like operations can generally be expected at the same time.

(5) Tenancy Function: Pros and Cons

The subject of tenancy is limited to "leased-in-lots" properties under the administration of joint venture corporation between the Government and the private sector.

Tenants should be confined to actual facility users but need neither be limited by type of organization, nor by functional scope and system of operation.

Types of tenants by conceptual form of organization include the following categories:

a) Individual operators of a relevant industry
b) Group of individual operators sharing a unit
c) Organized body of multiple operators in relevant industry
   - Joint venture corporation
   - Facility user cooperatives

Among these, category b) does not involve any significant organizational problem, and needs not to be considered separately from category a). Category c) is presently non-existent, and therefore is not practicable at this time. Since without such organization, small scale operators are unlikely to be able to get involved in the tenancy of truck terminal facilities for the simple reason of lack of financial capability, and since creation

of such an organization requires investigation of many problems beyond the scope of this study, this category will be excluded from consideration further on.

6.1.2 Selection of the Most Appropriate Organizational Participant(s)

Based on the above general considerations comparing alternative combinations of organizational participants which is summarized in Table 6-1, it is recommended that the government acquires the land and constructs and owns the facilities, but administration including leasing of the facilities be organized as a joint venture between the government and private sector.

6.1.3 System of Operation

Organization of a truck terminal facility can be classified in accordance with its physical layout and system of operation into the following categories.

i) Conventional type of singularly located and individually operated trucking business facilities.

ii) Conventional type of cumulatively developed trucking terminal areas of spontaneously concentrated, but individually operated trucking business facilities.

iii) Collectively developed area of multiple facility units for trucking operation on an individual basis, with common or separated structures. (Recommended)

- Owner occupied
- Rental

iv) Common structure shared by individual trucking operators for individual use with or without business coordination.

- Owner occupied in lots
- Rental in lots

v) Facility wholly owned or rented by an organized group of users for joint operation of terminal freight handling

- Joint ventured operation
- Closed membership cooperative

vi) Facility operated as an independent terminal freight handling agency.

Among these, category iii) which in operation is common to the current local practice, is considered the most suitable, and will therefore be taken as the basis for further consideration.

Table 6-1 Evaluation of Alternative Organizational Participants for Truck Terminal Development and Operation

Type of Organization			Organizational Functions						
			1	2	3		4	5	
Classification	Parties Involved	Neumonic Label*	Pro-motion	Invest-ment	Ownership: Totally	Ownership: in lots	Admini-stration	Tenancy	Variations
Public Sector	- Central Government	G	● G_1	● G_2	● G_3		▲		G_1 G_2 G_3 (P_4) (U_4)
	- Metropolitan Administration	g	▲	X	▲		▲		J_4 ●
	- J.V. between Central Government & Metropolitan Administration	G'	▲	▲	▲		▲		$T_3(P_3, U_3)$ ● (Sold in Lots)
Private Sector	- Non-Transport Related Firm	N	○ N_1	○	X	X	▲		
	- Transport Related Firm	T	○ T_1	○	X	● T_3	▲	● T_5	
	- Private T.T. Operation Co.	P	○ P_1	○	▲	● P_3	● P_4	● P_5	
	- T.T. User Cooperative	U	– U_1	–	▲	● U_3	● U_4	● U_5	
Joint between both Sectors	- G(+g) + Private Sector (multi-industry based)	J	●	●	● J_3		● J_4		J_1 J_2 J_3 J_4 ●
	- G(+g) + Truckers	j	▲ j_1	▲ j_2					$T_3(P_3, U_3)$ ● (Sold in Lots)

● Excellent Ability
● Good Ability
▲ Fair Ability
○ Ability not evaluated
X No Ability

□ Recommendation

* Note Lavels are acronyms of the organizational participants involved and subscripts are numbers for their roles

6.1.4 Type of Administrative Structure

As concluded in the previous sub-section, it is recommended that establishment including promotion, investment ownership be done by the government and that administration of the truck terminal facility system be a joint venture between the government and the private sector.

For the implementation of a multi-facility system, the following alternatives of administrative structure exist (Fig. 6-1).

i) Decentralized system

Each terminal is operated by an independent organization..

ii) Partially Centralized System (Recommended)

All facilities are equally administered under one organization, with authority for the terminal operation delegated to the terminal managers, while the central administration office concentrates on overall management and centralized clerical work.

iii) Totally Centralized System

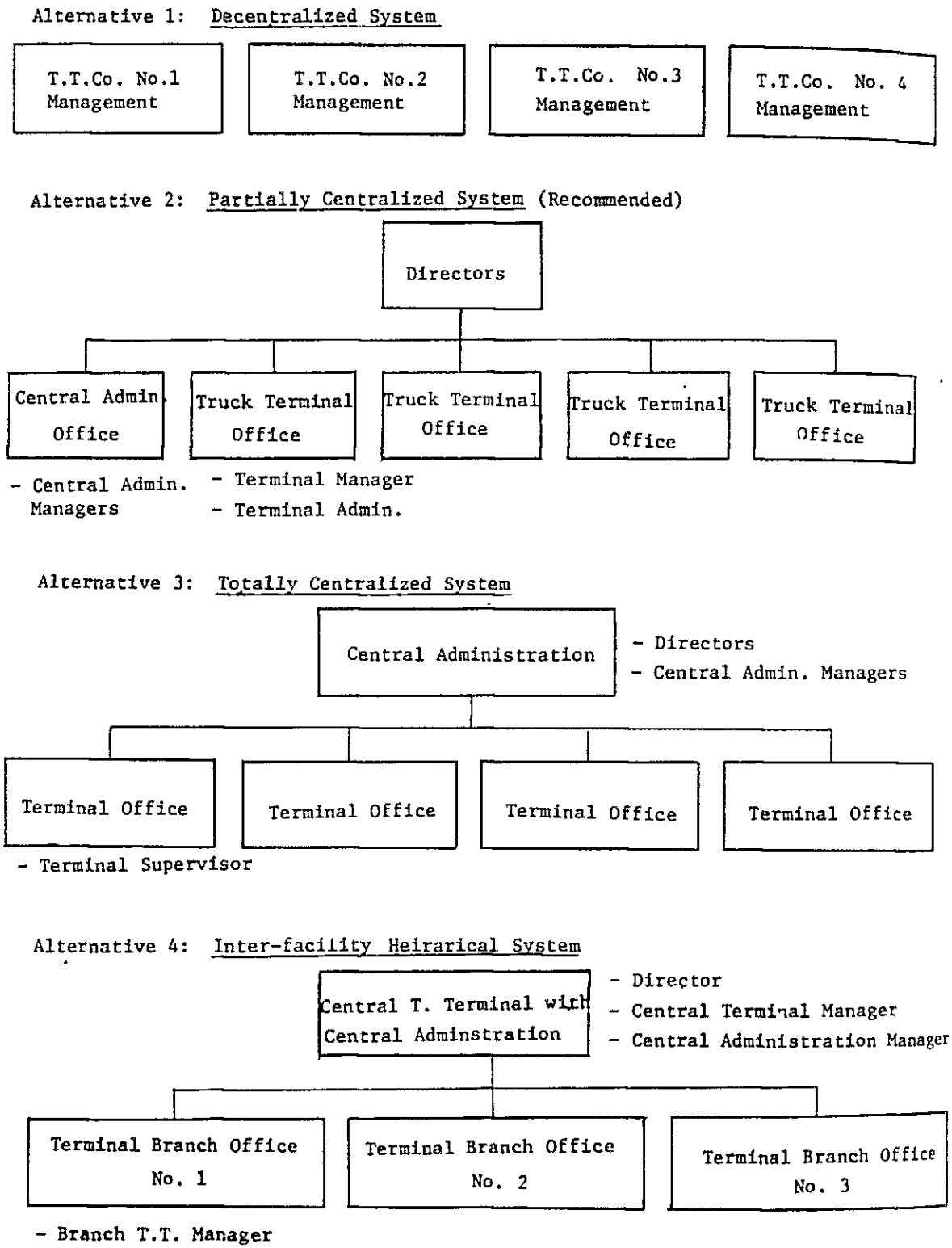
All facilities operated equally under the direct management and administration of the centralized organization, where the base office of terminal supervisers are also located.

iv) Inter-facility Heirarical System

One central terminal controls the rest of the terminals which function as branches of the central facility in all aspects of operation.

Of the 4 alternatives, mentioned above, the partially centralized system is recommended for the implementation of the truck terminals under consideration.

Fig. 6–1 ALTERNATIVE TYPES OF ADMINISTRATIVE STRUCTURE



6.2 Organization Development Program

6.2.1 Stages of Organization Development

The organization to implement the Truck Terminal Plan, tentatively designated as "the Truck Terminal Corporation" (TTC) will be developed essentially in three stages and require a temporary governmental commission to form it as described below.

Stage 1: (Initial Transitional Stage)

Organization in the initial transitional stage will take the form of a provisional office, starting with a few selected personnel from the private sector who work jointly with the governmental commission to establish the legal body of T.T.C. and operates until the organization is ready for full operation. Fig. 6-2 is a tentative draft organization chart fot the governmental commission (G/C) which outlines the concept of its functional components. The steps for establishing the G/C are outlined in section 6.2.2 below.

Stage 2: (Construction Stage)

The corporation commences full operation after having mobilized a sufficient number of key staff members and established the basic work procedures for the organization. From then on it continues to develop until the requirements for administrative personnel reaches its peak during the full scope of construction activities.

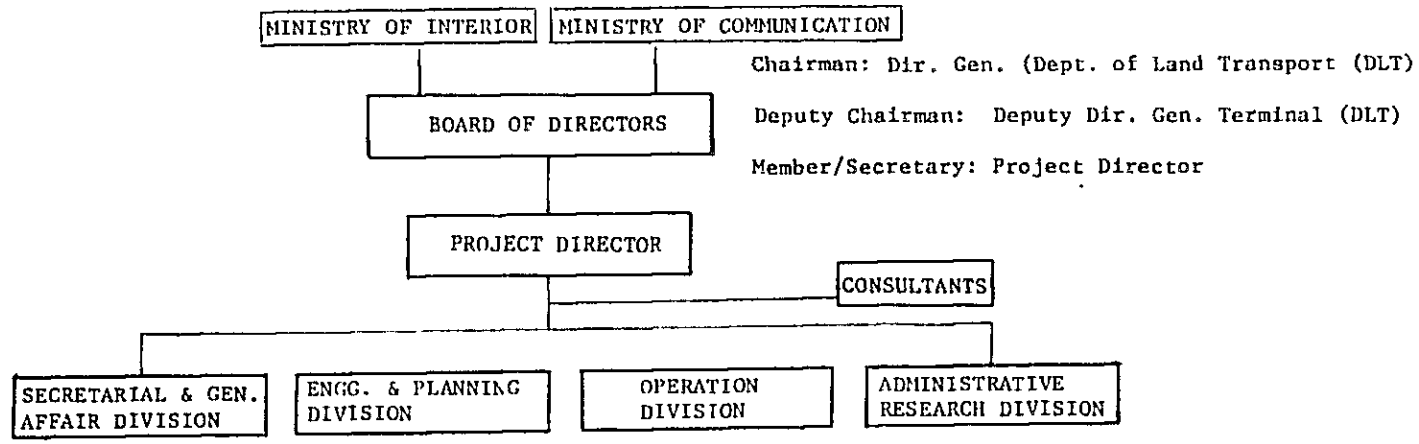
Fig. 6-3 presents a draft organization chart of the TTC at full capacity.

Stage 3: (Operation Stage)

After all terminals are opened for operations, the TTC organization will begin to phase down for the normal operations, Land Acquisition and Engineering Divisions are dissolved. Their functions will be absorbed by other administrative divisions, and each terminal office will become an independent sub-structure which reports to the general manager and cooperates in coordination with the central administrative divisions.

Fig. 6-4 is a draft organization chart of the TTC organization at its operation stage, showing the outline of its functional components.

Fig. 6–2 GOVERNMENTAL TRUCK TERMINAL PROMOTION COMMISSION (G/C) PROPOSED ORGANIZATION CHART (TRANSITIONAL INITIAL STAGE 1)



for:

- Correspondence, Documentation
- General Service
- Personnel Affairs
- Legal Services
- Etc.

for:

- Project Site Location Study
- Interface Study and Coordination with Other Programs for Regional, Urban, Traffic, Landuse, Social and Other Developments
- Truck Terminal Demand Study
- Facility Development Program & Schedule
- Supervision of Project Implementation
- Etc.

for:

- Public Hearing and Information
- Aiding Promotion of Land Transport Conference Organization
- Coordinating with LTC and Recruiting of Personnel for Truck Terminal Corp. Preparation Office Establishment
- Initiating Truck Terminal Corp. Provisional Office Operation
- Initiating Preparation of Various Internal Regulations
- Supervision of Organization Affairs
- Etc.

for:

- Study and Promotion of Legislative Actions
- Study and Promotion of Legal Procedures Establishment or Revision
- Review of Administrative Regulations
- Study and Promotion of Inter-Sectional Coordination within the Government
- Etc.

Fig. 6–3 "TRUCK TERMINAL CORPORATION" (T.T.C.) DURING CONSTRUCTION OF TERMINALS
PROPOSED ORGANIZATION CHART (CONSTRUCTION STAGE 2)

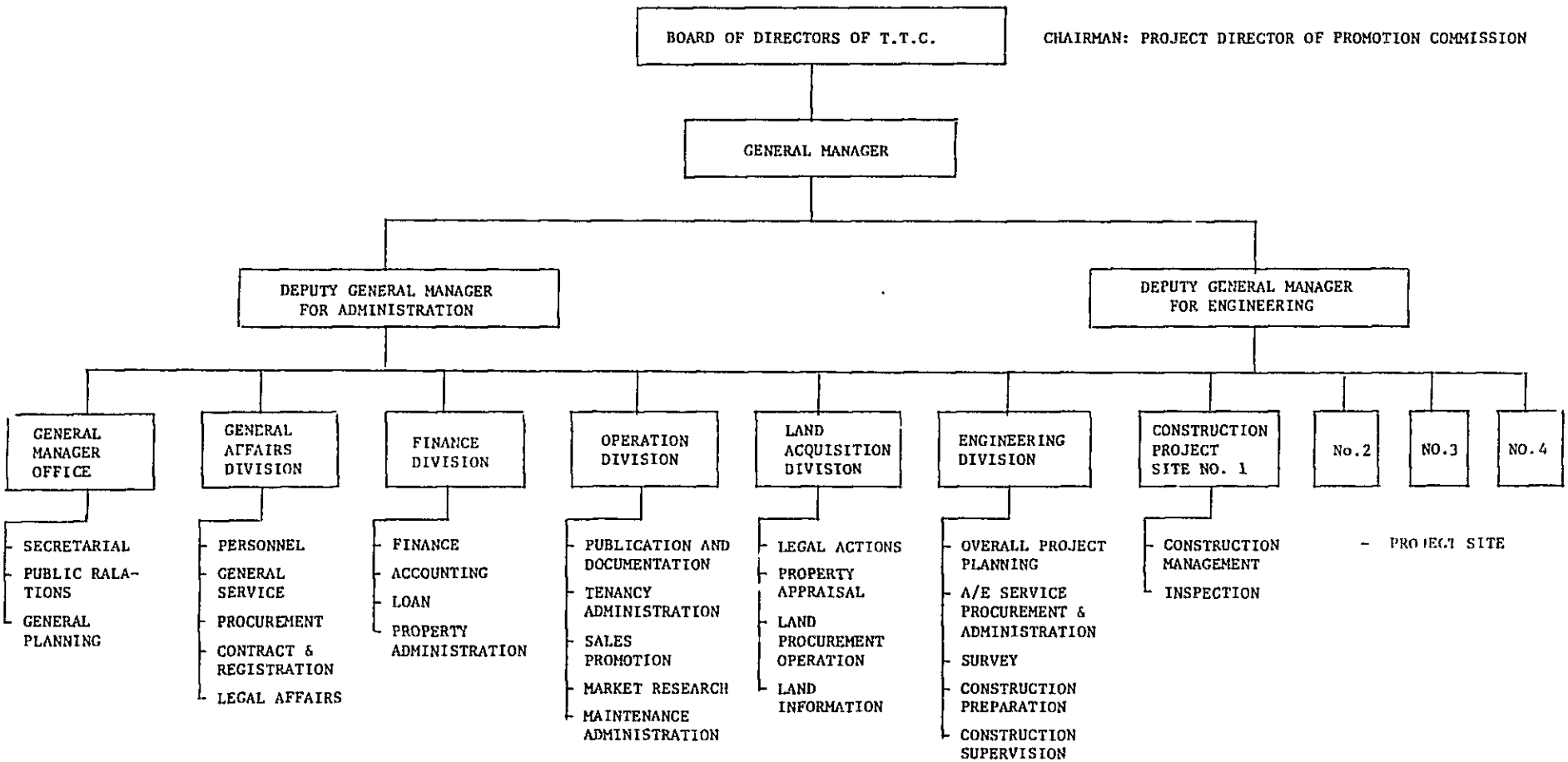
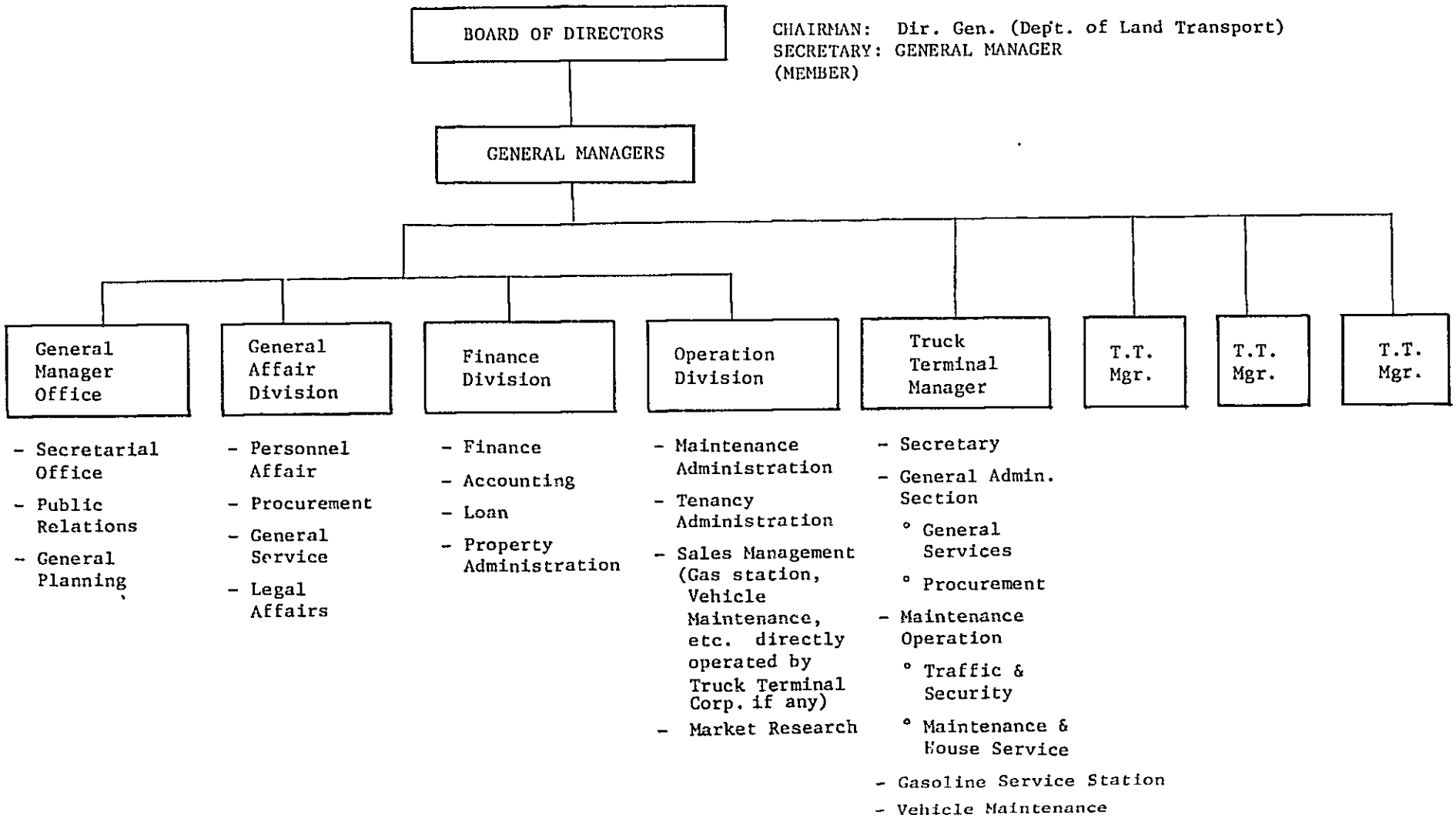


Fig. 6–4 TRUCK TERMINAL CORPORATION (T.T.C.), 2000 PROPOSED ORGANIZATION CHART (OPERATION STAGE 3)



6.2.2 Major Steps for Initiation of Governmental Commission Organizational Development

1. Government Commission - Government appoints a "Truck Terminal System Promotion Commission" (G/C)

2. Coordination Committee - G/C assembles representative of relevant transport related industries in the private sector, and promotes the establishment of a multi-industry based Land Transport (Truck Terminal) conference or coordination committee to coordinate the opinions of the relevant industries, and holds discussions with the G/C and the Government.

3. Appoint Private Sector Staff - G/C invites interested parties from private sectors for interviews and private conferences, and after pre-qualifying procedures and consultation with the coordination committee, recommend candidates for initial staff of the T.T.C. Provisional Office to the competent authority for appointment.

4. T.T.C. Provisional Office Start-up - Appointed private personnel join the G/C in commencing operation of T.T.C. Provisional Office.

5. Staffing - T.T.C. Provisional Office proceeds to establish the T.T.C. organization, including (for example) the following: legal procedures, inviting partners, mobilizing personnel, drafting house regulations, and operation procedures, etc. for the approval of the authority in-charge.

6. T.T.C. Inauguration - Truck Terminal Corporation begins operation.

6.3 Project Implementation Schedule

Fig. 6-6 through 6-9 present four alternative overall implementation schedules for the proposed truck terminal system in the alternative-33 and Fig. 6-5 is a summary of all the four alternatives:

Alternative I — Established based on estimated volume of demand as minimum time requirement for construction preparation an and execution and therefore indicates the fastest possible way of completing the first phase of one facility for operation.

This alternative does not atlow time for establishment of a new project implementing organization, and therefore is applicable to the case of "Government established, private or Government-private sector J.V. administered" facility program.

Alternative II — is a modified version of Alternative I, with a more reasonable amount of time allowed for the organization and construction program initiating operations.

Alternative III is a further modified version of Alternative II, with implementation time of most projects extended to avoid a concentration of similar operations for multiple projects at one time. (Recommended)

Alternative IV is established with ideal scheduling of facility development disregarding the time of facility requirement, and allowing a reasonably sufficient time for organization establishment and other construction preparation, as well as a short amount of time between the execution of the first construction project and the design of the second so that experience from the use of the former can be used for the latter.

Alternative I is used as the basis of all cost and economical analysis in this project since it is the costliest alternative and is logically the safest basis for the study where analysis of all alternatives is not possible for reason of time. However due to the limited amount of time available for implementation, this alternative is not considered possible.

Alternative IV in contrast to Alternative I is considered unsatisfactory from a timing standpoint, considering the time lag of 5 years between the opening of the first facility and the second.

Of the remaining two alternatives, alternative III is considered the better from the viewpoint of workload allocation and is therefore recommended for implementation.

Consequently, the recommended implementation schedule for the proposed truck terminal system (Alternative-333) is shown in Fig. 6-10. This schedule is a modification of the implementation schedule of Alternative 33-III recommended above.

Fig. 6–5 COMPARISON OF ALTERNATIVE IMPLEMENTATION SCHEDULES (Alt. 33)

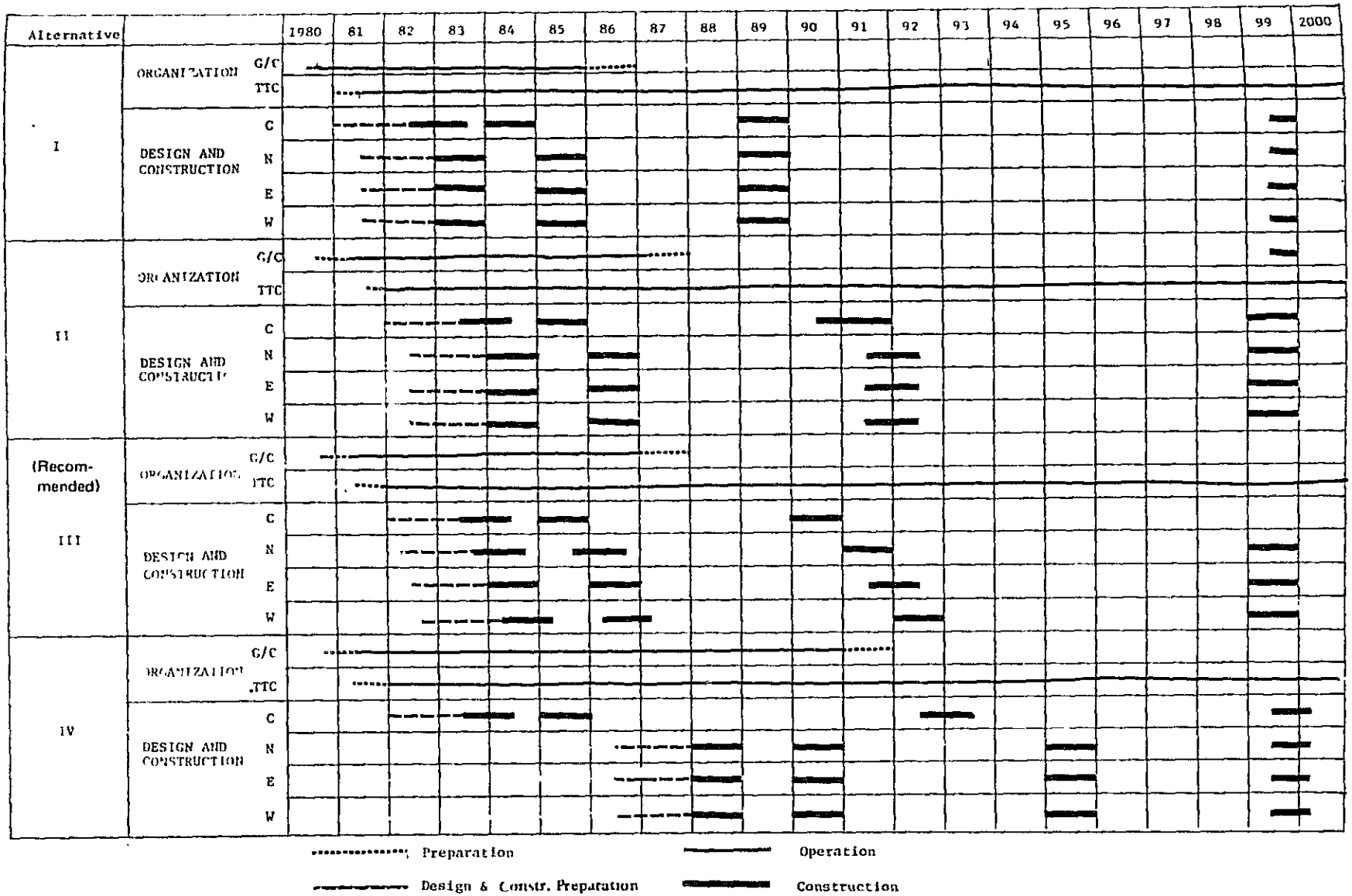


Fig. 6–6 IMPLEMENTATION PROGRAM – ALTERNATIVE I (Alt. 33)

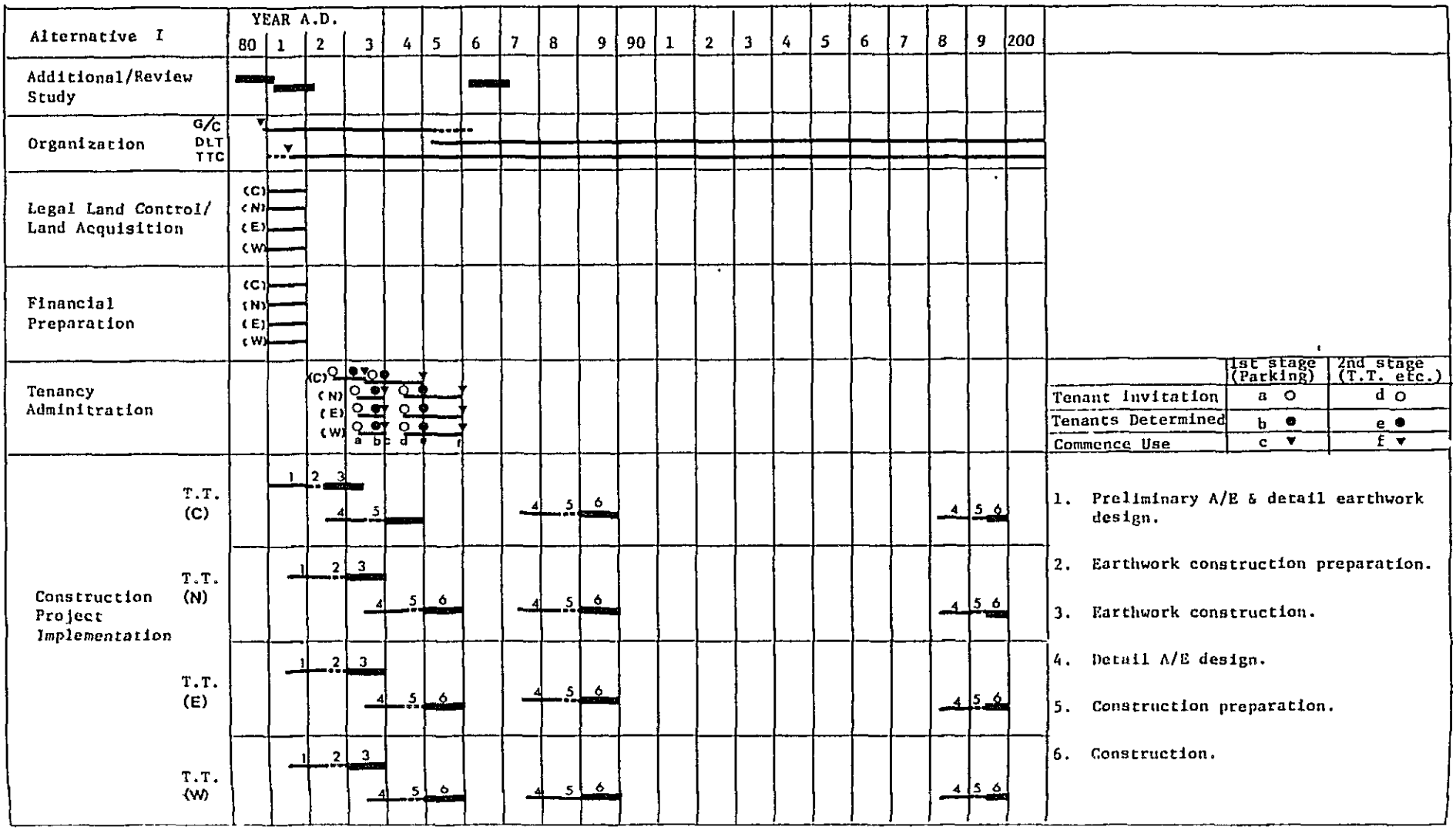


Fig. 6–7 IMPLEMENTATION PROGRAM – ALTERNATIVE II (Alt. 33)

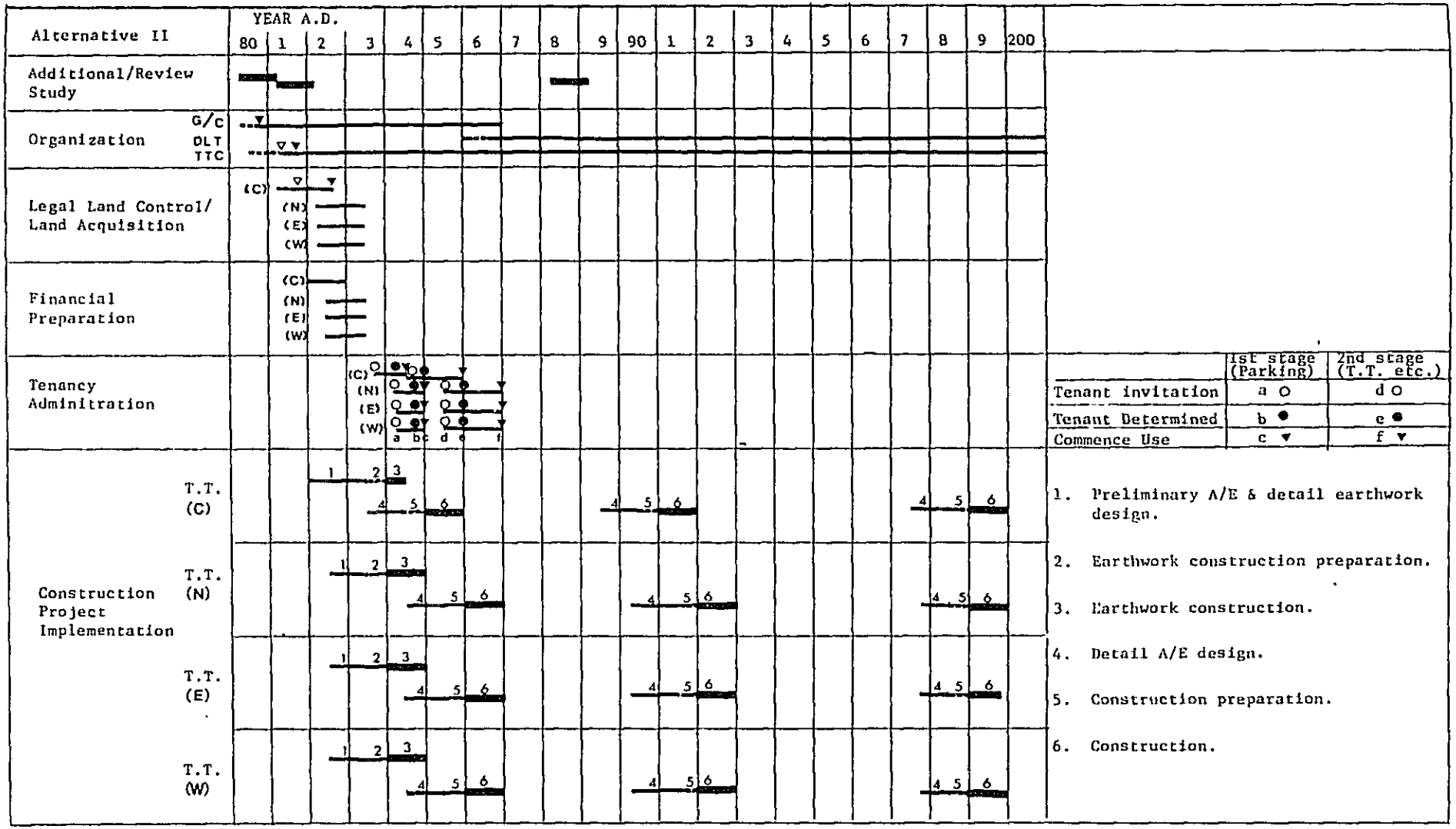


Fig. 6–8 IMPLEMENTATION PROGRAM – ALTERNATIVE III (RECOMMENDED (Alt. 33))

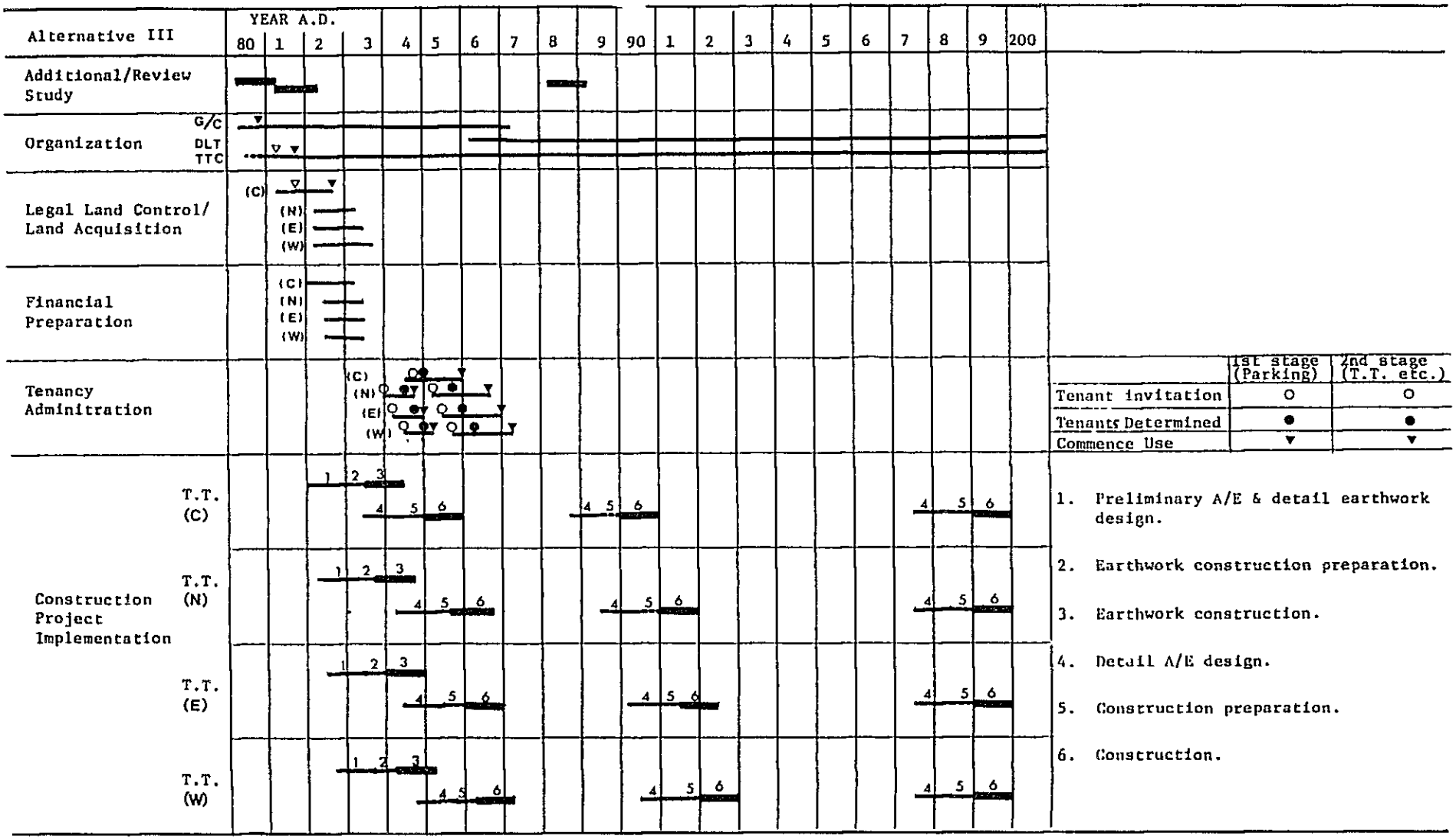


Fig. 6–9 IMPLEMENTATION PROGRAM — ALTERNATIVE IV (Alt. 33)

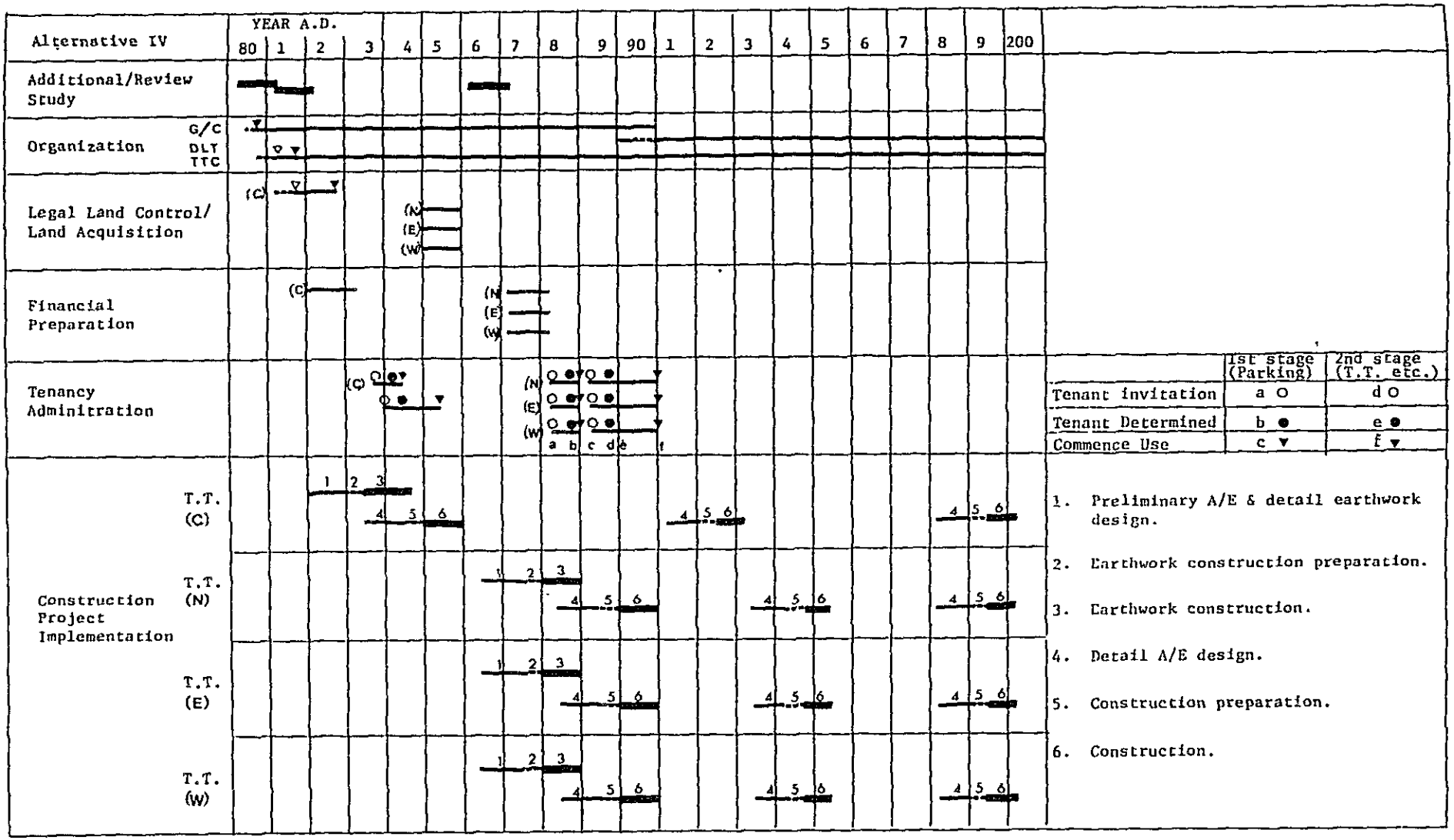
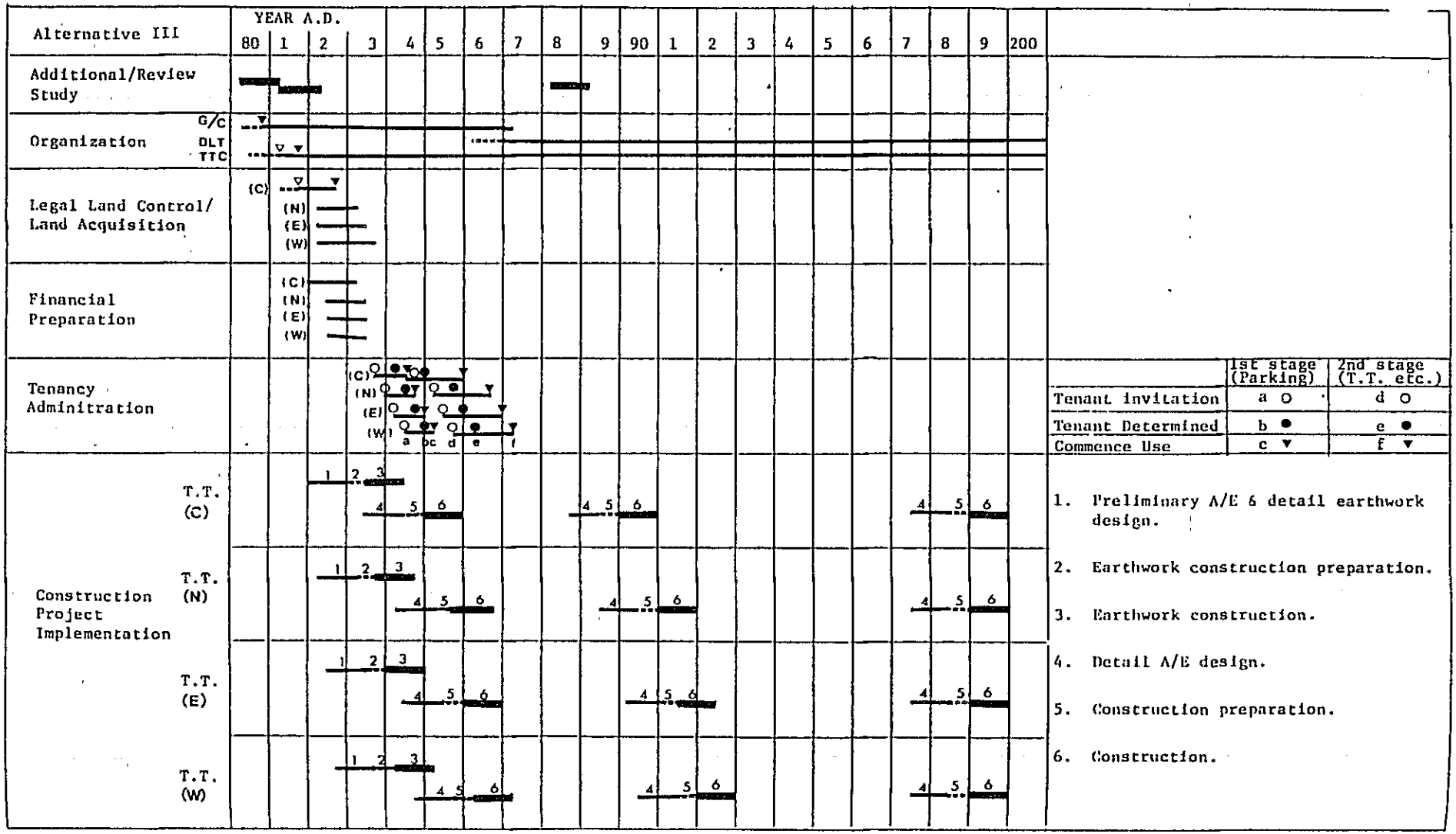
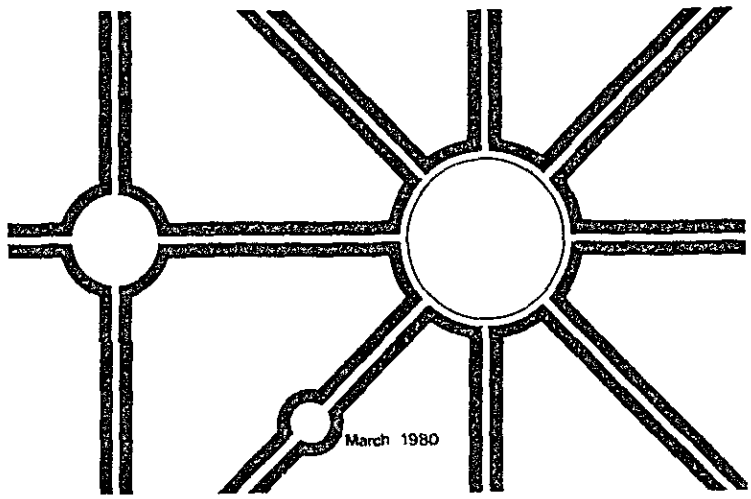


Fig. 6-10 IMPLEMENTATION PROGRAM - ALTERNATIVE III
(RECOMMENDED (Alt. 333))



CHAPTER 7 ECONOMIC EVALUATION



Chapter 7 ECONOMIC EVALUATION

7.1 Economic Cost Calculation

The economic evaluation is to determine whether this project will contribute to the over-all economy of Thailand based on a comparison of costs and benefits. Although costs represent commitments and consumption of resources (including labour) for the implementation of the project, transfer payments such as taxes and subsidies are not included in the economic cost since these elements have already been taken into consideration for the financial evaluation of the total financial costs of the project which were analyzed in Section 5.6.

7.1.1 Cost Breakdown

The method of defining economic cost is as follows. The total project costs consisting of land acquisition, construction work and final engineering/supervision services were broken-down and divided into the costs for materials, equipment, labour and overhead/profit components. In addition, each component was subdivided into the local and foreign portions and the tax elements of the respective portions were abstracted.

A summary of these proportions is presented in Table 7-1 along with the subdivided cost elements.

The cost of final engineering and supervision services was estimated to be 10% of the total economic cost of the construction, excluding land acquisition cost and compensation.

7.1.2 Construction Staging and Economic Costs

The construction staging has been proposed in Section 5.5.1. (3) based on the traffic demand for the terminal complexes.

The economic costs of each staged work were calculated and are summarized for the economic cost of each stage as shown in Tables 7-2(a) through 7-2(c).

7.1.3 Project Facilities and Economic Costs

The ultimate stage has been envisaged as a terminal complex consisting of four project elements: the truck terminal, warehouses, chartered truck center and public parking facility.

In this section, some alternatives concerning degree of construction for the facilities in the terminal complex were considered in order to determine the maximum desirable extent of the complex facilities within the limited scope of economic benefit incurred when only defined as savings in the total vehicle operating cost and the total time cost.

Accordingly, alternative consideration was given to the project facilities in the following three degrees of construction:

Table 7-1 Foreign/Local Currency Portions and Tax Elements of Project Costs

(unit: %)

	Material			Equipment			Labour			Overhead & Profit			Total Tax Portion
	Local	Foreign	Tax	Local	Foreign	Tax	Local	Foreign	Tax	Local	Foreign	Tax	
Earthwork:													
1. Clearing & Grubbing	-	-	-	11	48	7	6	-	-	6	15	7	14
2. Embankment	-	-	-	18	42	6	6	-	-	6	15	7	13
Drainage Facilities:													
3. RC-Pipe Culvert D=40	42	4	4	10	2	1	9	-	-	19	2	7	12
4. " D=100	44	5	5	8	3	1	6	-	-	19	2	7	13
5. U-Ditch 0.3x0.5	39	9	5	8	4	1	6	-	-	17	4	7	13
6. " 1.0x	41	9	5	7	4	1	5	-	-	17	4	7	13
Pavement:													
7. Cement Concrete Pavement	43	16	5	3	3	1	1	-	-	14	7	7	13
8. Asphaltic Concrete Pavement	19	33	6	3	9	2	1	-	-	6	14	7	14
Buildings:													
9. Transshipment Platform	23	23	5	7	9	2	4	-	-	10	10	7	16
10. Control & Business Offices	23	23	5	7	9	2	4	-	-	10	10	7	16
11. Warehouses	23	23	5	7	9	2	4	-	-	10	10	7	16
12. Garage	23	23	5	7	9	2	4	-	-	10	10	7	16
13. Petrol Station	23	23	5	7	9	2	4	-	-	10	10	7	16
14. Maintenance Shop	23	23	5	7	9	2	4	-	-	10	10	7	16
Other Facilities:													
15. Parking Yard	43	16	5	3	3	1	1	-	-	14	7	7	13
17. Docking Yard	43	16	5	3	3	1	1	-	-	14	7	7	13

1. Total terminal complex
2. Truck terminal facilities and warehouses only
3. Truck terminal facilities only

Construction staging was also applied to the above degrees of construction of project facilities and the results are shown in Table 7-2(a) through (c).

The detailed economic costs break-down are presented for each project facility in Appendix Table AP7-1 through AP7-12.

Table 7-2(a) Project Facilities and Economic Costs by Stage

(Alternative 33) (Unit: 1,000 Baht)

Terminal/Facility \ Stage		1	2	3	4	Total
N:	Total Complex	410,866	165,092	101,596	73,822	751,176
	T.T. & Warehouses only	291,808	127,556	101,596	73,822	594,782
	T.T. only	109,619	81,495	40,756	32,477	264,347
E:	Total Complex	196,971	140,787	51,523	27,593	416,874
	T.T. & Warehouse only	124,395	98,058	51,523	27,593	301,569
	T.T. only	84,786	78,217	27,717	27,593	218,313
W:	Total Complex	220,463	144,951	71,593	62,656	499,663
	T.T. & Warehouses only	168,091	103,106	71,593	62,656	405,446
	T.T. only	87,454	70,496	35,043	32,943	325,936
C:	Total Complex	1,066,950	122,024	81,467	-	1,270,441
	T T. & Warehouses only	954,886	122,022	81,466	-	1,158,374
	T.T. only	954,886	122,022	81,466	-	1,158,374
Total	Total Complex	1,895,250	572,854	306,179	164,071	2,938,354
	T.T. & Warehouse only	1,539,180	450,742	306,178	164,071	2,460,171
	T.T. only	1,236,745	352,230	184,982	93,013	1,866,970

N.B. T.T. = Truck Terminal

Table 7-2(b)

(Alternative 55)

Terminal/Facility \ Stage		1	2	3	4	Total
N':	Total Complex	1,309,136	228,608	221,589	43,578	1,802,911
	T.T. & Warehouses only	1,072,613	228,608	221,589	43,578	1,566,388
	T.T. only	794,505	204,642	142,722	-	1,141,869
E	Total Complex	196,971	140,787	51,523	27,593	416,874
	T.T. & Warehouses only	124,395	98,058	51,523	27,593	301,569
	T.T. only	84,786	78,217	27,717	27,593	218,313
W·	Total Complex	220,463	144,951	71,593	62,656	499,663
	T.T. & Warehouses only	168,091	103,106	71,593	62,656	405,446
	T.T. only	87,454	70,496	35,043	32,943	225,936
Total	Total Complex	1,726,570	514,346	344,705	133,827	2,719,448
	T.T. & Warehouses only	1,365,099	429,772	344,705	133,827	2,273,403
	T.T. only	966,745	353,355	205,482	60,536	1,586,108

Table 7-2(c)

(Alternative 7) (Unit· 1,000 Baht)

Terminal/Facility \ Stage		1	2	3	Total
	Total Complex	3,242,954	545,451	314,459	4,102,864
C.	T T & Warehouses only	2,528,301	428,448	314,459	3,271,208
	T.T. only	1,666,859	302,390	229,816	2,199,065

7.2 Economic Benefit Calculation

The benefit accruing from the project can be defined as the difference in socio-economic costs between the case where the project is implemented and the case where it is not. The socio-economic benefit attributable to the project includes various kinds of benefits which are both tangible and indirect.

In this study, the benefit is calculated from the savings in vehicle operating costs and time costs which accumulate as a result of truck terminal construction.

For the calculation of these cost categories, reference was made to the report of "Standardization of Vehicle Operating Costs, 1977-Ministry of Communications, Department of Highways".

7.2.1 Vehicle Operating Costs

Various operating cost components enumerated in this analysis are derived on the basis of bench mark speeds of vehicles. The bench mark speeds are considered the normal or average speeds of passenger cars, trucks and buses on roads with good surface conditions, provided the traffic volume has not reached a level to cause congestion and consequently a slowing down of traffic. The bench mark speeds used for each vehicle type in this study are presented in Table 7-5.

(1) Vehicle Operating Cost Components

Among vehicle operating costs, the following cost components were taken to form the total vehicle operating cost at the bench mark speed.

1. Fuel consumption,
2. Engine oil consumption,
3. Tyre wear,
4. Maintenance costs for labour and spare parts,
5. Vehicle depreciation and interest costs, and
6. Overhead costs for commercial vehicles.

The calculation of the above costs is based on 1979 prices and economic costs excluding the various taxes imposed on road users.

(2) Representative Vehicle Tyres

By observation of vehicle traffic on major streets in the study area and interview with dealers of vehicles, the following vehicles are selected to represent the existing as well as future traffic flow component.

(a) Motor Car: Selling price (Baht, Sep., 1979)

Toyota carolla 1200 cc 178,000+10,000(cooler) = 188,000 Baht

corona	1600 cc	219,000+13,000(cooler) = 232,000 Baht
crown	2600 cc	369,000+24,000(cooler) = 393,000 Baht

Corona was selected as the representative motor car.

(b) Light truck (Diesel):

Toyota Dyna	3000 cc	short body, 4-W	175,500 Baht
"	3000 cc	long body, 6-W	204,500 Baht
Isuzu Elf	2400 cc	short body, 4-W	174,000 Baht
	2800 cc	long body, 6-W	207,500 Baht

190,000 Baht was taken as the selling price of an average diesel light truck.

(c) Light truck (Petrol)

Toyota Hilux	1600 cc	104,500 Baht
Isuzu KB25		107,000 Baht
" KBD25		125,000 Baht
" KBD20		119,500 Baht

111,400 Baht was taken as the selling price of an average petrol light truck.

(d) Medium truck

Isuzu TXD-50HC	309,000 Baht	(Engine, chassis, cab and deck)
Hino KL-300	272,000 Baht	(Engine, chassis and cab)

Isuzu TXD-50HC was selected as the representative vehicle of a medium truck.

(e) Heavy truck

Isuzu TWD-80HJR	340,000 Baht	(Fngine, chassis and windshield)
" TWD-80HCR	370,000 Baht	(Engine, chassis and cab)
" JCM-490Y	421,000 Baht	(Engine, chassis, cab and deck)
Hino KT920	391,000 Baht	(Engine, chassis, cab and deck)
" KT925	423,000 Baht	(Engine, chassis, cab and deck)

As the selling price of an average medium truck 420,000 Baht was adopted in this study.

(f) Semi-Trailer

The semi-trailer in this study is considered to be a truck-tractor with a 200 h.p. diesel engine with a gross laden weight of truck and trailer of 30 tons.

The selling price of such a unit is estimated based on the information from a car dealer to be 740,000 Baht.

(g) Light bus (diesel)

The light bus (diesel) is a simple alteration of the light truck with bench seats fitted longitudinally in the rear and a light canopy of canvas or steel installed over the deck. The estimated cost of providing these fittings to make the conversion is Baht 4,500.

The representative vehicle was taken to have a selling price of Baht 190,000 + 4,500 = Baht 194,500.

(h) Light bus (Petrol)

The light bus (petrol) was treated in the same way as the diesel version. With a shorter body the cost of conversion is that much less and costs about Baht 2,900.

The representative vehicle was taken to have a selling price of Baht 111,400 + 2,900 = Baht 114,300.

(i) Heavy bus

There are a wide range of heavy buses on the roads in Thailand ranging from relatively inexpensive city service buses with locally built coachwork to highly expensive fully-imported airconditioned tour buses. Therefore, making reference to some relevant study reports, a selling price of the representative vehicle was estimated to be Baht 753,000.

To summarize, the selling prices of the above representative vehicles are listed in Table 7-4.

(3) Economic Costs of Representative Vehicle

Duties and taxes on vehicles and component parts in Thailand are shown in Table 7-3. Based on this, the economic costs of the representative vehicles were estimated as shown in Table 7-4.

Other necessary operating data for the representative vehicles is introduced in Table 7-5.

Table 7-3 Duties and Taxes on Vehicles and Component Parts in Thailand

Representative Vehicles or Components	Description	Customs Duty (%)	Business and Manicipal Tax (%)	Revenue Tax (%)	Rate of Standard Profit (%)
Car	CBU*	150	44	30	value
	Parts for assembly (PFA)	80	1.65	30	11
Four-wheel drive, Light Trucks and Buses	CBU	80	7.70	-	value
	PFA	40	1.65	0	11
Medium, Heavy and Semi-Trailer Trucks & Heavy Trucks	With Cab:				
	CBU	40	7.70	-	value
	PFA	30	1.65	-	11
	With Windshield Only:				
	CBU	20	7.70	-	value
	PFA	10	1.65	-	11
Component Parts	Imported	50	7.70	-	26

N.B. : CBU: Complete Built-up, PFA: Parts For Assembly

Note* The importation of the completely assembled passenger car was prohibited by law in 1978.

Sources "Customs Tariff and Business Tax", Ministry of Commerce

Table 7-4 Economic Costs of Representative Vehicles

(Unit: Baht)

Representative Vehicles	Selling Price (A)	Price less Taxes (B)	No. of Tyres	Cost of Tyres & Tubes (less Taxes) (C)	Economic Cost (B)-(C)
* Motor Car	232,000	113,500	5	2,095	111,405
Light Truck (Diesel)	190,000	111,400	5	3,725	107,675
Light Truck (Petrol)	111,400	80,700	5	3,080	77,620
Medium Truck	309,000	256,200	7	14,406	241,794
Heavy Truck	420,000	370,100	11	22,638	347,462
Light Bus (Diesel)	194,500	115,300	5	3,725	111,575
Light Bus (Petrol)	114,300	81,800	5	3,080	78,720
Heavy Bus	753,000	640,300	7	20,433	619,867
Semi-Trailer	740,000	516,400	15	30,870	485,530

* Note. Custom duty on passenger cars was changed in 1978 from 50% to 80% for the parts for assembly and the importation of the completely assembled passenger car was prohibited by law.

Table 7-5 Miscellaneous Operating Data for Representative Vehicles

Vehicle Type	Benchmark Speed (k.p.h.)	Lifetime Average Speed (k.p.h.)	Service Life (years)	Annual Distance Travelled (km)
Motor Car	80	56	10	18,000
Light Truck (Diesel)	72	56	10	25,000
Light Truck (Petrol)	72	56	10	25,000
Medium Truck	72	56	13	40,000
Heavy Truck	72	56	12	50,000
Light Bus (Diesel)	72	56	7	35,000
Light Bus (Petrol)	72	56	7	35,000
Heavy Bus	80	56	9	80,000
Semi-Trailer	72	56	12	60,000

Source: "Standardization of Vehicle Operating Costs for Thailand, 1977 - Ministry of Commerce"

(4) Fuel and Engine Oil Costs

The prices of fuel and engine oil in Bangkok were found as shown in Table 7-6.

Table 7-6 Fuel and Engine Oil Costs in 1979

(Unit: Baht/liter)

Cost Item	Retail Price	Duty & Tax	Economic Cost
Gasoline: Regular	7.45	1.075	6.375
Premium	7.84	1.083	6.757
Diesel	4.88	0.318	4.562
Engine Oil *	28.00	1.44	26.56

Note:* Oil costs vary considerably with grade and usage. The average price inclusive of taxes was estimated at Baht 28.00 per liter.

(5) Repair and Maintenance Costs

Repair and maintenance cost rates were quoted from the standardization. Labour cost on repair and maintenance including salary, tools, overheads was estimated at Baht 46.00 per hour.

(6) Fuel, Engine Oil Consumption Rate and Maintenance Costs

The consumption rates of the above costs have been found as shown in Table 7-7.

Table 7-7 Fuel Engine Oil Consumption Rates and Maintenance Costs

Vehicle Type	Fuel Cons. (km/l)	Oil Cons. (km/l)	Labour Cost hours/1000km)	Parts Cost (%Economic cost/1000km)
Motor Car	11.0 (45% Premium) (55% Regular)	1,000	1.65	0.126
Light Truck (Diesel)	8.0 (Diesel)	770	1.90	0.200
Light Truck (Petrol)	10.0 (Regular)	1,000	1.90	0.200
Medium Truck	4.5 (Diesel)	450	8.38	0.080
Heavy Truck	4.0 (Diesel)	450	9.38	0.080
Light Bus (Diesel)	8.0 (Diesel)	770	1.90	0.200
Light Bus (Petrol)	10.0 (Regular)	1,000	1.90	0.200
Heavy Bus	3.5 (Diesel)	450	9.38	0.080
Semi Trailer	2.6 (Diesel)	450	8.73	0.080

(7) Tyre Costs (tyre + tube)

The tyre costs of the representative vehicles were estimated by increasing the 1976 prices derived from the report of "Standardization of Vehicle Operating Costs for Thailand" by 15%. For the economic cost calculation, 7.7% of the business tax and 8% of the excise duty were deducted as shown in Table 7-8.

Table 7-8 Tyre Costs (Tyre + Tube)

(Unit: Baht/tyre)

Rep. Veh.	Selling Price	Economic Cost
Motor Car	497	419
Light Truck (Diesel)	884	745
Light Truck (Petrol)	731	616
Medium Truck	2,441	2,058
Heavy Truck	2,441	2,058
Light Bus (Diesel)	884	745
Light Bus (Petrol)	731	616
Heavy Bus	3,463	2,919
Semi-Trailer	2,441	2,058

The tyre cost per kilometer was derived using the following formula:

$$\text{Tyre cost (Baht/km)} = \frac{(\text{No. of Tyres}) \times [(\text{No. of Retreads}) \times (\text{Cost of Retread Tyre}) + (\text{Cost of New Tyre})]}{(\text{No. of Retreads}) \times (\text{Retread Tyre Life}) + (\text{New Tyre Life})}$$

The required data for calculating the above formula is summarized in the following table.

Table 7-9 Economic Costs of New Tyres and Retreads and Average Tyre Life

Vehicle Type	Tyre Size	New Tyres and Tubes		Retread Tyres			
		Cost Less Taxes (฿)	Average Tyre Life (km)	Cost	Cost Less Taxes (฿)	Average Tyre Life (km)	Number of Retreads from Casing
Car	5.60x13 4 ply	419	40,000	144	132	32,000	0.5
Light Truck	6.50x16 6 ply	745	35,000	276	254	28,000	0.5
Light Truck	6.00x14 4 ply	616	35,000	219	201	28,000	0.5
Medium Truck	8.25x20 12 ply	2,058	45,000	552	508	36,000	1.0
Heavy Truck	8.25x20 12 ply	2,058	50,000	552	508	40,000	1.5
Light Truck (Diesel)	6.50x14 4 ply	745	35,000	276	254	28,000	0.5
Light Truck (Petrol)	6.00x14 4 ply	616	35,000	219	201	28,000	0.5
Heavy Bus	10.00x20 12 ply	2,919	50,000	788	725	40,000	1.5
Semi-Trailer	8.25x20 12 ply	2,058	40,000	552	508	32,000	1.5

Source: "Standardization of Vehicle Operating Costs for Thailand, 1977"

Note: The data derived from the above report was increased by 15% for adjustment to 1979 prices.

(8) Depreciation and Interest Costs

In order to derive the rate of annual cost incurred by vehicle owners, the following formula was employed :

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

where, A = pro-rated annual cost of owning the vehicle
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.

In this study 12% was taken as an annual rate of interest.

The salvage value of the representative vehicles was determined in reference to the study report of "Standardization of Vehicle Operating Costs in Thailand" and presented in Table 7-10.

(9) Overhead Cost

The overhead cost is assumed to include other cost components such as rent for a building or a land, labour costs of administrative personnel, etc. This means that the overhead cost differs due to the size and type of operators. Therefore, the overhead cost was assumed to be 10 percent of the running cost for light truck and light bus, while 20 percent of the running cost for medium truck, heavy truck and heavy bus.

(10) Summary of Data

The data necessary to the calculation of vehicle operating costs have been summarized as shown in Table 7-10.

(11) Vehicle Operating Cost by Speed

For the variation of operating costs for different vehicle speeds, reference was made to "Quantification of Road User Savings" by Jan de Weille and "Standardization of Vehicle Operating Costs in Thailand". The results are summarized in Table 7-11,12, and graphically presented in Fig. 7-1.

Table 7-10 Base Data for Calculating the Economic & Financial Vehicle Operating Costs

Item No.	Particular		Motor Car	*Light Truck	Medium Truck	Heavy Truck	*Light Bus	Heavy Bus	Semi-Trailer
1	Number of Tyres		4	4	6	10	4	6	14
2	Oil Consumption (Km/L)		1,000	920	450	450	920	450	450
3	New Tyre Life (Km)		40,000	35,000	45,000	50,000	35,000	50,000	40,000
4	Retread Tyre Life (Km)		32,000	28,000	36,000	40,000	28,000	40,000	32,000
5	Cost of Vehicle:	Economic (฿)	111,405	88,139	241,794	347,462	90,219	619,867	485,530
6		Financial(฿)	232,000	138,910	309,000	420,000	142,370	753,000	740,000
7	Cost of New Tyre:	Economic (฿)	419	661	2,058	2,058	661	2,919	2,058
8		Financial(฿)	497	785	2,441	2,441	785	3,463	2,441
9	Cost of Retread Tyre:	Economic (฿)	132	220	508	508	220	725	508
10		Financial(฿)	144	239	552	552	239	788	552
11	Salvage Value (฿)		2,875	2,875	34,500	40,250	2,875	51,750	51,750
12	Annual Distance Travelled (Km)		18,000	25,000	40,000	50,000	35,000	80,000	60,000
13	Average Service Life of Vehicle (Years)		10	10	13	12	7	9	12
14	Percentage Premium/Regular Petrol		45/55	0/100	-	-	0/100	-	-
15	Percentage Petrol/Diesel		100/0	65/35	0/100	0/100	65/35	0/100	0/100
16	Parts Costs (% of Cost/1000Km)	Economic	0.126	0.200	0.080	0.080	0.200	0.080	0.080
		Financial	0.062	0.127	0.063	0.063	0.127	0.063	0.063
17	Labour Cost (Hours/1000Km)		1.65	1.90	8.38	9.38	1.90	9.38	8.73
18	Percentage Overheads		-	10	20	20	10	20	**
19	Fuel Consumption (Km/L)		11	9.3	4.5	4.0	9.3	3.5	2.6
20	Number of Retreads from Casing		0.5	0.5	1.0	1.5	0.5	1.5	1.5
21	Fuel Cost: Premium Petrol	(Economic)	6.757						
22	(Baht/L)	(Financial)	7.840						
23	Regular Petrol	(Economic)	6.375						
24		(Financial)	7.450						
25	Diesel	(Economic)	4.562						
26		(Financial)	4.880						
27	Oil Cost: (Economic)		26.56						
28	(Baht/L): (Financial)		28.00						
29	Cost of Labour (Baht/Hour)		46.0						
30	Interest Rate (%)		12						

Notes: * The vehicle composition between patrol and diesel trucks (buses) was estimated to be 65% and 35% respectively.

** Light buses were assumed to have the same value as derived for heavy trucks.

Table 7-11 Economic Vehicle Operating Costs by Speed

(Unit: Baht/km)

Speed (K.P.H)	Motor Car	Light Truck	Medium Truck	Heavy Truck
10	2.0698	1.7875	4.1421	4.7972
16	1.9803	1.7234	3.7950	4.4105
24	1.9146	1.6580	3.4790	4.0608
32	1.8604	1.6025	3.2228	3.7809
40	1.8352	1.5918	3.1173	3.6703
48	1.8343	1.6095	3.0915	3.6507
56	1.8514	1.6408	3.1259	3.6985
64	1.8815	1.6946	3.2152	3.8098
72	1.9240	1.7694	3.3686	3.9937
80	1.9759	1.8611	3.5719	4.2357
88	2.0340	1.9592	3.7755	4.4779

Speed (K.P.H.)	Light Bus	Heavy Bus	Semi-Trailer
10	1.7238	5.3909	6.3320
16	1.6599	5.0005	5.7613
24	1.5946	4.6461	5.2432
32	1.5394	4.3611	4.8314
40	1.5289	4.2496	4.6659
48	1.5467	4.2311	4.6331
56	1.5782	4.2816	4.6990
64	1.6323	4.3963	4.8581
72	1.7071	4.5849	5.1186
80	1.7991	4.8310	5.4663
88	1.8973	5.0756	5.8129

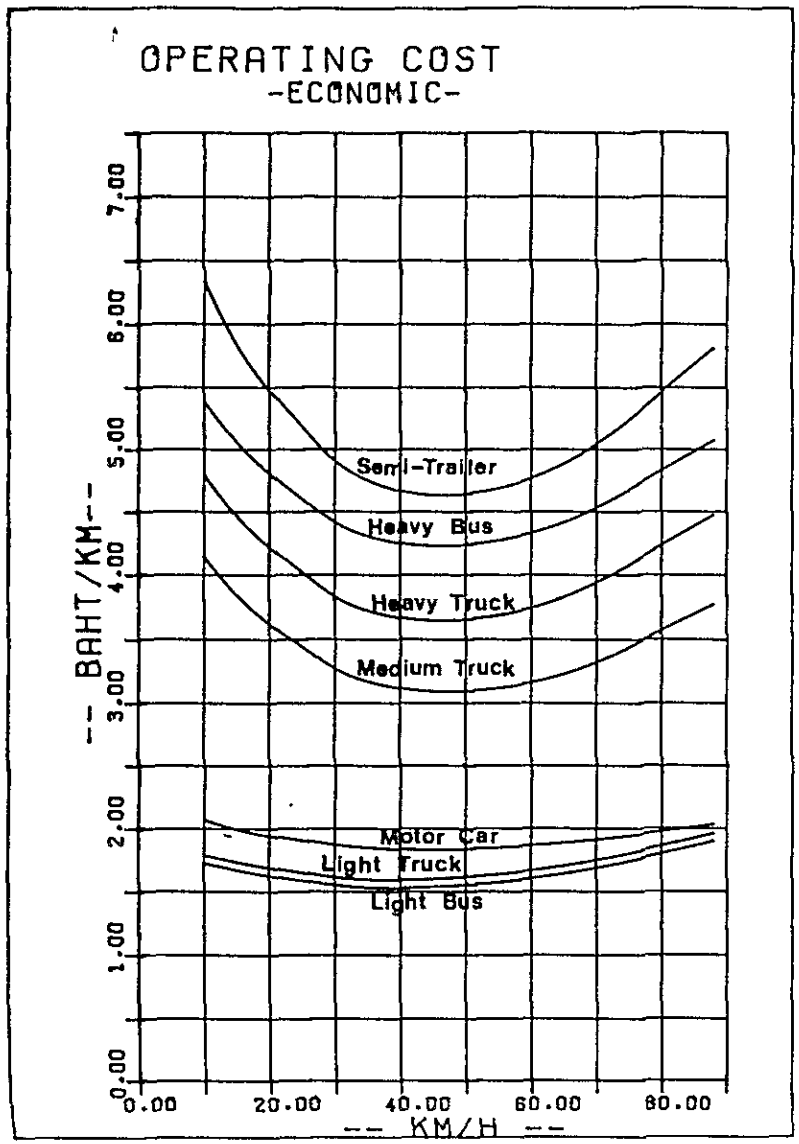
Table 7-12 Financial Vehicle Operating Costs by Speed

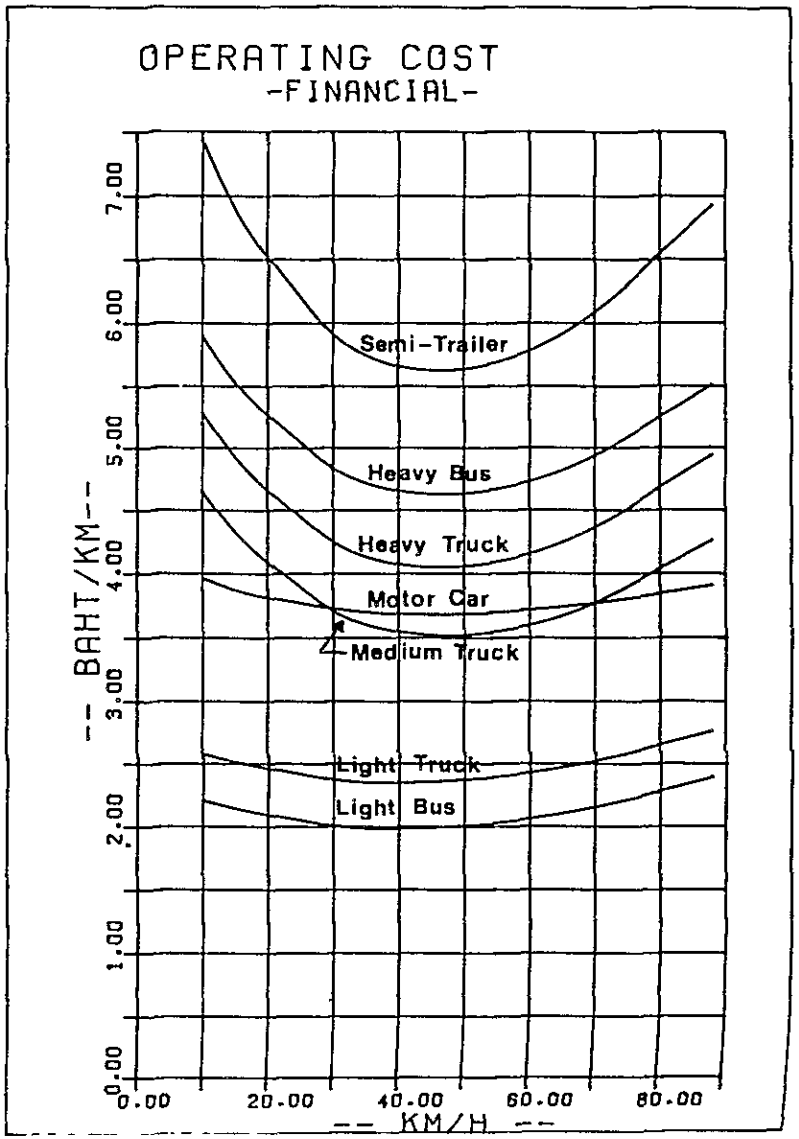
(Unit: Baht/km)

Speed (K.P.H.)	Motor Car	Light Truck	Medium Truck	Heavy Truck
10	3.9644	2.5773	4.6472	5.2843
16	3.8599	2.5031	4.2742	4.8677
24	3.7826	2.4274	3.9351	4.4916
32	3.7189	2.3630	3.6611	4.1916
40	3.6884	2.3496	3.5485	4.0729
48	3.6863	2.3685	3.5216	4.0520
56	3.7052	2.4029	3.5590	4.1032
64	3.7391	2.4631	3.6558	4.2232
72	3.7874	2.5473	3.8215	4.4212
80	3.8465	2.6509	4.0415	4.6826
88	3.9131	2.7616	4.2625	4.9451

Speed (K.P.H.)	Light Bus	Heavy Bus	Semi-Trailer
10	2.2081	5.9016	7.4317
16	2.1342	5.4762	6.8218
24	2.0585	5.0902	6.2696
32	1.9945	4.7795	5.8333
40	1.9812	4.6547	5.6608
48	2.0002	4.6297	5.6312
56	2.0349	4.6786	5.7071
64	2.0954	4.7969	5.8841
72	2.1796	4.9944	6.1700
80	2.2835	5.2546	6.5515
88	2.3944	5.5139	6.9332

Fig. 7–1 ECONOMIC AND FINANCIAL VEHICLE OPERATING COSTS BY SPEED





7.2.2 Value of Travel Time Savings

The valuation of time is one of the crucial factors in benefits accrued from the truck terminal investment. Therefore, time values adopted in the recent transport studies in Thailand were compared as shown in Table 7-13 .

Table 7-13 Comparison of Authoritative Time Values

(Unit: Baht/hr.)

Type of Vehicle	(1)	(2)	(3)	(4)
Motor Car	43.665	29.1	21.0	-
Light Truck	23.370	10.0	10.0	-
Medium Truck	23.985	20.0	20.0	-
Heavy Truck	24.600	20.0	20.0	-
Light Bus	68.880	-	-	-
Heavy Bus	214.020	189.0	212.2	106.8
Semi-Trailer	24.600	20.0	20.0	-
Base year of the value	1976 prices	1978 prices	1978 prices	1978 prices

Sources: (1) "Standardization of Vehicle Operating Costs for Thailand"
(2) "The Comprehensive Study for Bangkok Suburban Transportation Project"
(3) "Feasibility Study for Outer Bangkok Ring Road"
(4) "First Stage Mass Transit System in Bangkok, Special Report No.3"

In this study, the conservative time value (2) in Table 7-13 was used in the benefit calculation. Hence, those time values at 1978 prices were converted to values at 1979 prices based on the real growth rate of per capita income and the inflation rate from 1978 to 1979. These rates were estimated at 4.77% and 8% respectively and the time values at 1979 prices were determined to be 12% higher than those at 1978 prices.

The future time values were projected also based on the growth rates for per capita income. The future growth rate of the income per capita from 1979 to 2000 has been estimated at 3.78% as found in Section 3.2.3. The resulting time values in 1979 and 2000 were estimated as shown in Table 7-14.

Table 7-14 Time Value at 1979 Prices

(Unit: Baht/hr.)

Year / Veh. Type	1979	2000
Motor Car	35.5920	71.1157
Light Truck	11.2000	24.4384
Medium Truck	22.4000	48.8768
Light Bus	68.0960	148.5855
Heavy Bus	211.6800	461.8858
Semi-Trailer	22.4000	48.8768

7.2.3 Total Benefits

The direct benefits are assumed to consist of savings in vehicle operating costs and travel time costs. According to the traffic assignment to the road network, the total vehicle-hours and vehicle-kilometers results are as shown in Tables 4-11 and 4-12. From this table it was found that the average travel speed of vehicles for the construction alternatives hardly changed over the null case. Namely, the average travel speeds for the passenger car, bus and truck were estimated to be 52.0, 38.0 and 35.0 k.p.h. respectively.

The total vehicle operating cost and time cost is calculated for Thailand based on the total vehicle-kilometers and the average speed, and vehicle-hours by using the unit vehicle operating costs by speed and the unit time values which were estimated in Section 7.2.1 and 7.2.2. However, the type of buses adopted in the traffic assignment analysis includes both light and heavy buses; and the type of heavy truck in the assignment analysis includes both heavy trucks and semi-trailers. Therefore, bus and truck vehicle composition was analysed based on the traffic survey results conducted in recent years.

According to the survey by the Department of Highways, the light bus accounts for about 54% and the heavy bus 46% in 1978 so that the composition rate in 2000 was assumed to be 40% light bus and 60% heavy bus. The composition of heavy trucks (10-wheel) and semi-trailers was estimated from the number of registered vehicles. According to the data from the Department of Land Transport, the composition rate of semi-trailers was 6.9% and heavy trucks (10-wheel) was 93.1% for Thailand in 1978. The future composition rate in 2000 was assumed to be 10% for semi-trailers and 90% for heavy trucks. Based on the above composition ratios, the vehicle operating cost and the time values were estimated in line with the classification of vehicles for the assignment analysis and the results are as shown in Table 7-15.

Table 7-15 Vehicle Operating Cost and Time Value, 2000

Cost / Veh. Type	Operating Cost (฿/km)		Time value (฿/hr)
	Economic	Financial	
4-W truck	1.5985	2.3580	24.4384
6-W truck	3.1832	3.6189	48.8768
10-W truck & over	3.8424	4.3092	48.8768
Sedan	1.8429	3.6958	71.1157
Bus	3.1791	3.6053	336.5657

Consequently, the total cost of vehicle operation was estimated for each of the selected alternative cases 33, 55 and 7 and the cost saving results derived from the comparison with the null case are summarized in Table 7-16. Alternative 33 brings the greatest benefits.

Table 7-16 Economic Benefit in 2000

(Unit: 1,000 Baht/yr)

Alt. Case	Total Benefit
33 (NEWC)	537, 448
55 (EWN')	432, 185
7 (C)	478, 124

7.3 Economic Comparison for Alternatives 33, 55 and 7

7.3.1 Cost and Benefit Flows for Alternatives 33, 55 and 7

The staged investment cost has been estimated in Section 7.1.3. The investment amount for each stage was annually distributed based on the construction schedule estimated in section 5.5.2. The economic operation and maintenance costs were estimated to be 3% of the building and equipment costs plus the overhead expenses excluding tax that are explained in the financial analysis, section 8.3.3.

Using the expansion ratio for average daily traffic as shown in the table below, the total benefit for each year of operation was calculated.

Table 7-17 Expansion Ratio for Average Daily Traffic

	1980	1985	1990	2000
Projected	0.256	0.371	0.581	1.000
Adopted	0.232*	0.336*	0.581	1.000

Note: * Taking account of a slower development speed in the areas around N,E,W Terminals, lower expansion ratios for 1980 and 1985 were adopted.

The salvage value was considered to be added in the last year of the project life span as a minus cost element. The land cost was assumed to be recovered 100 percent and the cost of earth works and pavement 50 percent.

Consequently, the annual cost and benefit flows were estimated and presented for each alternative case in Appendix Table AP7-13 through AP7-15. For comparison, the case study excluding the land acquisition cost was examined and the results are also shown in the same tables.

From the summary of cost and benefit flows for the economic internal rate of return (EIRR), it was found that the alternative-33 for the project element of the truck terminal only was the most economically feasible among others as shown in Table 7-18.

Table 7-18 Summary of Project Alternatives by EIRR

PROJECT ELEMENTS \ ALTERNATIVE	WITH LAND ACQUISITION			WITHOUT LAND ACQUISITION		
	33	55	7	33	55	7
TOTAL COMPLEX	6.54	5.17	4.53	9.55	8.05	6.79
T.T. + WAREHOUSES	8.66	6.84	5.72	11.39	10.05	9.22
T.T. ONLY	10.64	9.77	8.83	15.80	14.71	12.52

N.B. T.T. = Truck Terminal

7.3.2 Sensitivity Analysis for Alternative-33

For the purpose of considering the economic sensitivity of the project, the costs and benefits were varied by 20% in several combinations to examine the best and worst possible outcomes of adopting Alternative-33 (Terminals N.E.W. and C).

The results of sensitivity analysis, summarized in Table 7-19 and 20 indicate from the economic viewpoint that the project will not be particularly sensitive to price escalation since a 40% variation in project benefits and costs will only produce a 3.5% reduction in the return. EIRR is found to be less sensitive to the increase of costs than to the reduction of benefits. In contrast with this, EIRR is much more sensitive to the reverse case: a reduction of costs and an increase of benefits.

Table 7-19 Sensitivity Analysis: EIRR

Cost Sensitivity Range \ Benefit Sensivitity Range	+20%	+10%	0	-10%	-20%
+20%	-	10.0	9.24	8.31	7.15
+10%	11.43	-	9.94	9.09	8.02
0	12.57	11.53	10.64 (Base)	9.86	8.89
-10%	13.71	12.77	11.66	-	9.76
-20%	14.85	14.02	13.03	11.81	-

Table 7-20 Sensitivity Analysis by Difference from Base EIRR

Cost Sensitivity Range \ Benefit Sensitivity Range	+20%	+10%	0	-10%	-20%
+20%	-	-0.64	-1.40	-2.33	-3.49
+10%	0.79	-	-0.70	-1.55	-2.62
0	1.93	0.89	(Base)	-0.78	-1.75
-10%	3.07	2.13	1.02	-	-0.88
-20%	4.21	3.38	2.38	1.17	-

7.3.3 Economic Viability of Alternative-33

(1) Economic Evaluation Results

Based on the preceding analysis, the following results were found:

a) The alternative-33 showed the highest EIRR among the selected project alternatives for every evaluated combination of project facility elements.

b) Although it is natural that the project facility element of "Truck Terminal Only" produces a higher EIRR than having more project elements, it should be noted that the direct benefits quantified in this study cover

benefits for terminal only and do not cover the full economic benefits of the total complex construction. If the benefits for Chartered Truck Center, Warehouses and Public Parking area are considered, project viability will be enhanced. Further study to find ways to reduce the investment cost are considered in Section 7.4 below.

c) The EIRR of the alternative-33 with "Truck Terminal only" is the highest among others, but its 10.6% EIRR will not fully support the feasibility of the project. Therefore, as mentioned in item b) above, further feedback checking of the costs and benefits is considered in Section 7.4 below.

d) In a comparison of the cases "with" and "without" the land acquisition cost, the "without-case" improves the EIRR considerably and therefore is a significant factor in determining project feasibility. Consequently, the timing of land purchase should not be put off unless the interest cost accruing from the postponement of the investment is less than the loss of benefits if the project was in operation.

e) The results of sensitivity analysis show that the study efforts to improve feasibility by reducing the preliminary estimation of the investment cost will effect EIRR more than efforts to increase the benefit.

7.4 Economic Evaluation for Optimum Designing (Alternative 333)

In the preliminary economic evaluation of alternatives-33, 55 and 7 in the previous section, it was found that the alternative-33 produced the highest economical return to the nation. However, since the resulting economic internal rate of return, namely 10.6% for the truck terminal only, is not sufficient enough to fully support the project, facility designing was re-considered and the project costs were optimized for a new case (alternative-333) as explained in detail in section 5.7.

7.4.1 Economic Costs for Alternative-333

Alternative case 333 is a revision of alternative-33 developed to minimize project costs.

Based on the financial re-estimation of project costs and the construction schedule, the economic project cost were estimated by subtracting the tax portion from the financial cost as shown in Table 7-21.

Table 7-21 Economic Cost by Facility and Terminal
(Alternative-333)

(unit: 1000 Baht)

Facility \ Terminal		N	E	W	C	Total	%
Truck Terminal	Main Elements	67,148	60,474	66,807	290,562	484,991	36.2
	Supporting Elements: Main	15,744	14,882	16,189	67,656	114,471	8.5
	Supporting Elements: Other	15,190	14,394	15,170	52,144	96,898	7.2
	Sub-total	98,082	89,750	98,166	410,362	696,360	52.0
Related Facilities	Warehouse Area	56,825	12,973	30,031	0	99,829	7.5
	Chartered Truck Center	64,283	60,344	66,300	86,228	277,155	20.7
	Public Parking	50,025	32,075	39,909	0	122,009	9.1
	Other	30,869	22,310	30,149	60,984	144,312	10.8
	Sub-total	202,002	127,702	166,389	147,212	643,305	48.0
G. Total		300,084	217,452	264,555	557,574	1,339,665	100.0
%		22.4	16.2	19.7	41.6	100.0	-

Note: Main Elements consist of: Platform, apron, roadway and administration building.

Main Supporting Elements: Platform office, truck parking, platform car park.

Other Supporting Elements: Employee facilities, petrol station, maintenance shop and other elements inside the terminal.

Warehouse Area: Land prepared for warehouse, apron, roadway and others.

Chartered Truck Center: Garage, office, petrol station, roadway and others.

Other: Access roads and main drainage around the terminal complex.

For further reference, refer to Table AP7-16 in Appendix which shows the breakdown of economic cost of each major item for each terminal.

The investment schedule was subsequently determined in line with the construction staging and the operational implementation program previously mentioned in Chapters 5 and 6 respectively. The resulting flow of economic investment costs is shown in Table 7-22, where the truck terminal facilities are considered in various combinations to meet the minimum requirements of terminal function on the one hand (the "Main Elements") and to meet the full needs of terminal users by having additional supporting elements (the "All Elements") on the other. The economic costs for access roads and main drainage (Other") are shown in Table 7-21. The economic cost flow projections of the above combinations of elements are shown in Table 7-22.

Table 7-22 Economic Investment Cost Flows of Combinations of Elements

(unit: 1000 Baht)

Facility		Year	Land acq.	Land Development	Buildings/ Drainage	Engineering/ Supervision	Contingency	Total	%
TRUCK TERMINAL FACILITIES ONLY	MAIN ELEMENTS ONLY	1982	141,157	0	0	0	14,116	155,273	25.0
		1983	0	21,194	18,395	3,959	4,355	47,903	7.7
		1984	0	17,187	16,135	3,332	3,665	40,320	6.5
		1985	0	11,631	32,794	4,443	4,887	53,756	8.7
		1986	0	26,129	42,476	6,861	7,547	83,015	13.4
		1989	0	3,834	57,903	1,926	2,119	23,307	3.8
		1999	55,425	32,988	154,594	12,968	19,808	217,880	35.1
		Total	196,582	112,966	221,919	33,489	56,497	621,454	100.0
		%	31.6	18.2	35.7	5.4	9.1	100.0	
	MAIN ELEMENTS + MAIN SUPPORTING ELEMENTS ONLY	1982	159,525	0	0	0	15,953	175,478	23.8
		1983	0	23,580	20,394	4,398	4,837	53,211	7.2
		1984	0	18,951	17,589	3,654	4,020	44,215	6.0
		1985	0	13,009	40,039	5,305	5,835	64,189	8.7
		1986	0	28,726	53,453	8,218	9,040	99,439	13.5
		1989	0	4,853	72,613	2,401	2,641	29,055	3.9
		1999	67,671	40,948	193,561	16,190	24,576	270,334	36.7
		Total	227,196	130,070	271,585	40,166	66,902	735,921	100.0
		%	30.9	17.7	36.9	5.5	9.1	100.0	
	ALL ELEMENTS: MAIN ELEMENTS + MAIN SUPPORTING ELEMENTS + OTHER SUPPORTING ELEMENTS	1982	172,468	0	0	0	17,247	189,715	22.8
		1983	0	25,376	21,899	4,728	5,200	57,203	6.9
		1984	0	19,827	18,684	3,851	4,236	46,599	5.6
		1985	0	14,401	47,681	6,208	6,829	75,120	9.0
		1986	0	29,999	66,386	9,639	10,602	116,626	14.0
		1989	0	4,853	89,482	2,795	3,074	33,819	4.1
		1999	76,299	42,729	236,675	18,992	28,521	313,734	37.7
		Total	248,767	137,186	324,940	46,213	75,709	832,816	100.0
		%	29.9	16.5	39.0	5.5	9.1	100.0	

7.4.2 Economic Benefit for Alternative-333

The revised facility design (Alternative-333) was rendered based on the same cargo volume estimated for the Terminals designed for Alternative 33. Therefore, the total economic benefit derived from the alternative 333 terminals is also the same as the value estimated in section 7.2.3. The benefit flow is shown below for reference.

Year	Benefit Flow (1000 Baht)	Percent of Year 2000
1982	0	
1983	0	
1984	0	
1985	0	
1986	71568	13.3
1987	90672	16.9
1988	98483	18.3
1989	106294	19.8
1990	228212	42.5
1991	248386	46.2
1992	268562	50.0
1993	288736	58.7
1994	308910	57.5
1995	329086	51.2
1996	349260	65.0
1997	369434	68.7
1998	389609	72.5
1999	409784	76.2
2000	537448	100.0
2001	562666	104.7
2002	587885	109.4
2003	613103	114.1
2004	638321	118.8
2005	663540	123.5
2006	676149	125.8
2007	688758	128.2
2008	701367	130.5
2009	713976	132.8
2010	726585	135.2

7.4.3 Economic Feasibility Evaluation

The economic operation and maintenance costs were assumed to be six percent of the building/drainage cost and added to the economic cost-benefit cash flows already calculated. Accordingly, both cost and benefit flows are shown in Appendix Table AP7-17.

(1) Economic Evaluation Indicators

Based on the above cost and benefit flows, economic internal rate of returns, B/C ratios and net present values were calculated for the project facilities as shown in Table 7-23.

Table 7-23 Economic Evaluation of Project

	Project Elements	IRR (%)	B/C			Net Present Value (1000 Baht)		
			31%	26%	21%	31%	26%	21%
TRUCK TERMINAL FACILITIES ONLY	MAIN ELEMENTS ONLY	28.3	0.8	1.1	1.7	-37,306	36,804	183,452
	MAIN ELEMENTS + MAIN SUPPORTING ELEMENTS ONLY	26.2	0.7	1.0	1.5	-67,285	3,216	144,967
	ALL ELEMENTS	25.0	0.6	0.9	1.3	-91,555	-24,404	112,796

According to the above table, "Main Elements only" produces the highest economic return against the resources used for the project. "All Elements", however, also shows a similarly high return in spite of a larger requirement of the investment cost. From the viewpoint of terminal users such facilities as petrol stations, maintenance shops, car park included in "All Elements" are necessary and very convenient in the terminal area. Since the recently issued "Land Transport Act" requires truck terminals to set up vehicle inspection and weighing facilities, it is recommended to implement "All Elements" as a project rather than confining the project to "Main Elements Only". Besides, such safety related facilities will contribute to a reduction of traffic accidents and will produce a higher benefit to the public than the case of "Main Elements Only".

(2) Sensitivity Analysis

To consider the effects of future unknown factors, the costs and benefits were varied by 20% in several combinations to examine best and worst scenarios which might result after adopting Alternative-333.

The results summarized in Table 7-24 show that even in the worst case (a 20% increase in cost plus a 20% decrease in benefits), the construction of the "All Truck Terminal" is still very feasible since it will produce a minimum EIRR of 19.9%.

In addition to the investment for the Truck Terminal facilities, investment costs were estimated for the related facilities (warehouses, chartered truck center and public parking area) and economic returns were estimated (see Appendix Table AP7-18).

Table 7-24 Sensivity Analysis: EIRR (%)

MAIN ELEMENTS ONLY — SENSITIVITY: EIRR

COSTS		BENEFITS +20%	+10%	0	-10%	-20%
+20%		28.3	27.0	25.6	24.4	22.8
+10%		29.6	28.3	26.8	25.4	24.0
0		30.8	29.7	28.3	26.7	25.1
-10%		32.7	31.1	29.8	28.3	26.4
-20%		34.6	33.2	31.5	30.0	28.3

MAIN ELEMENTS ONLY — DIFFERENCE FROM BASE EIRR

COSTS		BENEFITS +20%	+10%	0	-10%	-20%
+20%		0.0	-1.3	-2.7	-3.9	-5.4
+10%		1.2	0.0	-1.4	-2.9	-4.3
0		2.4	1.3	BASE	-1.6	-3.2
-10%		4.3	2.7	1.4	0.0	-1.8
-20%		6.2	4.8	3.1	1.6	0.0

MAIN ELEMENTS AND MAIN SUPPORTING ELEMENTS — SENSITIVITY: EIRR

COSTS		BENEFITS +20%	+10%	0	-10%	-20%
+20%		26.2	25.1	24.0	22.6	20.9
+10%		27.6	26.2	25.0	23.7	22.1
0		29.0	27.7	26.2	24.9	23.4
-10%		30.5	29.3	27.9	25.2	24.8
-20%		32.4	30.9	29.6	28.1	26.2

MAIN ELEMENTS AND MAIN SUPPORTING ELEMENTS — DIFFERENCE FROM BASE EIRR

COSTS		BENEFITS +20%	+10%	0	-10%	-20%
+20%		-0.0	-1.0	-2.1	-3.5	-5.2
+10%		1.4	0.0	-1.1	-3.5	-5.2
0		2.8	1.5	BASE	-1.2	-2.7
-10%		4.3	3.1	1.7	0.0	-1.3
-20%		6.2	4.6	3.4	1.9	-0.0

ALL TRUCK TERMINAL ELEMENTS — SENSITIVITY: EIRR

COSTS		BENEFITS +20%	+10%	0	-10%	-20%
+20%		25.0	23.9	22.6	21.0	19.9
+10%		26.0	25.0	23.8	22.4	20.7
0		27.6	26.1	25.0	23.7	22.0
-10%		29.1	27.8	26.3	25.0	23.5
-20%		30.7	29.6	28.2	26.5	25.0

ALL TRUCK TERMINAL ELEMENTS — DIFFERENCE FROM BASE EIRR

COSTS		BENEFITS +20%	+10%	0	-10%	-20%
+20%		-0.0	-1.0	-2.3	-3.9	-5.1
+10%		0.9	0.0	-1.1	-2.6	-4.2
0		2.5	1.1	BASE	-1.3	-2.9
-10%		4.1	2.8	1.3	0.0	-1.4
-20%		5.7	4.6	3.2	1.5	0.0