B. Viriya Utsahakam Co., Ltd.

The outline of their plan is tabulated in Table 5.2.2

The features of their plan are summarized as follows:

1. site locates along the planned highway which is expected to open to public at the end of 1994.

2. the government is expected to provide an access road

3. truck terminal project is a part of a integrated development plan

Table 5.2.2 Outline of plan by Viriya Utsahakam

Item	Description
Name of Investor	Viriya Utsahakam Co., Ltd.
Site Location	The site locates 10 kilometers south-east of Lat Krabang and about 40 kilometers far from the center of Bangkok. This area locates between Sukhumvit 77 road and Route No. 34. (See Figure 5.2.2)
Size of Land	The total site is about 320 rai. There is no access road to this site at present.
Planning Concept	Truck terminal, warehouse and other relevant facilities are planned in this area which has 320 rai. Other facilities such as housing, motel are planned in the neighboring area. However only truck terminal and relevant facilities are shown in the proposal.
Peripheral Conditions	There exists only damp ground at present. New international airport is planned west of this planned area. Highway 36 (Srinakharin - Chon Buri) road will connects to north and south in accordance with truck terminal project.
Access from BKK	New highway 36 is planned and scheduled to open at the end of 1994. A sufficient access to the center of Bangkok will be guaranteed by this highway.

5.2.2 Transportation Association's Proposal

Transportation Association had made its opinion public about a necessity of truck terminals since the JICA Study on Truck terminal in BMR had completed in 1980. It also intends to construct its own truck terminals on

their own lands. Land acquisition plan is in preparation. Now, it schedules a submission of a proposal for plural sites in coming a few month.

This association is a kind of truck company's association and its member truck companies reaches 170. It has already established a executing company named "Truck Terminal Co., LTD." and tackled the project. The proposal mentioned above is scheduled to be submitted by this Truck Terminal Co., Ltd.

Plan outline by the Association is shown in Table 5.2.3.

5.2.3 Government's Ad hoc Committee

A committee, the Solving Coordination Traffic Congestion in Greater Bangkok Area Committee", has been set up to relieve the traffic congestion in Bangkok and its ad hoc working group has worked in seeking for available governmental land and in forming a management company of truck terminals. According to this Ad hoc Working Group, the priority is given to followings in descending order.

A. It is the most desirable for the government to construct the truck terminal by a private sector alone without any governmental expenditure.

B. However past experiences prove that an expected investment return cannot be sufficient if it has to purchase the necessary land of more than 100 rai by themselves. Therefore the government is now ready to provide government's land to lighten the financial burden and cost expenditure of the private sector.

   And if necessary, the government is to form a joint venture company between the private and the governmental sector. Some lands for this project are actually on the list and some are under investigation so far.

Outline of plan is shown in Table 5.2.4.

Table 5.2.3 Outline of Plan by the Transportation Association

Item	Description
Name of Investor	Truck Terminal Co., Ltd.
Site Location	No. 1: Near the conjunction of Routes No. 1 and No. 30 which locates at northern part of BMR. No. 4: Located at 10 kilometers east from Minburi No. 8: Located along Route No. 4 around 20 kilometers west of the center of Bangkok.
Size of Land	No. 1: about 400 rai No. 4: about 220 rai No. 8: about 210 rai
Planing concept	Details of plan are not known. Draft concept which includes truck terminal, warehouse and so forth as a whole at this peripheral area. As Japanese truck terminal companies did, this company intends to apply for governmental supports such as low interest loan, returning conditions and others. Their plan is prepared based on the consensus that it has become difficult to operate large trucks under the prevailing conditions of traffic congestion and parking restrictions in the center of Bangkok, and it is anticipated that it will become more difficult in future.
Others	This company (Association) advocates that only a part of trucking companies can use truck terminals and charge will become rather high if private investors such as the one mentioned in previous section would manage truck terminals.
Peripheral Conditions	No 1: Construction of the Outer Ring Road is scheduled in adjacent area No. 4, 8: Any specific plans cannot be informed.
Access for BKK	No. 1: Route No. 1 connects to the center of Bangkok at present. The Outer Ring Road will provide alternative route to Bangkok. No. 4: same as present condition No. 8: Route No 4 connects to the center of Bangkok.

(see Figure 5.2.2 respectively)

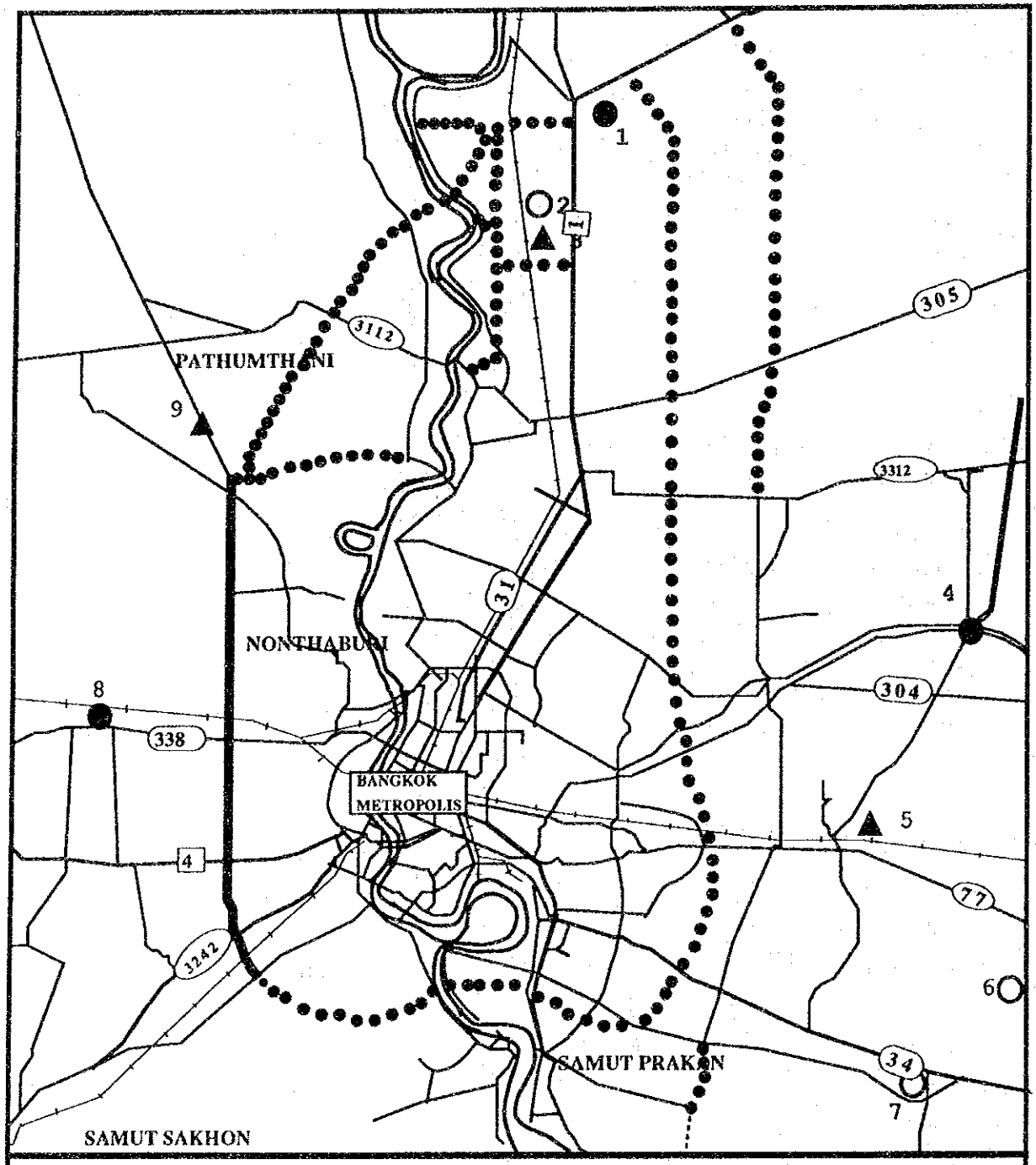


Figure 5.2.2 Location Map of Various Plans

Legend

- Truck Association
- Private Company
- Ad-Hoc Commitee

Map Source: SPURT (Seventh Plan Urban and Regional Transpot), NESDB

Table 5.2.4 Outline of Plan by the Government

Item	Description
Site Location	No. 3 Located at north area, along Route No. 1, facing to the north of Asian Institute of Technology (AIT). This site is placed near No. 2 which is proposed by one private investor. This land belongs to the Ministry of Agriculture and Cooperatives and is planed to be used for agricultural institution. No. 5 located in the Inland Container Depot (ICD) of State Railway of Thailand (SRT) at Rat Krabang. Reflecting the development of industrial estate in the eastern seaboard, ICD for sea container is planned near Lat Krabang. This is undertaken by SRT and a part of ICD is expected to be used as truck terminals to consolidate with handling of the containers. No. 9 No evidence of land acquisition can be seen, but now under investigation.
Size of Land	No. 3: 200 meters in width and 970 meters in length No. 5 not fixed No. 9: more than 100 rai is desirable but no segment with such physical acreage cannot be found. So the government land of about 50 rai is now under investigation. Planning concept Investigation to find out the suitable lands is urgent matter. Any fixed plan cannot be drawn at present. It is desirable to implement by private sector by itself. However, when it is difficult it will be a possible alternative that truck terminals will be constructed jointly by the government and private sectors. No. 5 Highway 36 (Srina Kharin - Chonburi) will penetrate the site of No. 5, which SPURT plans to construct in its period by 1994. This site locates close to the planned new international airport and the eastern line of SRT.
Peripheral Conditions	NO. 3 This site located adjacent to AIT and secondary school. Therefore it seems necessary to pay attentions to preserve environmental circumstances in good. Other conditions are basically same as No. 2.
Access from BKK	No. 3 same as No. 2 No. 5 This site will connect to the center of Bangkok by the new Highway 36 No. 9 West side of the Outer Ring Road will provide the most convenient access to the center of Bangkok when it is open to the public.

5.3 The Criteria for Selecting the Location Spots

5.3.1 Accessibility

A. Delivery and Collection

Distances of delivery and collection are one of the most important index to evaluate the location of truck terminals. The premises are set as follows:

1. Present situation of delivery and collection

Currently the most prevailing delivery and collection have been operated by pick-up of consignors or 4-wheel trucks in BMR except in case of full loading by same consignors or heavy cargo such as steels.

2. Criteria

Locations of truck terminal are mainly decided by the distance of transportation by consignors. Therefore truck terminal should locate in certain distance from the center and in the peripheral area of urbanized Bangkok. There is no definite method to identify this distance. However, following index was adopted in this study.

a) Setting of Basic Conditions

(1) loading volume of large truck: 10.5 ton

(2) loading volume of truck for the use of freight delivery and collection: 3.5 ton (expected in future)

(3) loading/unloading time; 30 minutes

(4) Working hours: 8 hours

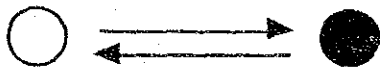
b) Delivery/Collection Efficiency

(1) When a freight-loaded truck arrives, the cargo is then transferred to three (3) delivery trucks (10.5/3.5 = 3).

(2) Most efficient pattern is to finish this delivery activities in a day. If it takes more days or hours, they needs some storing facilities to keep cargoes until line-haul and/or delivery truck arrives.

(3) Necessary delivery time

The following figure illustrates how the freight is handled and necessary time for these activities.



30 minutes for loading

30 minutes for un-loading

(a) 3 times loading per day and each unloading work takes three (3) hours.

(b) Running time of vehicle for delivery is thus 0.83 hours. Calculation is shown below:
(8.0-3.0)/3/2
= 0.83 hours (50 minutes)

(c) Distance for delivery

50/60 x Average speed (40 km/h) = 33 km.

This calculation shows the maximum distance from truck terminals to the center of Bangkok should be less than 30-35 km. Figure 5.3.1 shows the most distant area suitable for truck terminals.

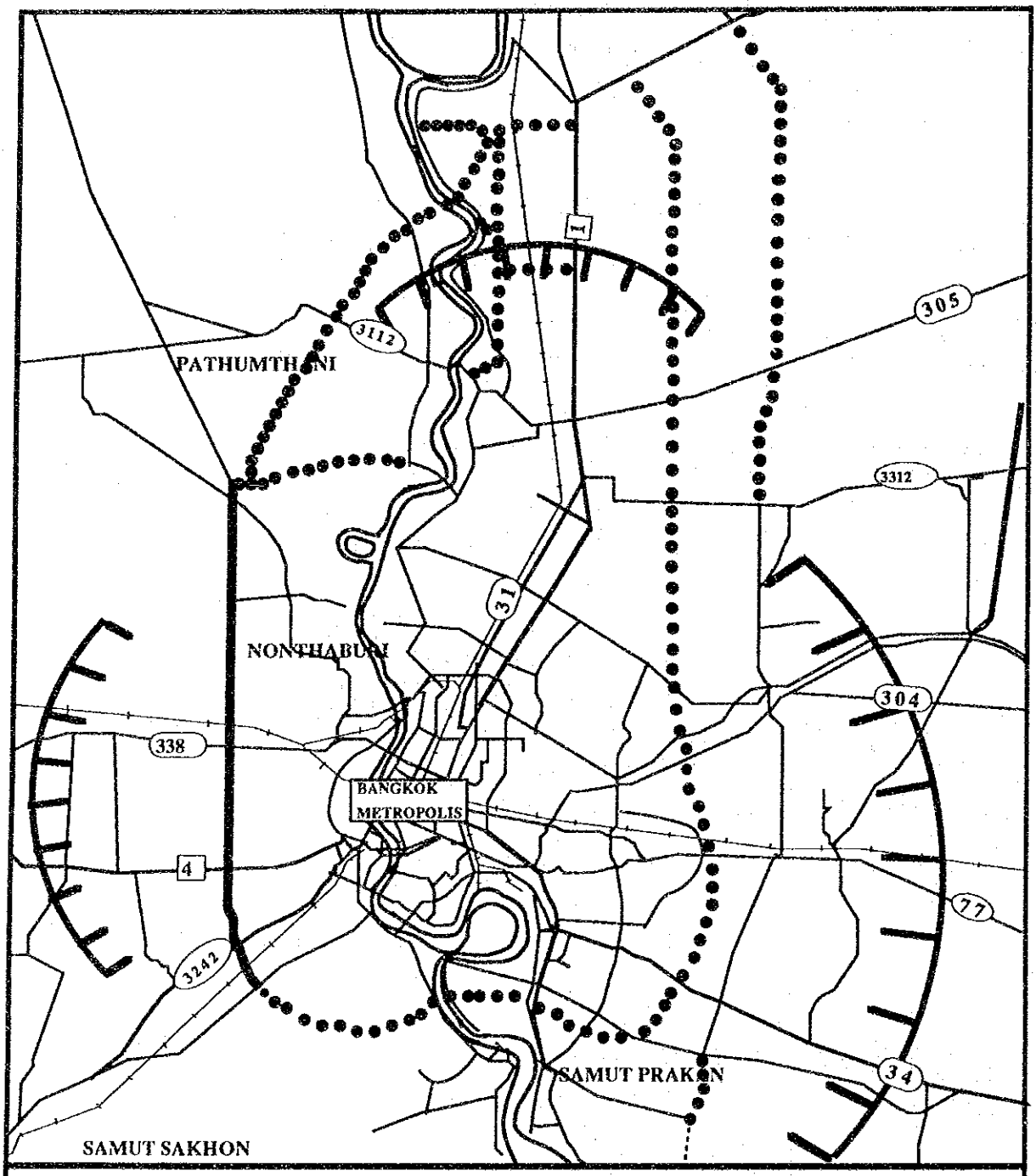


Figure 5.3.1 Desired Boundary of Delivery Activities

Legend

Desired Boundary

Figure 5.3.2 shows the delivery efficiency.

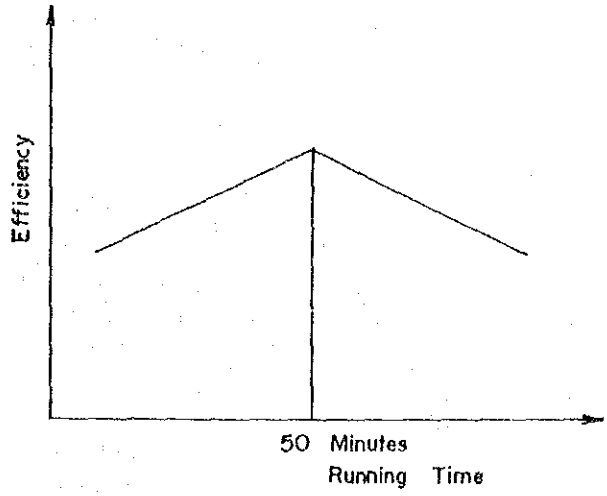


Fig. 5.3.2 Delivery Efficiency as Image

B. Road Network

Following locations are selected for proposed sites with due considerations on the present and future road networks in BMR.

1. Along the radial arterial roads.

2. Near node points between these arterial roads and the Outer Ring Road.

This is because the almost all of commodity inflow and outflow concentrate on BMR or adjacent area to BMR, and because a collecting vehicle is able to run on alternative routes to go to final destination to avoid traffic. In addition, after the opening of plural truck terminals, it is supposed that the relayed cargo among truck terminals will be generated and the accessibility to each will become more important for these relayed cargoes in future (See Figure 5.3.3).

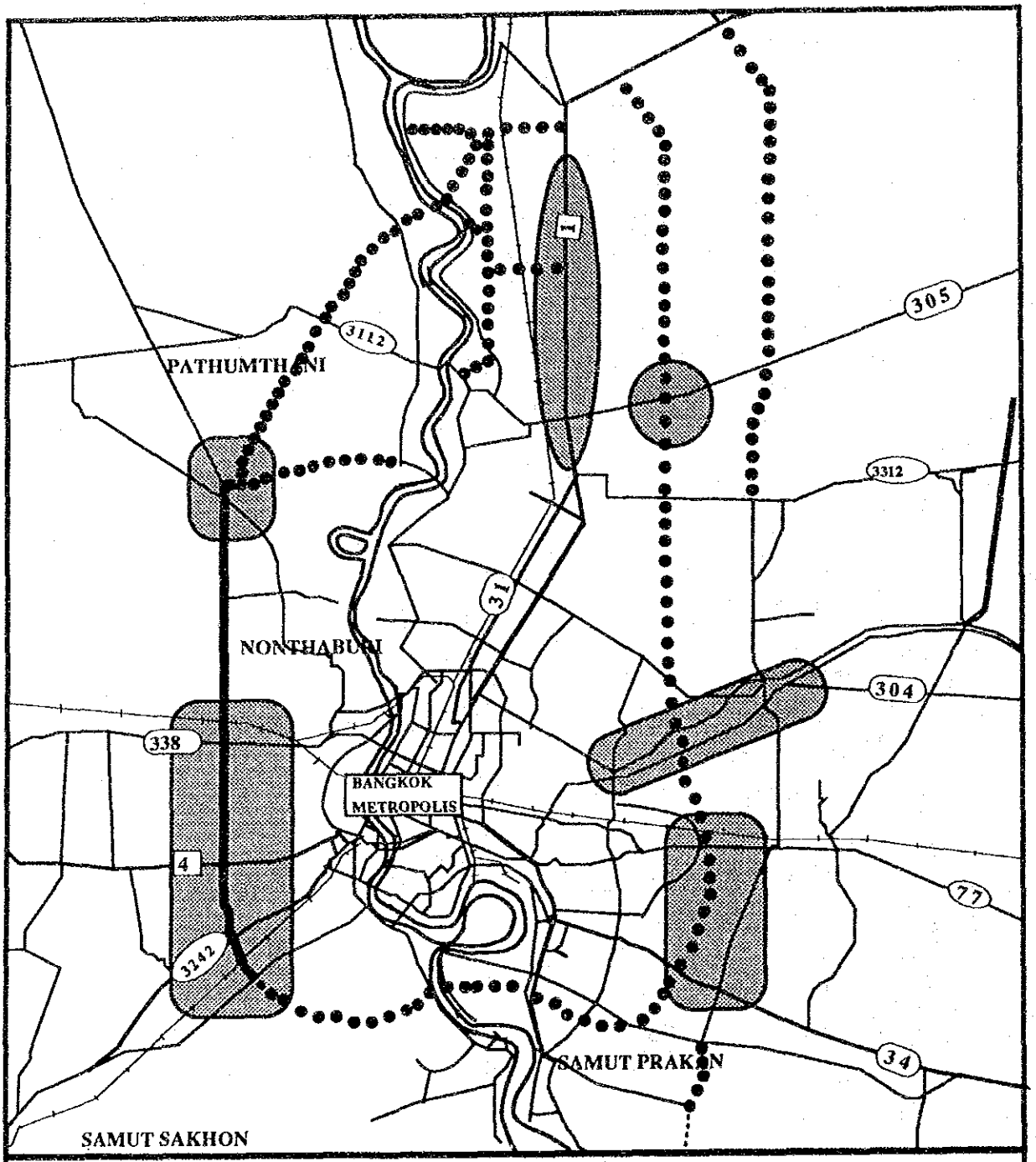


Figure 5.3.3 Arterial Node Area

5.3.2 Freight Movement Pattern

Freight movement pattern on each direction to/from Bangkok is diagrammatically shown in Figure 5.3.4.

Judging from this freight pattern, the routes listed below have much freight volume and the surrounding areas have advantages for pivotal freight distributing points to Bangkok.

A. Route No. 1 as distribution pivot mainly for central region,
B. Route No. 34 as distribution pivot mainly for both eastern area and central regions,
C. Route No. 338 as distribution pivot mainly for western region.

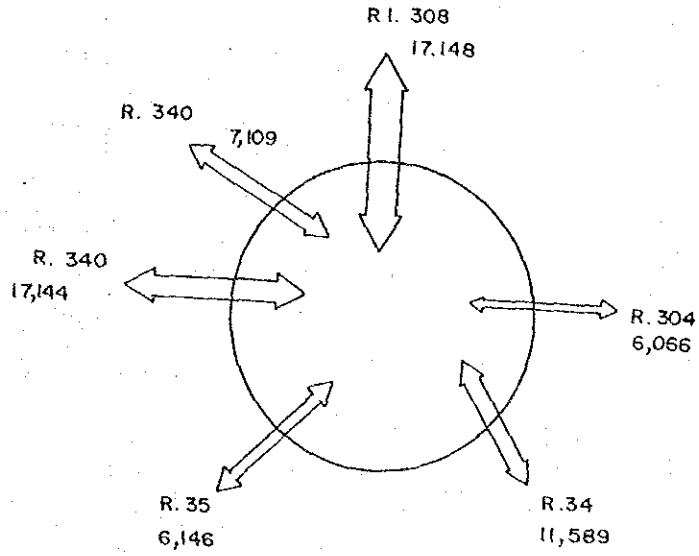


Figure 5.3.4 Freight Movement Pattern

5.3.3 Land Use

A. Relocation of Present Transferring Facility

It is anticipated that the further concentration of freight generation and attraction to BMR will progress in the future.

Under such circumstance, the present forwarders' transferring facilities located at the center of Bangkok will surely face more serious problem, judging from land use point of view.

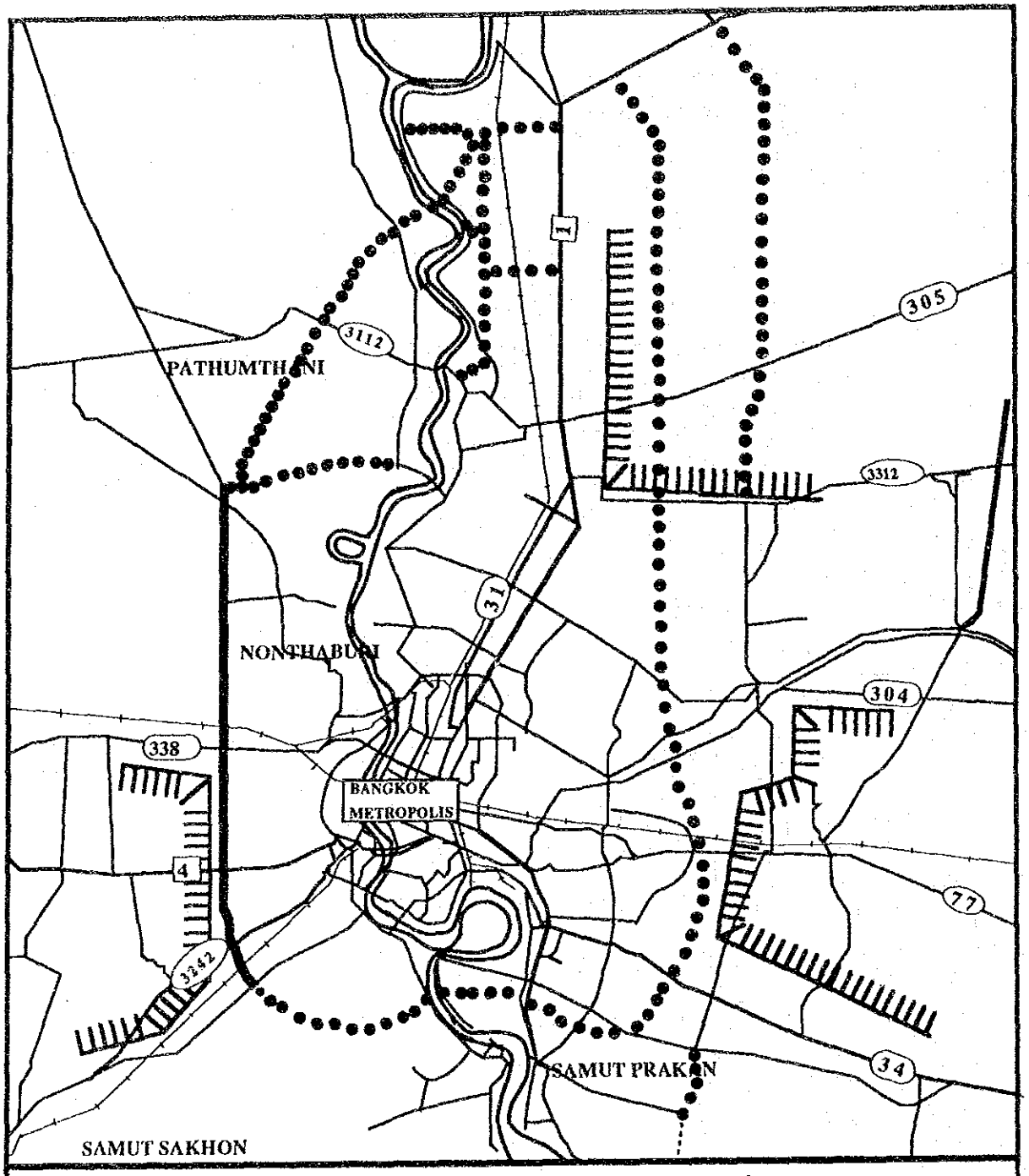


Figure 5.3.5 Desired Area by Physical Distribution Land Use

Legend

Desired Area

It is desirable to relocate these transferring facilities which necessarily use large trucks and occupy roadsides as parking space, to outskirt of Bangkok city.

It is also necessary that the places of relocation is corresponding to the area designated in the Seventh Plan Urban and Regional Transport (NESDB) which designates some parts as a physical distribution area as shown in Figure 5.3.5.

B. Future Land Use Pattern

As for the present land use plan (draft) for Bangkok city, its characteristics of future urban structure are summarized as follows:

1. Redevelopment of central business district (CBD)

2. Industrialized development on the eastern area

3. Residential development on the western area

4. Promotion on further supply of sub core towns in the outskirts of Bangkok city.

In this framework driven from the prevailing trends and planning policy, the truck terminals are, it is concluded, to be established at following places:

1. Places where are surrounding or neighboring area of a industrialized district because of functions.

2. Places where are yet un-urbanized area in order to guarantee environmental preservation and further expansion in future.

3. Places along the area where have been developed or will be developed in the future.

4. Places where is designated as some new large development plans such as industrial complex, airport and so forth but excluding the housing development projects.

From these points of view, some areas are concluded to be the most suitable for the truck terminals, which are shown in Figure 5.3.6

North:	Urbanized area has been expanded into the outskirts and further expansion to the same direction would continue in future, and expected to form an urbanized corridors. Therefore the area is selected but it is necessary to avoid present urbanized area.
East:	This area has an important hinterland of eastern industrial area including the Eastern Seaboard Industrial Estate, and actually the area alongside Route No. 34 has been developed as a industrialized area. In addition, a new international airport and a inland container depot are planned to locate in the eastern area. A new pivot of physical distribution is necessary to meet the freight transport demand generated in this region. From these points of view, this area is selected.
West:	The area alongside Route No. 338 in the western area has been developed as residential area. However this area might be a hinterland which is expected to develop as industrialized area in the Southern Region. Therefore the suitable area in this area is selected out of the existing urbanized area.

5.3.4 Land Acquisition

It might not be mentioned here about land acquisition as one of criteria because it is purely a matter of finance. However considering that any public truck terminals had not been constructed actually mainly due to high cost of proposed land so far, it is necessary to take into considerations about land acquisition as a supplemental criteria. It might be said that feasibility as a whole will become more high when the governmental land is available. And there exists possibility, judging from the present circumstances in the government of the Kingdom of Thailand. But it is necessary to be considered as just for the reference.

By the way, though it seems difficult to decide definitely how much price is suitable to keep feasibility, the following steps are taken into account.

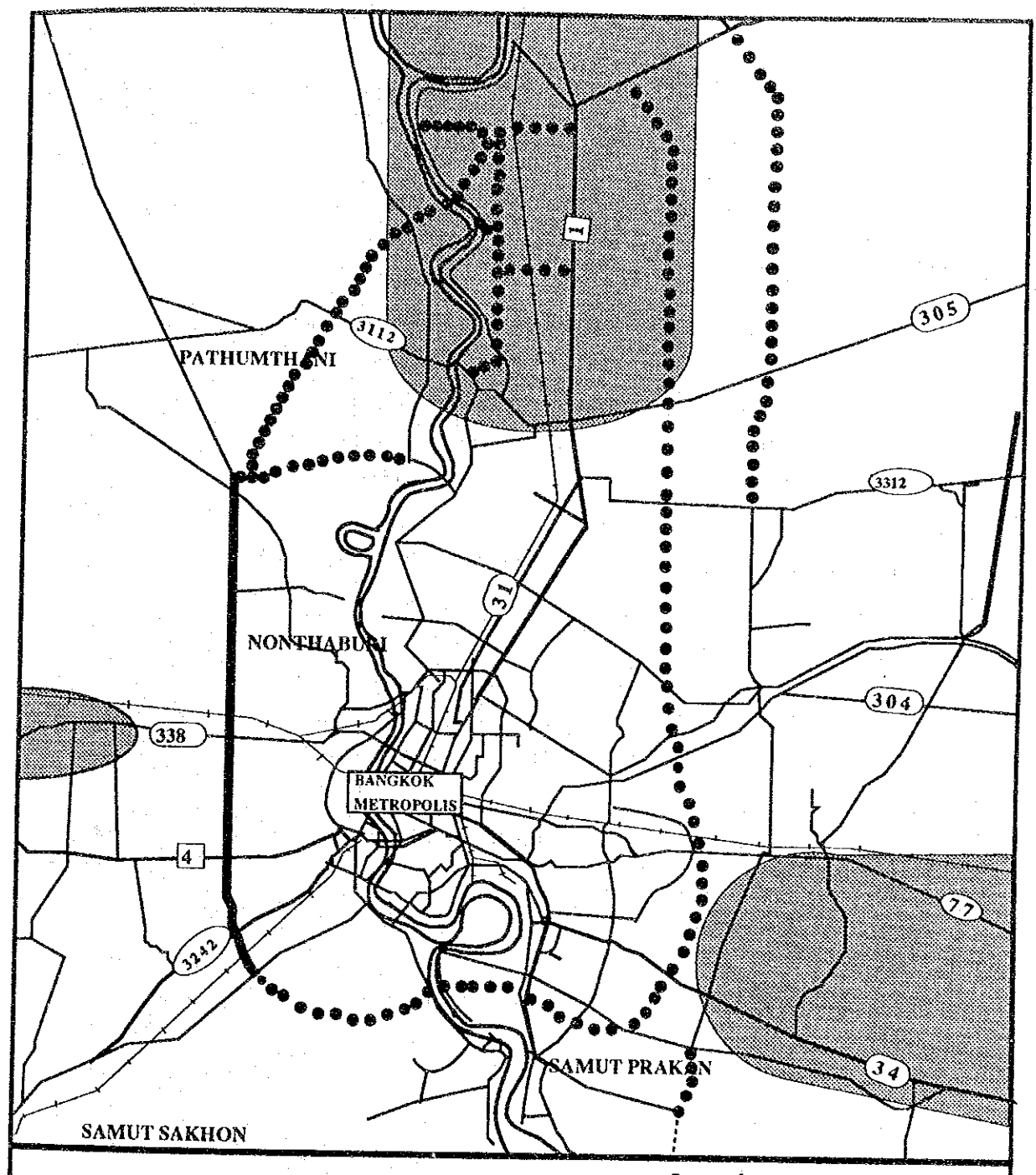


Figure 5.3.6 Criteria by Land Use

Legend

by Land Use

A. Pre-conditions

Following pre-conditions are set up:

1.	Estate;	100 rai
2.	Usage rate;	10 Baht/ton
3.	Total interest;	4% (expecting some kind of financial support)
4.	Total construction cost;	150 million Baht
5.	No. of berth;	250 Berth
6.	Handling volume;	5,000 tons/day
7.	Project life;	20 year
8.	Rising of usage rate;	6% /year

B. Annual Revenue

This is calculated as follows:

5000 ton/day x 300 days x 10 Baht/ton
= 15.0 million bahts/year

15.0 x 2.6 = 39.0 million baht/year

*) 2.6 is the ratio of total revenue / revenue from berth

C. Expenditure (including maintenance and so forth)

Revenue x 60%
=39.0 x 0.6 = 23.4 million baht/year

D. Present value of supposing surplus for 20 years

(39.0-23.4) x 24.3
= 379 million Baht

*) 24.3 is discounted value

E. Construction Cost

100 rai x 1600 m^2 x 2100 Baht/m^2
= 336 million baht

F. Desirable Land Price

379-336 = 43 million baht/100 rai

According to this rough calculation, there seems to be no margin to acquire a land for truck terminal.

Approximate 40-50 million Baht for 100 rai will be a maximum ceiling and this is used as a supplemental criteria.

Lands with the price boundary less than 50 million Baht are shown in Fig. 5.3.7. These price data were provided by the Department of Land and are the government price. There are few available land for this criteria. This fact suggests that the some government's supports are indispensable.

5.3.5 Ideal Area of Truck Terminals

A. Ideal Area

The results examined in the previous section are summarized in Figure 5.3.8. Ideal areas for the public truck terminal can be set up as shown in Figure 5.3.9.

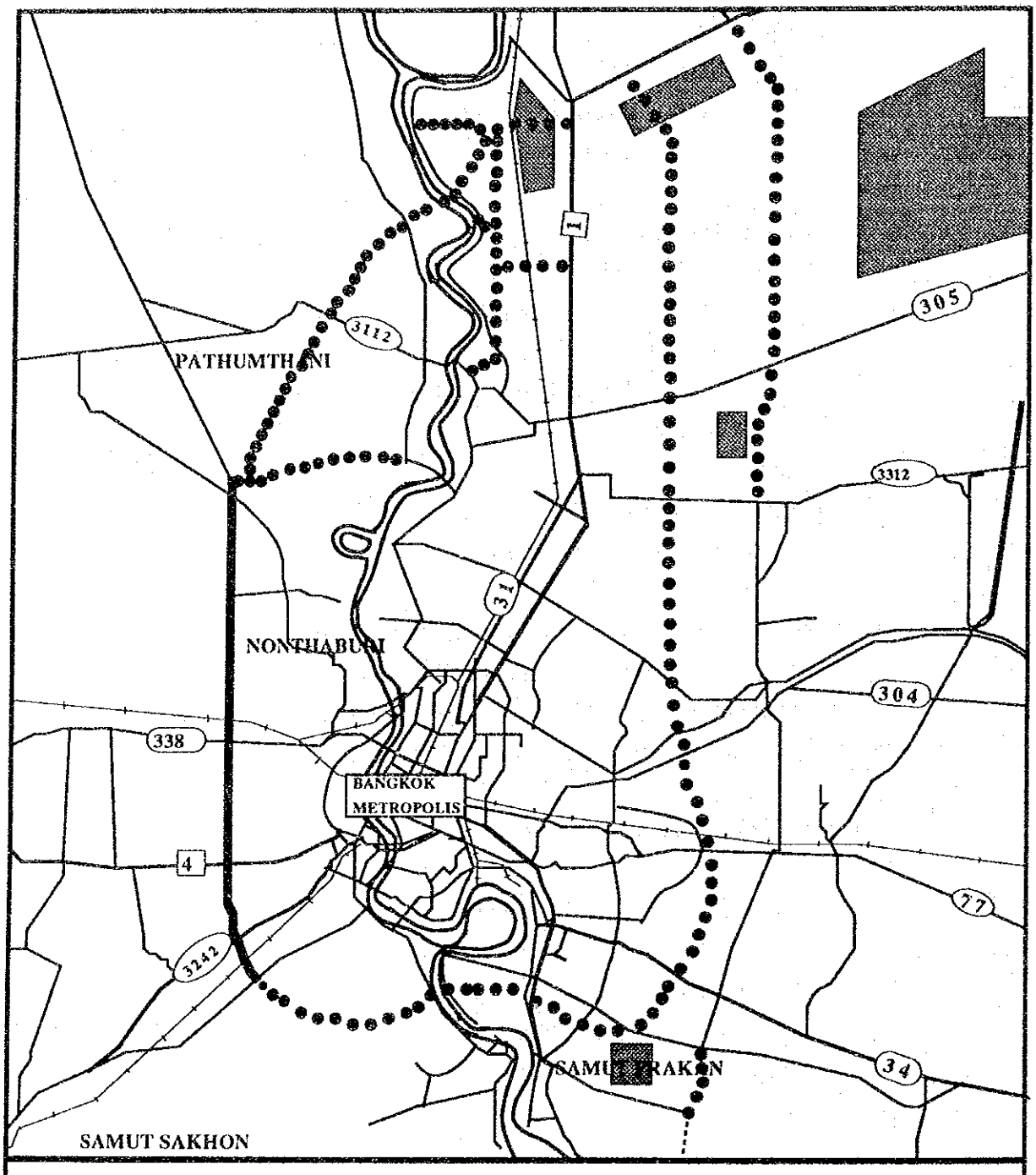


Figure 5.3.7 Criteria by Price

Legend

Land Price

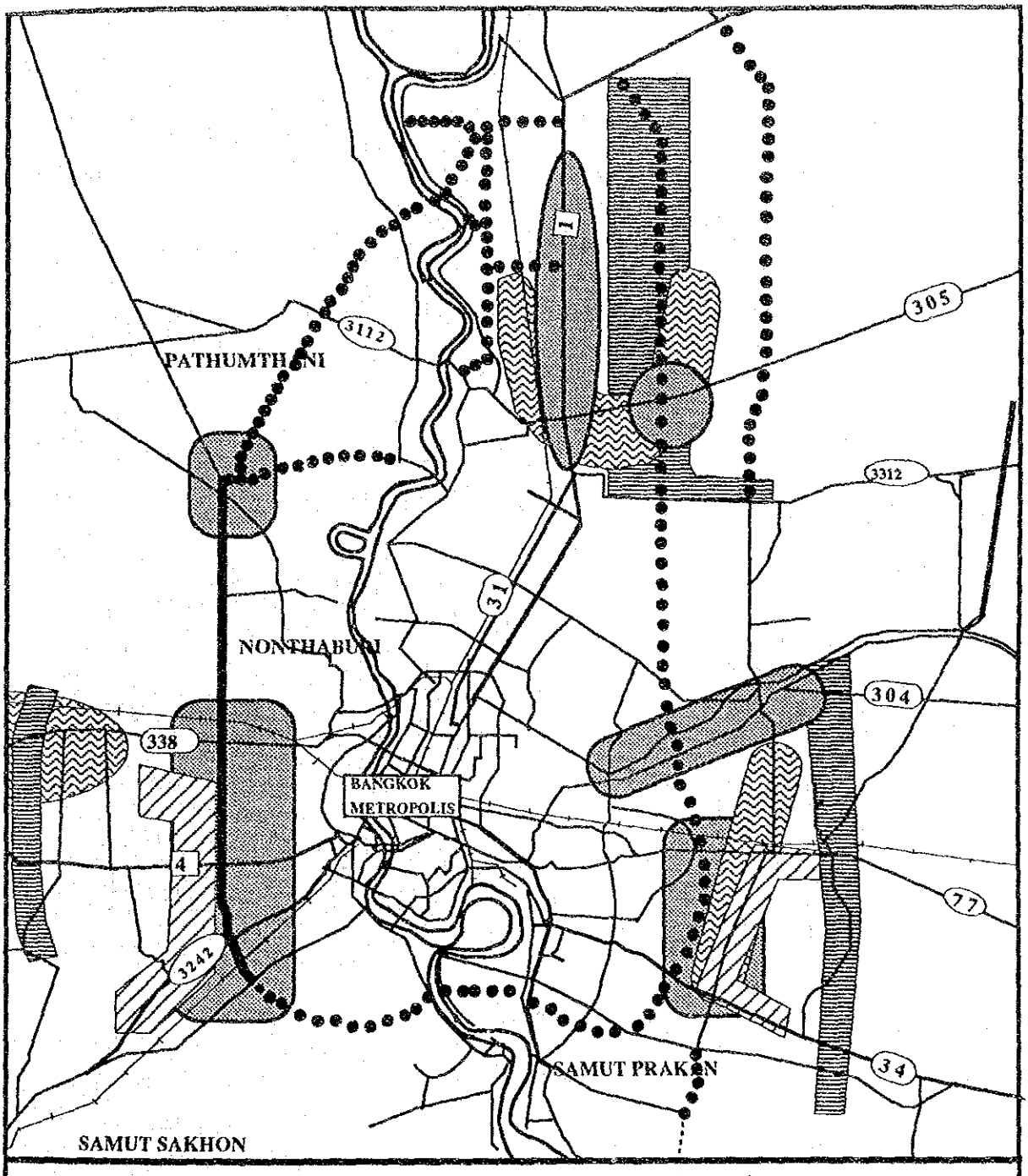


Figure 5.3.8

Whole Criteria
(Excluding Land Price)

Legend

- Node Area
- Land Use (2)
- Land Use (1)
- Accessibility

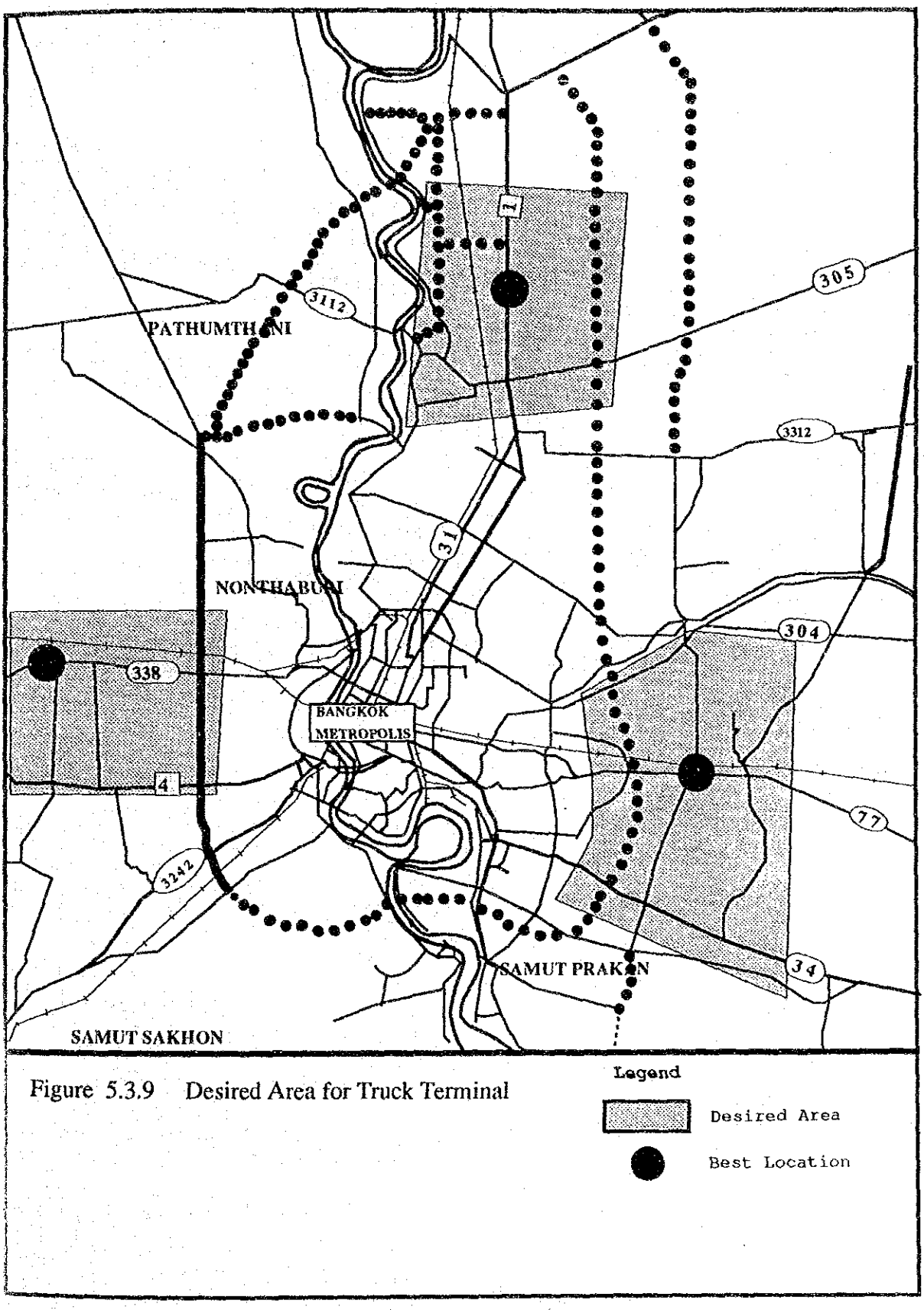


Figure 5.3.9 Desired Area for Truck Terminal

North: (Area A)	This area is located north of BMR and has two regions as hinterland. Both regions yield agricultural products and transport its products to BMR. And these regions have many population. Therefore many industrial products including miscellaneous goods are transported from BMR to northern and other regions. Since Route No. 1 and Route No. 305 merge at the north of BMR, this area is decided alongside Route No. 1.
East: (Area B)	This is located east of BMR. As the eastern region has industrial area, various industrial estates including for the export industries are developed here. Routes No. 304 and 34 and Sukhumvit 77 Road function as access routes to BMR, and SRT's inland container depot and a new international airport are planned. Considering these access roads and delivery and collection time, this area is judged suitable for the physical distribution center.
West: (Area C)	This area locates western part of BMR and has also the southern area as its hinterland. There exist two arterial roads, i.e. Routes 4 and 338. Since the latter was constructed earlier than the former, both sides of Route No. 338 have been already urbanized. It seems difficult to find out suitable land for truck terminals. Considering these conditions, the area C is set up.

Three areas of A, B and C are judged to be the ideal places for the public truck terminal and it is recommended to construct the terminal in these areas.

B. Ideal Truck Terminal Sites

Although the selection of truck terminals having a high priority is examined concretely in Chapter 6, the following two methodology are considered in case of evaluating these three areas.

1. Evaluating actually proposed sites

2. Evaluating the ideal truck terminals as a presumed case.

In case of (1), the concrete comparison can be carried out easily, but it also holds the weak point that an comparison of various alternatives is almost impossible if some other additional sites will emerge as a proposed area in the future. Therefore only the currently proposed sites can be compared, excluding sites which might be proposed in future.

As for case (2), this is lacking of actuality. However the priority among areas can be easily examined under same conditions and it is advantageous with big merit that this comparison can includes sites to be proposed in future.

In considering these merits and demerits, this study concludes that the methodology (2) is more advantageous for the purpose of screening the areas for comparison since this evaluation model can be applied to any kinds of sites, even the area now not envisaged in our minds. This condition is especially vital in such a situation that the new proposals are endlessly prepared by the various investors as has been experienced in the present Thailand.

Further study in this study was proceeded based on the methodology (2) and the locations for truck terminals are selected, which is evaluated in Chapter 6.

Three of the actual ideal truck terminals are presented below and presented in Fig. 5.3.9:

North:	The site locates at about 32 kilometer north from the center of Bangkok and along Route No. 1 which connects to the northern and north-eastern regions.
East:	The site locates about 20 to 25 kilometer east from the center of Bangkok and also locates along the confluence of three trunk roads, i.e. Routes 3119 and 3256, and Sukhumvit 77.
West:	The site locates about 20 kilometer west from the center of Bangkok and placed along Route No. 338.

CHAPTER 6

SELECTION OF THE HIGHEST PRIORITY TRUCK TERMINAL

CHAPTER 6 SELECTION OF THE HIGHEST PRIORITY TRUCK TERMINAL

This section aims at setting priority for three alternatives selected in previous chapter as the ideal public truck terminal.

In this chapter, first the ideal truck terminal is explained on its various dimensions that provide basic data for calculating priority indices. Secondly, three ideal truck terminals are compared and given the priority order in terms of seven aspects. Thirdly seven priority indices are integrated into one overall priority index with a policy preference weight. The last part of this chapter explains the results

Chapter concludes that the North Ideal Truck Terminal has the highest priority, followed by the East Ideal Terminal. The West Ideal Terminal has the lowest priority among the three candidates.

It is also recommended that the North Ideal Truck Terminal be a subject of the feasibility study in the coming study stage.

6.1 Dimension for Ideal Public Truck Terminal

6.1.1 Necessary Function of Ideal Public Truck Terminal

The indispensable functions for a proposed ideal public truck terminal are drawn up in a framework of:

A. providing current conditions of commodity flows by trucking companies in Bangkok area.

B. meeting the forecasted necessary functions in future

In this framework, four basic functions of truck terminal are picked up namely,

1. truck terminal,
2. warehouse,
3. truck center, and
4. others.

These are illustrated in Fig. 6.1.1.

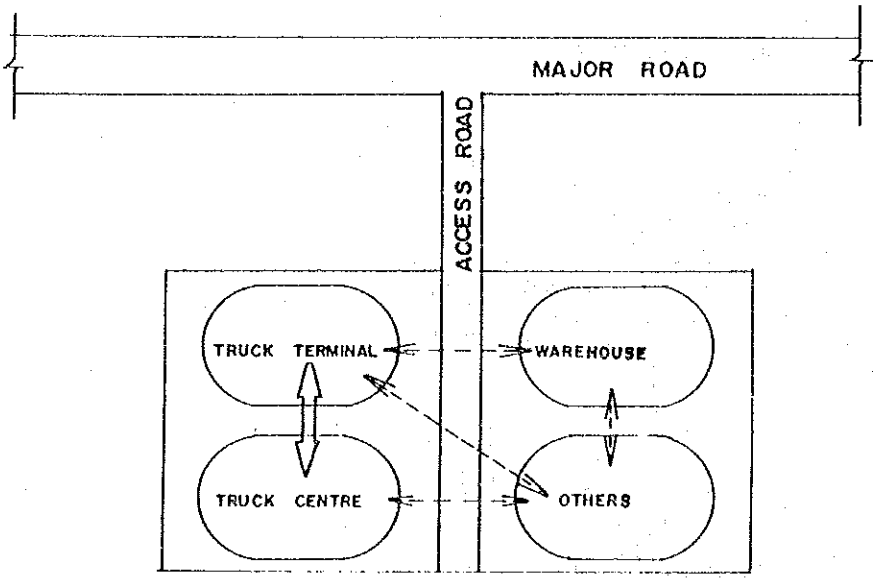


Fig. 6.1.1 Four Basic Function of Truck Terminal Complex

Four functions have various facilities and are explained as follows:

1. The truck terminal:

   This is planned as a center of truck terminal complex. The cargo handling platform, parking area for line-haul truck and pick-up/delivery truck, service facilities such as petrol station, car wash area, repair shop and administration building are provided.

2. Truck Center

   The truck center should be given to rationalize truck company businesses. Necessary facilities are listed below:

   a) Office space
   b) parking area for vehicles
   c) distribution center
   d) temporary storage area

3. Warehouse

This will function as a commercial warehouse and company-owned warehouse. The former is a facility for general cargoes with relatively longer period, and the latter facility is for wholesaler's stock point.

4 Others

This will serve as residential flats for office workers in terminal complex, and will be maintained as a space for necessary expansion in future.

The truck terminal complex will be constructed in a way of stage construction. First, the truck terminal should be constructed, and other necessary functions in the following stages.

6.1.2 Standard Layout of Ideal Public Truck Terminal

Standard layout of ideal public truck terminal is illustrated in Fig. 6.1.2.

In this figure, various additional facilities are added. They are lodging, service area, parking area, green belt, administration building and so on.

6.1.3 Dimensions of Three Ideal Public Truck Terminals

Necessary dimensions for screening three ideal truck terminals are the number of berth, physical acreage of truck terminal, and a minimum land necessary for acquisition works. These are calculated with data of freight demand forecast and a list of indispensable terminal facilities. Table 6.1.1 shows these dimensions.

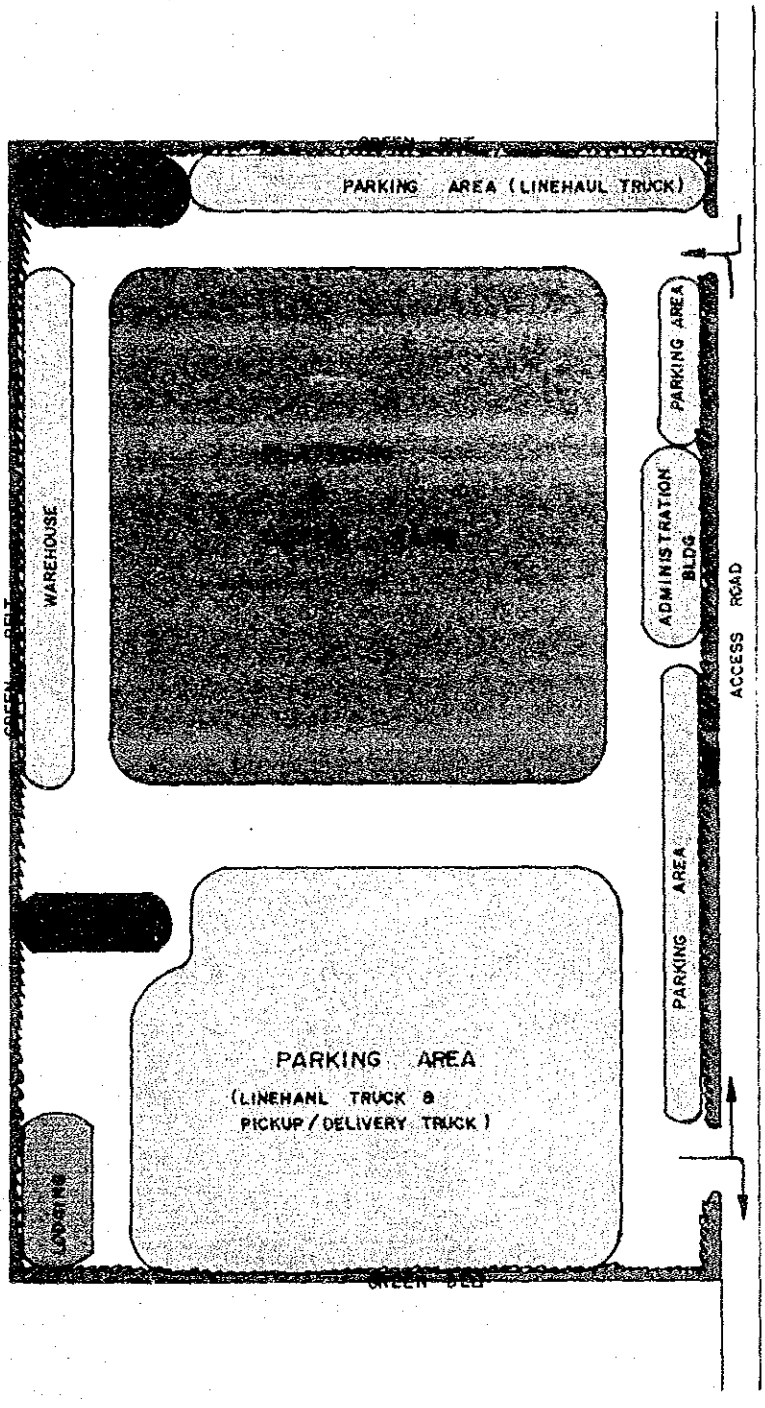


Figure 6.1.2 Standard Layout of Ideal Public Truck Terminal

Table 6.1.1 Dimensions of Ideal Truck Terminal

	Required Number of Berth *1	Truck Terminal Area *2 (sq. meter)	Land Acquisition *3 (sq.meter)
North Truck Terminal	500	270,000	291,000
East Truck Terminal	500	270,000	291,000
West Truck Terminal	350	200,000	220,000

Note; *1 Refer to 4.3.3 facilities Sizes for Each Truck Terminal. Figure shows rounded number with multiple by fifty.

*2 Truck Terminal Area
= (Required terminal area per berth)
x Number of Berth

*3 10 meter line apart from Truck Terminal area was assumed as Land acquisition area. (See Below)

6.2 Methodology for Screening

Socioeconomic indicators are adopted to evaluate priority of three ideal terminals. They cover a wide range of aspects such as cargo flow rationalization effect, traffic congestion relieving effect and so on. The ordinary method with internal rate of returns is not used at this stage. For the purpose of the screening is not to evaluate these three projects for investment but to select one for feasibility study as a next step.

As for the socioeconomic indices, the following seven indicators are selected to give the priority order to three ideal public truck terminals, i.e., the North, the East and the West.

A. Cargo flow rationalization index
B. Transport cost saving index
C. Transport congestion relieving index (1)
(delivery and collection related)
D. Transport congestion relieving index (2)
(road capacity-related)
E. First year revenue/cost index
F. Land acquisition cost index
G. Urban development index

These indices are effective to clarify the priority order to project alternatives that are all evidently feasible in terms of national economy (see 1980 JICA Study).

6.3 Calculation of Index

6.3.1. Cargo Flow Rationalization Index

A. Concept of rationalization index

The concept integrates the degree of the rationality of cargo flow and the effect on the rationalization of the cargo flow system due to the establishment of public truck terminal. The changes of cargo flow will considerably depend on the location of the truck terminal. So the rationality of the location of truck terminal can be shown by the total freight trip length of collection and delivery. And the tendency of the rationalization of cargo flow such as the specialization in long distance trucking business will be expedited by the distance and cargo flow between Bangkok and upcountry.

B. Measurement and index

Assuming that each truck terminal handles the whole cargo estimated to be handled at three truck terminals, three indices were synthesized as one index.

The first one is the index of expediency for the delivery and collection in Bangkok. This index was measured by the moment method putting the center on the truck terminal(B). Cargo flow volume and distance between truck terminal and zone center were used.

The second one is the index of the degree of detour between Bangkok and Region(C). This index was measured detour distance multiplied by cargo volume assuming all cargoes use the truck terminal concerned.

Cargo volumes and distances between truck terminals were used. The smaller the value of indices is, the better for the rationality. The third one is the index of rationalization for the promotion and rearrangement of the trucking companies(A). Also this index was measured using the cargo

flow volume and the distance between Bangkok and Upcountry. Regarding this index, the larger the better for the realization.

As the dimensions of each index were the aforementioned, the following numerical expressions were devised.

$$ID1i = (1/Ai)/(\sum(1/Ai)/3)$$
$$ID2i = ((Bi)+(Ci))/(\sum((Bi)+(Ci))/3)$$

The rationalization index was adopted as follows:

$$INDi = (ID1i+ID2i)/2$$

C. Comparison of index values

As for index (B), East Truck Terminal has the advantage of collection and delivery. However, regarding the index (C) and Index (A), North truck Terminal was excellently evaluated, because of the comparatively longer depth toward the northern area of Thailand and the more abundant volume of cargo.

As the Synthesized index, it can be concluded that North Truck Terminal has the good advantage for rationalization of cargo flow.

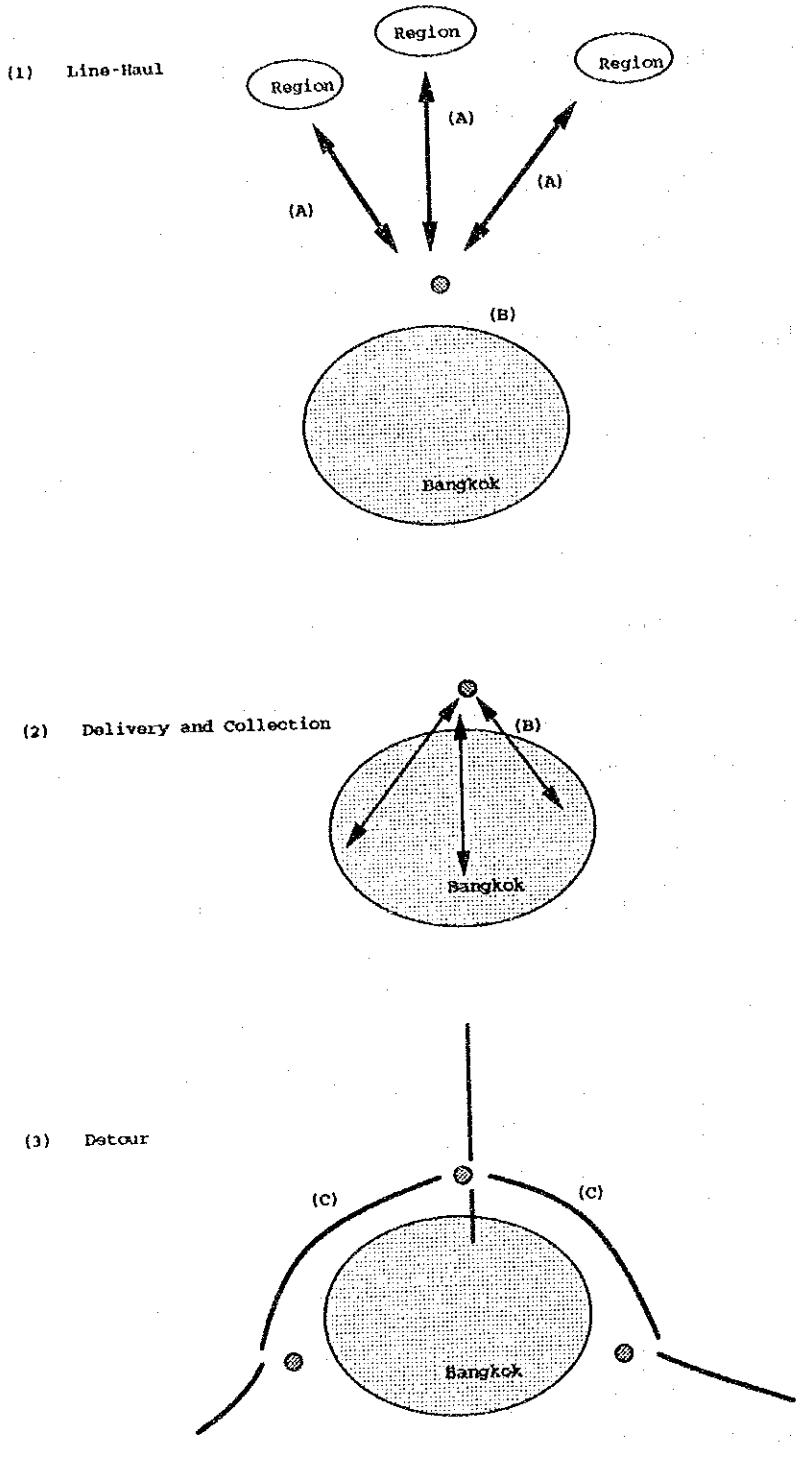


Figure 6.3.1 Type of Cargo Flow

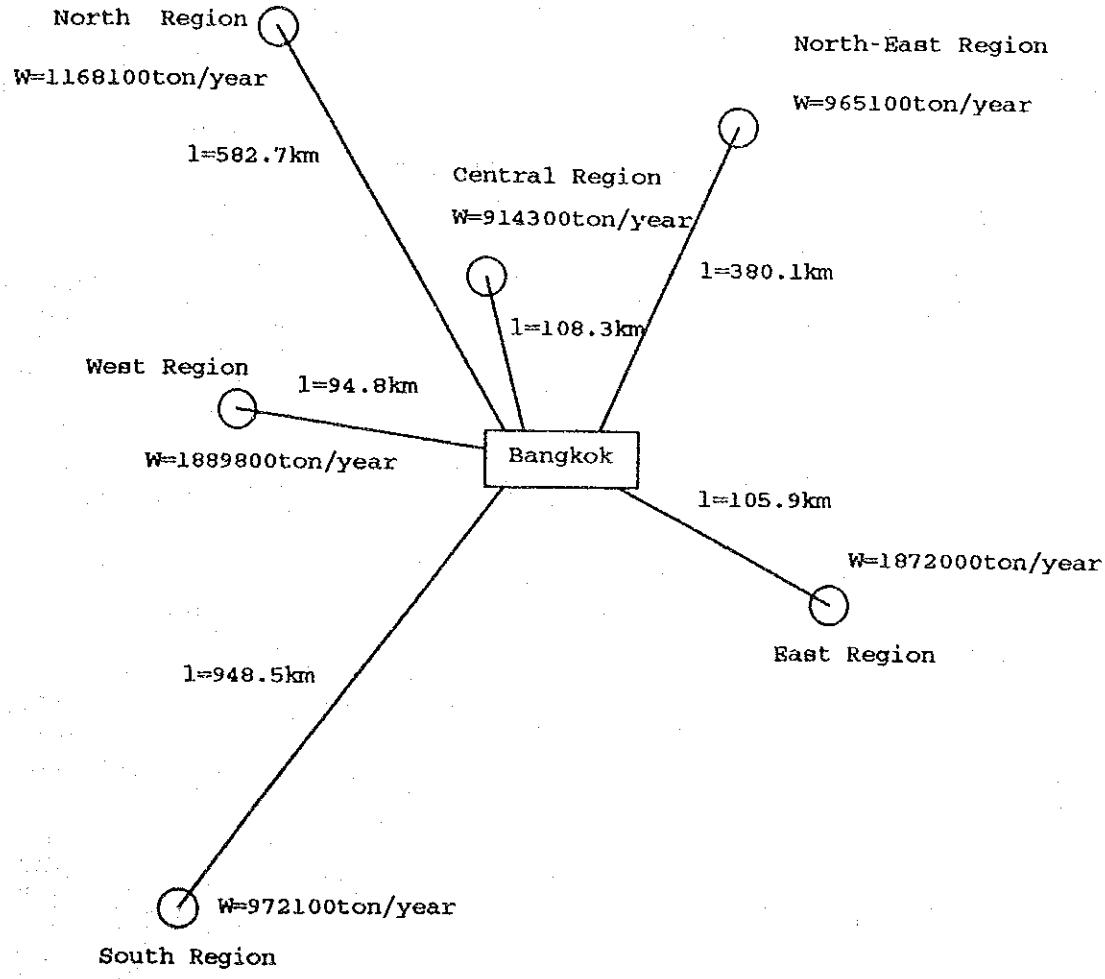


Figure 6.3.2 Regional Cargo Flow and Average Distance

6.3 2 Transport Cost Saving Index

A. Concept of transport cost saving index

The concept is the index of total curtailed duration of time owing to the establishment of truck terminals. The number of trucks waiting the time for intruding the inner city will depends on the use ratio of truck terminal. It was considered total curtailed duration of time as one of the transport cost saving index.

Table 6.3.1 Cargo Flow Rationalization Index

Truck Terminal	Rationalization Index ID1i	Rationalization Index ID2i	Rationalization Index INDi
North Truck Terminal	1.41	1.18	1.30
East Truck Terminal	0.23	0.82	0.53
West Truck Terminal	1.35	0.10	1.18

Table 6.3.2 Efficiency for Delivery and Collection

	North T.T.			East T.T.			West T.T.		
	Distance(C)	Weight(D)	(C)X(D)	Distance(E)	Weight(F)	(E)X(F)	Distance(G)	Weight(H)	(G)X(H)
	Km	ton/year	tonkm/year	Km	ton/year	tonkm/year	Km	ton/year	tonkm/year
zone 1	27.6	1711906	47324790	28.1	1711906	48061001	26.56	1711906	45472056
zone 2	32.5	521353	16955862	27.7	521353	14417743	28.41	521353	14813852
zone 3	22.0	427977	9409396	28.2	427977	12056467	27.28	427977	11673804
zone 4	23.2	264567	6144970	22.6	264567	5969386	32.23	264567	8527948
zone 5	29.9	1634093	48827454	19.1	1634093	31291278	36.25	1634093	59237917
zone 6	14.8	785921	11610100	26.6	785921	20936838	32.45	785921	25499245
zone 7	14.0	225660	3151936	21.9	225660	4946692	37.71	225660	8509885
zone 8	21.2	272349	5781820	16.4	272349	4466859	39.12	272349	10653289
zone 9	37.2	505791	18815388	30.9	505791	15628957	27.75	505791	14035974
zone 10	28.0	357944	10023333	32.6	357944	11661025	22.03	357944	7883866
zone 11	27.5	178972	4923728	7.2	178972	1288997	55.77	178972	9981732
zone 12	36.7	902642	33148880	36.1	902642	32620011	20.94	902642	18903211
Total(B)			216123660			203345250			235192780
N.T.T-E.T.T.	32.3	1871964	60435949	32.3	3047533	98388947			
E.T.T-W.T.T				43.9	2861897	125506978	43.9	1871964	82093980
W.T.T-N.T.T	33.6	2861897	96269797				33.6	3047533	102514301
Total(C)			156705746			223895925			184608282
Total(B+C)			372829406			427241175			419801061

Table 6.3.2 Comparison of the Cargo Flow Pattern

	North Truck Terminal	East Truck Terminal	West Truck Terminal
Total (A)	1,146,505	198,245	1,101,190
Total (B)	216,124	203,345	235,193
Total (C)	156,706	223,896	184,608
(A)-(B)-(C)	773,676	-228,996	681,389

B Measurement and index

There was the tendency that the destinations were dispersed around the inter-regional artery roads in Bangkok metropolitan area. On assumption that some of trucks will be absorbed by the truck terminal located near the inter-regional artery road, the following numerical expression was adopted:

$$DRi = Ek \times GR \times UT \times Tk$$

Where ;

DRi	:	Total duration of time in future
Ek	:	Observed number of trucks waiting for intruding time
GR	:	Growth rate of inbound cargo volume from 1991 to 2000
UT	:	Ratio of inbound cargo volume handled at truck terminal to total inbound cargo flow
Tk	:	Average duration of time

The transport cost saving index was adopted as follows:

$$DURi = DRi/(sigmaDRi/3)$$

C. Comparison of the index values

At present the trucks from the northern area of Thailand are the most out of trucks waiting at the boundary of restriction area. North Truck terminal will have the advantage for the absorption of waiting trucks.

Table 6.3.4 Transport Cost Saving Index

Truck Terminal	Index DURi
North Truck Terminal	1.33
East Truck Terminal	0.47
West Truck Terminal	1.20

Table 6.3.5 Estimated Duration of Time

	Duration of Time		RS-1 Route 34	RS-2 Route 304	RS-3 Route 1	RS-4 Route 32	RS-5 Route 340	RS-6 Route 6	RS-7 Route 35
Waiting Truck		total	562	754	730	453	553	394	706
Number of 1991	0		498	692	630	365	458	371	423
(vehicle)	<30min.		11	9	19	4	2	0	35
	0.5hr-1hr		27	23	23	24	22	10	61
	1-2hr		7	12	23	23	13	10	121
	>2hr		19	18	29	37	58	3	66
Estimated		total	125	121	183	171	185	45	551
Waiting Truck	<30min.		21	18	37	8	4	0	68
Number of 2000	0.5hr-1hr		53	45	45	47	43	19	119
(vehicle)	1-2hr		14	23	45	45	25	19	236
	>2hr		37	35	56	72	113	6	129
Expected		total	3	3	5	4	5	1	14
Truck Number	<30min.		0.54	0.44	0.93	0.20	0.10	0.00	1.71
to be Absorbed	0.5hr-1hr		1.32	1.12	1.12	1.17	1.08	0.49	2.98
of 2000	1-2hr		0.34	0.59	1.12	1.12	0.64	0.49	5.91
(vehicle)	>2hr		0.93	0.88	1.42	1.81	2.83	0.15	3.23
Estimatd Total Duration of Time (min.)			265	268	421	482	617	92	1273
			East T.T.		North T.T.			West T.T.	

6.3.3 Traffic Congestion Relieving Index (1) (delivery and collection-related)

A. Concept of traffic congestion relieving index (1)

The concept is the index of total reduced truck trip density of each truck terminal collection and delivery territory owing to the changes of the truck trip pattern and traffic volume caused by the establishment of the truck terminal. The Changes of trip pattern into making round trip pattern for both collection and delivery will get the reduction of empty truck trips. And the use of large sized trucks and the loading with high efficiency also will get the reduction of truck trips.

B. Measurement and index

This index involves total tripend in each truck terminal's territory, curtailed truck tripend and size of each truck terminal's territory.

Considering this matter, a density of tripend was calculated as follows:

$$DNi = TRi/Ai - dTi/Ai ;$$

where ;

DNi : Traffic congestion relieving index
TRi : Total tripend in each territory of 1989 (source : SIMR)
Ai : Area of each truck terminal territory
dTi : Curtailed truck tripend by each truck terminal

The higher this value is, the larger the traffic congestion relieving effect is.

For the estimation of the curtailed truck tripend, based on the supplementary survey, following assumptions were adopted.

1. present light truck used for the outbound cargo has two destinations after starting from the origin in average.

2. average loading volume of collection and delivery trucks without truck terminal was 1.6 ton per vehicle (this figure is likely to be overestimated by supplementary survey)

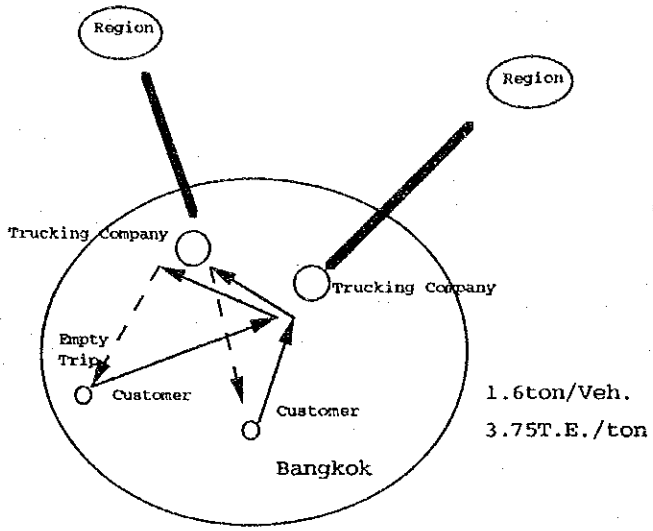
3. average loading volume using truck terminals was 3.5 ton per vehicle considering the grading up of the trucks.

The traffic congestion relieving index was adopted as follows.

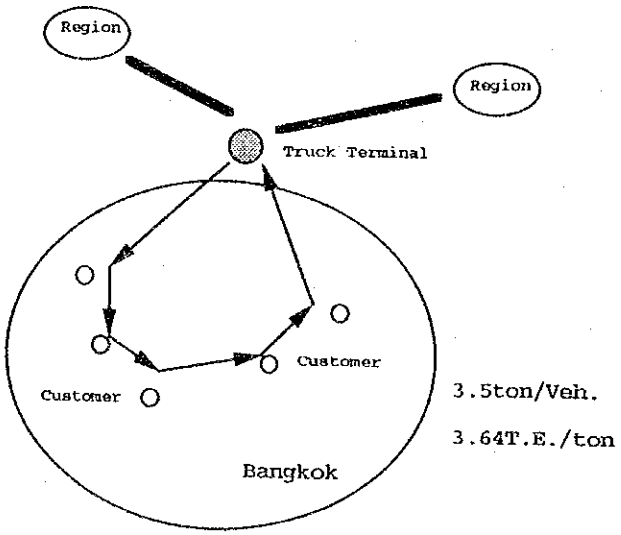
$$DENi = DNi/(\sum DENi/3)$$

C. Comparison of the index values

For the local congestion relieving, it was clarified that North Truck Terminal was the most effective after the comparison of the



(Without Truck Terminal)



(With Truck Terminal)

Figure 6.3.3 Collection Truck Trips

Table 6.3.6 Congestion Relieving Index (1)

	North Truck Terminal	East Truck Terminal	West Truck Terminal	Total	Remarkks
Truck Trip Ends (TR) 1989 (SMIR)	61,622	54,153	45,984	131,759	
Teritory Extnet (A) (km.km)	253	817	495	1,565	
Handled Carg Volume (ton/day) Outbound	6,724	6,868	4,503	18,095	
Number of Tripend by Pick-up Truck without Truck Terminal (tipends/day)	25,215	25,755	16,886	67,856	Average 1.6 ton/veh. 3.75 T.E./ton
Number of Tripend with Truck Terminal (tipends/day)	24,475	25,000	16,391	65,866	Average 3.5 ton/veh. 3.64 T.E./ton
Curtailed Tripend (dT) Tripend	740	755	495	1,990	
DNi ((TR)/(A)-(dT)/(A))	122.1	65.4	91.9	279.3	
DENi=DNi/(∑DNi/3)	1.31	0.70	0.99	-	

value of index. However the ratio of curtailed truck trips to the total trips was considerably small. It should be noticed that the traffic congestion relieving by truck terminal must not be exaggerated.

6.3.4 Traffic Congestion Relieving Index (2)
(road capacity-related)

A. Concept of index

The concept is the index of present congestion condition in the territory of each truck terminal. It was conceived that the degree of necessity can be intuitively measured by the total length of congested roads.

B. Measurement and index

The density of the total road lengths that showed the volume/capacity ratio over 1.0 by each truck terminal territory was adopted as an index. The source data were based on the volume/capacity ratios on 1997 base network as the results of seventh plan reported by NESDB.

The traffic congestion index was adopted as follows.

$$Di = DD_i / (\sum DD_i / 3)$$

Where ;

DDi: Total road length of congested road (V/C ratio over 1.0) in each territory

C. Comparison of the index values

Density of the congested road showed the necessity of the traffic congestion relieving in North Truck Terminal territory.

Table 6.3.7 Traffic Congestion Relieving Index

	Total Road V/C Ratio over 1.0	Density of Congested Road in territory of Truck T.	Index Di
North Truck Terminal	39 km	0.27 km/km	1.98
East Truck Terminal	45 km	0.05 km/km	0.37
West Truck Terminal	69 km	0.09 km/km	0.37

6.3.5 First Year Revenue/Cost Index

A. Concept of index

The index of first year revenue is intended to compare easily the feasibility of each alternative that is proposed in this chapter, the North, the East and the West terminals.

This index is calculated by the revenue divided by the cost in each alternative.

B Measurement of Index

The index is calculated as follows:

Index = First Year Revenue / cost / 20 year

whereas:

1. First year revenue: Cargo volume to be handled x 10 baht/ton x 2.6 x 360 days (2.6 means a ratio of total revenue/ revenue from utilization of berth)

2. Cost / 20 years: Construction divided by project life (20 years) and maintenance and other costs are excluded.

a) First year revenue

(1) North Terminal

9,530 ton/day x 10 baht.ton x 360 days x 2.6 = 89.2 million baht/year

(2) East Terminal

9,891 x 10 x 360 2.6 = 92.6

(3) West Terminal

$$6{,}517 \times 10 \times 360 \times 2.6 = 61.0$$

b) Construction cost

The construction cost of each terminal are calculated by using easy diagrams as shown in Table 6.3.8

Table 6.3.8 Cost Estimation

Alternative	Number of Berth *)	Construction Cost	1/20 (million Bath)
North Truck Terminal	480	560	28
East Truck Terminal	480	560	28
West Truck Terminal	320	560	21

Note *) indicates the figures in the year 2000.

c) Calculation of index

The results of calculation of index are tabulated in Table 6.3.9.

Table 6.3.9 First Year Revenue Index

Alternative	Revenue / Cost	index
North Truck Terminal	3.18	1.019
East Truck Terminal	3.30	1.058
West Truck Terminal	2.90	0.929
Average	3.12	1.00

C. Comparison of the index value

As for the indices calculated here, the East Terminal has the highest priority although the deference between the East Terminal and the North Terminal are small. However the West Terminal has less advantage.

6.3.6 Land Acquisition Cost Index

A. Concept of index

This index aims at showing the possibility of land acquisition. Since high land price and difficulties of land acquisition had been the obstacles in actual implementation of the truck terminal construction project, this kind of pioneering analysis has a significance even though it is a trial.

B. Calculation of index

The government prices of the sites that the investors propose to construct their truck terminals are shown in Table 6.3.10.

Table 6.3.10 Land Price

Alternative	Size (rai)	Unit Price (million Baht/rai)	Land Price (millin Baht)
North Truck Terminal	180	7.2	1,296
Wast Truck Terminal	180	8.0	1,440
West Truck Terminal	140	7.0	980

Weight attached to each alternative is prepared with due consideration on the results of field reconnaissance and contents of proposals submitted by the investors, the Transportation Association, and the government ad hoc working group. Those are shown in Table 6.3.11.

Table 6.3.11 Weight Attached to Each Terminal Land

Alternative	Number of Proposed Sites	Possibility	Weight
North Truck Terminal	3	High	0.3
Wast Truck Terminal	4	High	0.5
West Truck Terminal	2	Low	0.2

At the final step, the Index was calculated as its calculation processes are shown in Table 6.3.12.

Table 6.3.12 Land Acquisition Index

Alternative	Land Price	Weight	Index	Average of Indices
North Truck Terminal	1,296	0.3	389	0.89
Wast Truck Terminal	1,440	0.5	720	1.66
West Truck Terminal	980	0.2	196	0.45

C. Results

Results give the highest remarks to the East Terminal. This high remark is attributable to the fact that the land with large physical acreage in this area is rather easily found out. This is attributable that land is arranged for the industrial development and industrial development had launched in the earlier period in this area compared with other areas. The inland container depot (ICD) and a new international airport are planned to locate in this area.

As for the North Terminal, rather low remark is attributable to the fact that the northern area has been already urbanized and few wide areas suitable for truck terminal is available now.

In the western part of Bangkok metropolitan area, there are plenty of residential development projects and only small segments of land are available for our purpose. It is judged that the lowest remark on the West Terminal reflects this situation.

6.3.7 Urban Development Index

A. Redevelopment of central district

Forwarder's facilities are built up especially in several places in central business districts (CBD) and their presence in CBD is an obstacle to induce efficient land use and form one of major causes of traffic congestion.

The concept of index depends on which area is easier to carry out redevelopments more smoothly in CBD.

As for business and commercial activities, both the North Terminal and the East Terminal mark higher scores than the West Terminal. Because the North locates along main corridor where has been developed into business and commercial places at present, the East is an industrialized area having port and industrial estate developments. In its hinterland, construction of Inland Container Depot (ICD) is planned.

B. Inducement of land use for physical distribution

With respect to land use formation for physical distribution, it seems that the North and the East in marks high score following the West. The North has been developed commercial and business area forming large corridor at present, and extension to east and west direction seems to be important more to develop BMR in future but west part of BMR is placed as residential area if anything.

C. Networks

Considering future movements of trucks and delivery and collection, evaluation by road networks seems to be important. Judging fro a view of road networks, the East and the West have higher priority comparing to the North. Since the East and the West locate out of the Outer Ring Road, the East and the West have better accessibility to other surrounding areas.

D. Present potential

As for present potential of land use, it seems that the North has large potentiality for the re-urbanization comparing to other areas. Results are summarized in Table 6.3.13, and shows that the East is ranked at the top of the list in this comparison.

Table 6.3.13 Urban Development Index

	North Truck Terminal	East Truck Terminal	West Truck Terminal
Redevelopment of Central District	H	H	M
Inducement of Land Use	H	H	M
Networks	M	H	H
Index	2.5	3.0	2.0
Average	1.00	1.20	0.80

6.3.8 Summary of Each Priority Index

Seven indices are tabulated in Table 6.3.14. In their summed-up figures, a preliminary top priority order is given to the North Ideal Public Truck Terminal.

Preliminary Priority Order	
First priority;	North truck terminal
Second priority;	West truck terminal
Third priority;	East truck terminal

For reference, all the indices are again tabulated in Table 6.3.14. In this preliminary prioritization, the North Ideal Public Truck Terminal remarks 8.83, fouty-three (43) per cent higher than the second priority terminal of 6.20 (the West Terminal), and fouty-seven (47) per cent higher than the third priority terminal of 5.99 (the East Terminal). This suggests that the North Terminal has far significant and urgent necessity than other two terminals.

It is also noticed that the deference between the second and the third is marginal and both are almost equivalent in importance.

6.4 Weighted Screening Indicators by Policy Preference

Criteria for heavier weight are given to the following items:

A. how much it fits an original purpose, and

B. how much it is effective to solve the obstacles in the experience in the truck terminal project.

Table 6.3.14 Summary of Preliminary Priority Index

Index	North Truck Terminal	East Truck Terminal	West Truck Terminal
1. Cargo Flow Rationalization Index	1.30	0.53	1.18
2. Transport Cost Saving Index	1.33	0.47	1.20
3. Transort Cengestion Relieveing Index (1)	1.31	0.70	0.99
4. Transort Cengestion Relieveing Index (2)	1.98	0.37	0.65
5. First Yeart Revenue/Cost Index	1.02	1.06	0.93
6. Land Acquisiton Index	0.89	1.66	0.45
7. Urban Development Index	1.00	1.20	0.80
Total	8.83	5.99	6.20

The original function of the truck terminal is to rationalize the cargo flow. In the past expedience of the truck terminal project, the apparent obstacle to implement was the availability of the land at a level that the project can be feasible. Thus the following three indices are given the highest weight of 0.20 while others 0.10, which are

1. Cargo flow ratinalization index
2. First year revenue/cost index
3. Land acquisition index

Traffic congestion relieving index has also important meaning. However, this can be realized with the combination of various kinds of policies such as trafic control system, road development programme, transport system improvement and so on. Sole measure of truck terminal construction alone cannot induce the improvement in relieving the traffic congestion. Thus this index is grouped in with the ligher weight.
Aggregation of the each index weight is 1.00.

Weights attached to the each index are shown below:

1.	Cargo flow rationalization index	:	0.20
2.	Transport cost saving index	:	0.10
3.	Traffic congestion relieving index (1)	:	0.10
4.	Transport cost relieving index (2)	:	0.10
5.	First year revenue/cost index	:	0.20
6.	Land acquisition index	:	0.20
7.	Urban Development index	:	0.10

6.5 Results of Sclection of the Highest Priority Terminal

The seven priority indicators are integrated into a single overall priority index by means of policy preference weight.

The integrated priority order indices prove that **the highest priority truck terminal** falls on **the North Ideal Public Truck Terminal**, followed by

the East Terminal. This time the West Terminal is ranked at the bottom. There is a difference in the ranking of the last two terminals from the preliminary prioritization.

Integrated Priority Order	
First prioritythe	**North truck terminal**
Second priority;	**East truck terminal**
Third priority;	**West truck terminal**

In the northern part of the Bangkok metropolitan area, there are three alternative locations. Of which, two are shown in the proposals that the investors had prepared and submitted to DLT. As of February 1992, evaluation is progressing.

It is noticed that the priority order is examined among the three candidates i.e. the North Terminal, the East and the West. Its absolute level of feasibility should be evaluated with more detail information and the practical guideline should be recommend about the measures of how to make the truck terminal project more attractive to the investors and how to make this project easy to implement. For this purpose, some policy measures are to be recommended.

6.6 Subject of Pilot Study

This study proceeds to the feasibility study on the North Ideal Public Truck Terminal as a pilot study.

It is recommended that a model feasibility study on the North Ideal Public Truck Terminal, which can be applicable to any case, be conducted as a polot study in a next study stage.

Table 6.5.1 Integrated Priority Order Index

	Index	Weight	North Truck Terminal	East Truck Terminal	West Truck Terminal
1.	Cargo Flow Rationalization Index	0.20	0.260	0.236	0.106
2.	Transport Cost Saving Index	0.10	0.133	0.047	0.120
3.	Transort Cengestion Relieving Index (1)	0.10	0.131	0.070	0.099
4.	Transort Cengestion Relieveing Index (2)	0.10	0.198	0.037	0.065
5.	First Yeart Revenue/Cost Index	0.20	0.204	0.212	0.186
6.	Land Acquisiton Index	0.20	0.178	0.332	0.090
7.	Urban Development Index	0.10	0.100	0.120	0.080
	Total	1.00	1.204	0.924	0.876

This is attributable to the facts that:

A. the land for the truck terminal is now under the selection by the government, and

B. the method and results of the feasibility study should be applied to any of candidate lands since DLT is to conduct the same kinds of study on the other sites in the other area.

Major contents of the pilot study are as followings:

1.	Size of Pilot Study	:	- 350 Berth (1995) - 150 berth (2000)
2.	Construction Period	:	first step 1993-1995 second step 1998-2000
3.	Open	:	first step 1995 second step 2000
4.	Land Ownership	:	the government land private land, private land to be purchased
5.	Acquisition of land	:	145 rai (1992) 65 rai
6.	Distance from Bangkok	:	32 km
7.	Distance from trunk road	:	2 cases: 1st stage 0 meter 2nd stage 1000 meter
8.	Infrastructure	:	the government fund
9.	Management type	:	private, the government, and a government/private Joint Venture
10.	Finance	:	a) private's own capital b) the government fund c) stock or loan d) combination of the above
13.	Traffic control	:	24 hour ban against heavy truck in CBD
14.	Others	:	preliminary design, maintenance cost, number of truck that use the truck terminal, charge, etc.

These preconditions cover almost all the site's conditions for the feasibility study.

However, it should be noticed that the cases of the East and the West truck terminals, transport commodity, vehicle composition and trip distance are expected to change, and other new study is necessary.

Part 2 Feasibility Study of the Highest Priority Truck Terminal

CHAPTER 7

DESIGN STANDARD OF TRUCK TERMINAL

PART II FEASIBILITY STUDY OF THE HIGHEST PRIORITY TRUCK TERMINAL

CHAPTER 7 DESIGN STANDARD OF TRUCK TERMINAL

7.1 General

This section aims at presenting the design standard applicable for any of the truck terminal. In this study, this standard provides the basic conditions of the facility layout plan and of the preliminary design of the Ideal North Public Truck Terminal.

This design standard is prepared with an assumption that some items are pre-requisite. Those are, for instance, land shape of the truck terminal and cargo volume handled at the terminal and so on.

In section 7.2, an overall work flow of standard setting is explained with a help of figure and then each work item is explained in depth in section 7.3.

7.2 Overall Work Flow

Fig. 7.2.1 shows overall work flow for the standard setting. Each item is briefly explained below.

First, a list of necessary facilities of the truck terminal is prepared with an appropriate size standard, which are designed to guarantee the operations of terminal efficient.

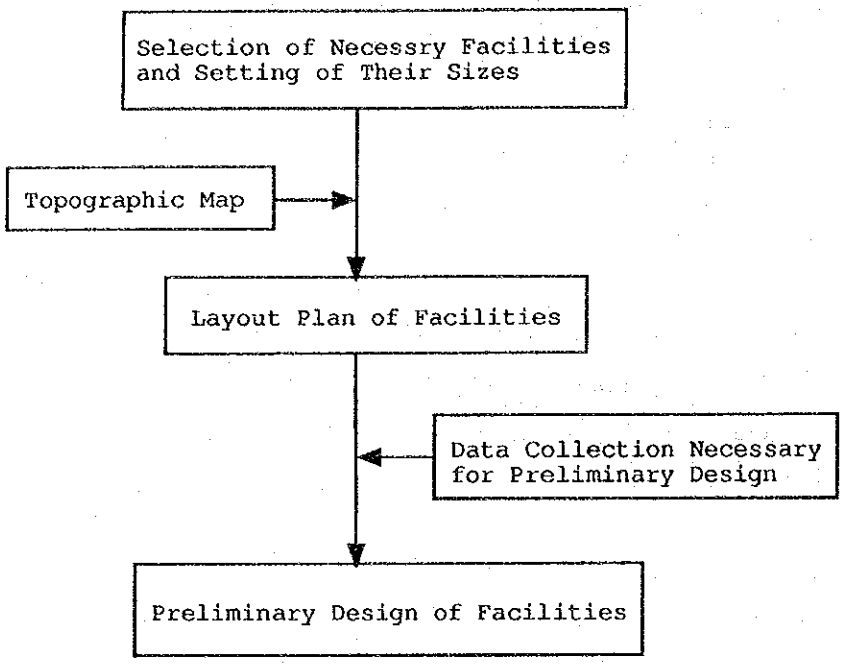


Fig. 7.2.1 Flowchart of the Works

Secondly, geographic conditions in the terminal's spot and its adjacent area are carefully reviewed with an information of topographic map.

Third work item is carried out with the geographic information so that the layout plan of facilities can be a cost saving and an operation efficient.

Then, more detail information is collected prior to a preliminary design of each facility based on the layout plan and the geographic conditions.

Lastly, preliminary design works of each facility is conducted. This covers various facilities and be explained in Section 7.3 in more detail.

7.3 Contents of Each Work Item

7.3.1 Necessary Facilities and their Size

A. Selection of Necessary Facilities

In selecting the necessary facilities, the following factors were taken into considerations.

1. Characteristic and/or features of a planned truck terminal:

   Especially, transport network system and physical distribution status in the surrounding area should be well reviewed and incorporated in the setting the role of the planned truck terminal.

2. Appropriateness of the truck terminal's location in terms of town planning;

   The truck terminal should locate at the most appropriate spot to guarantee a shortest route length for pick-up/delivery activities and at the pivot of the spatial dispersion of the various clients. This closely relates with the town planning, especially for the future.

   The following facilities are indispensable for any truck terminal:

   a) Platform
   b) Apron
   c) Parking
   d) Administration Building
   e) Service station (Repair Shop, Petrol Station, Car Wash facility)
   f) Green Belt
   g) Road & Others

B. Setting of Facilities' Sizes

Size of each facility above is dependent factors of (1) dimensions of trucks and (2) the cargo volume that the truck terminals have to handle in the future. Therefore, the representative types of truck are set prior to a setting of actual size of facilities.

Major types of the trucks now prevailing in the Bangkok Metropolitan area are shown below. Both of them are extracted from the DLT's data.

Line-haul truck	;	6 to 10 ton vehicle
Picking-up/delivery truck	;	2 to 4 ton vehicle

However, vehicle type adopted for the design standard of truck terminal is larger than those above since larger-scale trucks are getting share and this trend is expected kept unchanged in the future. They are;

Line-haul truck	;	13 to 16 ton vehicle
Picking-up/delivery truck	;	2 to 4 ton vehicle

(same as the prevailing dimensions)

Fig. 7.3.1 shows main features.

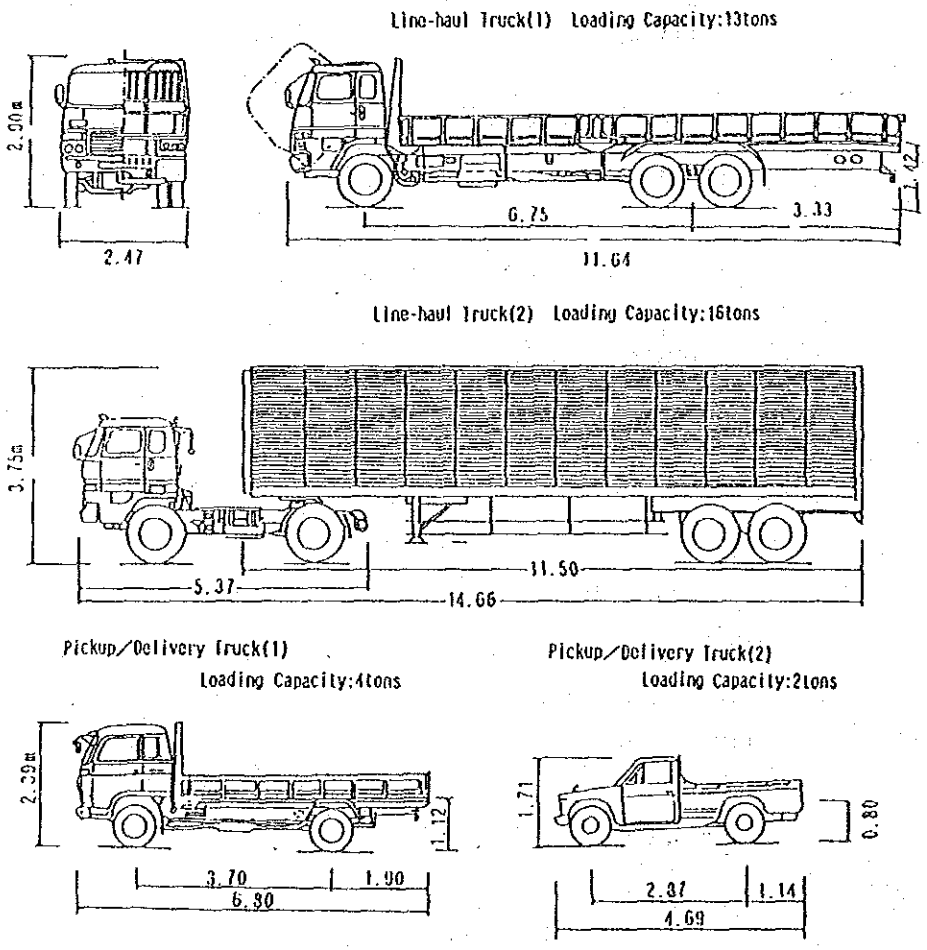


Fig. 7.3.1 Main Features of Trucks

Figs. 7.3.2 and 7.3.3 illustrate a turning radius and locus of the trucks.

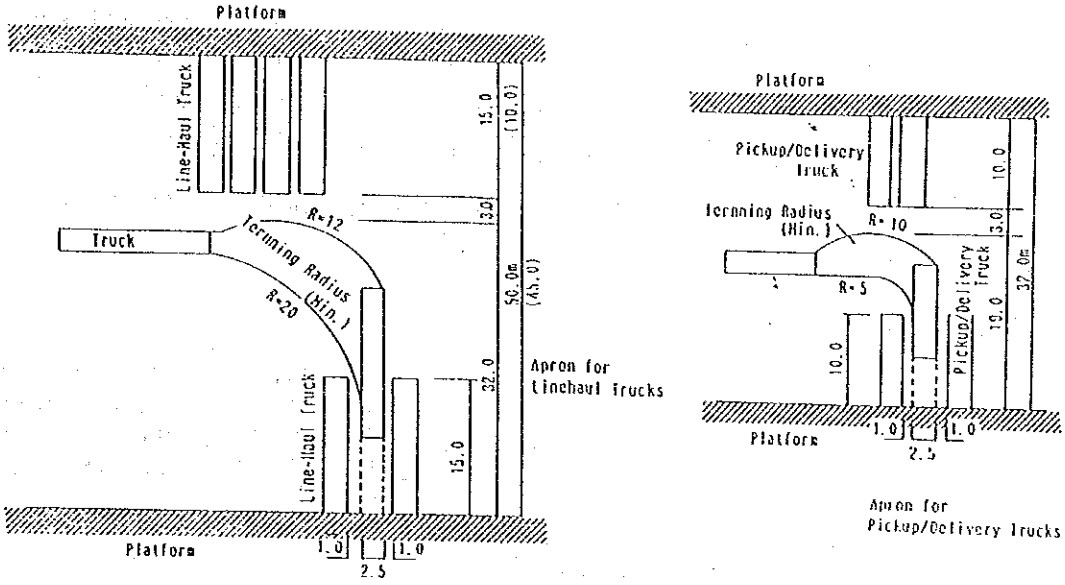


Fig. 7.3.2 General Dimensions of Truck Berth and Spacing between Platforms

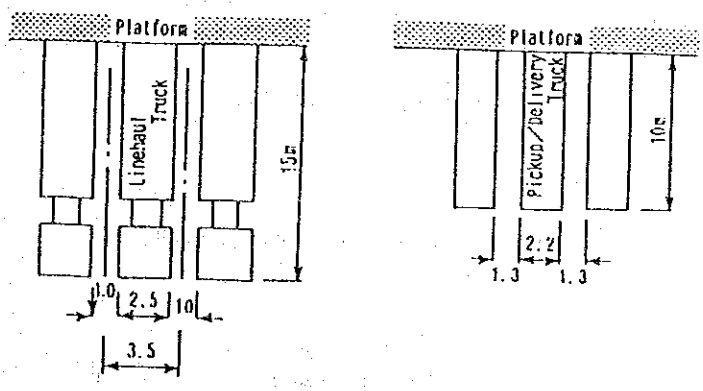


Fig. 7.3.3 Berth Dimensions for Trucks

With these vehicle's dimensions, required size of each facility is calculated. Detail calculation procedures are shown one by one in the following space.

1. Platform

Number of platform gives the basic condition in setting the size of platform, which is calculated as follows;

Necessary Number of Berth
= (Cargo Volume Daily Handled) (ton/day) / 20 (ton/berth)

where;

Twenty (20) ton per day in the function above indicates the handling capacity of cargoes at one berth per day. Equivalent figure in the Japanese truck terminal is about 25 ton per day, larger than this new standard for Thailand.

Average cargo handling capacity is set according to truck numbers which have to park at the same time.

This average cargo handling capacity should be reviewed when the platform workers would get experienced and each worker's handling capacity would be improved. In addition, new data about peak hour, peak volume, and cargo volume in stagnating in handling will provide other aspects in reviewing average handling capacity at the platform.

Total Length of Platform
= (Necessary Number of Berth)
x 3.5 (meter)

where; 3.5 meters indicate the width of each berth.
(See Fig. 7.3.3)

Platform has a shape of a long, narrow rectangular and the length of platform is to be one hundred seventy-five (175) meters, equivalent to fifth (50) berth since these are the best to optimize the working efficiency from the various experiences in Japan. It is dependent factor of land's shape for truck terminal and its size.

Width of platform is 20 meters in this design standard, which is a minimum width to guarantee the smooth and efficient operation with operational machines such as forklift. It is set to be 20 to 25 meters. However, in case that the largo-scale of operational machines such as belt conveyer would be introduced, width of berth should have wider space of 50-60 meters.

Space between each berth is set as follow;

Line-haul truck	;	50 meters
Pick-up/delivery truck	;	32 meters

2. Apron

Apron is the space where the truck approaches and lunches to the platform. Necessary space is calculated based on the turning radius, spatial width between each berth. Calculation procedure is shown below;

Apron for line-haul truck
= 3.5 (meter) x 15 (meter)
x (number of berth) (m^2)

Apron for pick-up/delivery truck
= 3.5 (meter) x 10 (meter)
x (number of berth) (m^2)

3. Parking Area

Three kinds of parking spaces are indispensable for the operation of truck terminal. They are;

- Parking space for line-haul truck
- Parking space for pick-up/delivery truck
- Parking space for staff use

These are explained one by one in the following space.

a) Parking space for line-haul truck

It is calculated by following steps.

Loading capacity of line-haul truck is set 10.5 ton/vehicle.

Then, the number of both the inbound and outbound line-haul trucks in need of parking is set by the two functions;

Number of parking vehicles (N_1)
= (Outbound Cargo Volume*)(ton/day)
/ 10.5

(Note)* This factor with star sign (*) should be larger figure of either of the outbound cargo volume or the inbound cargo volume. In the case of the Ideal North Public Truck Terminal, the outbound cargo volume exceeds the inbound cargo volume, and thus the figure of outbound cargo volume is used in the calculation function in this study.

As for the number of inbound line-haul trucks that use parking space (N_2), all the trucks are assumed to use the parking for the temporary doze.

Number of inbound line-haul trucks in need of parking space (N_2)
= (Inbound Cargo Volume) (ton/day)
/ 10.5

In addition, it is assumed that one-thirds (1/3) of the difference ($N_3 = N_1 - N_2$) would use the parking and the remaining portion would park at berth.

Thus, the total number of line-haul trucks in need of parking space is obtained by the function below;

Total Number of Line-haul Trucks in need of Parking Space (N_L)

$= (N_1 - N_2)/3 + N_2$

The necessary parking space (A_L) is obtained by multiplying N_L with parking space per vehicle;

Necessary Parking Space (A_L)

$= 3$ (meter) x 15 (meter) x N_L

$= 45 \times N_L$ (sq. meter)

b) Parking Space for Pick-up/Delivery Truck:

Secondly, this parking space is calculated as follows;

Average loading capacity of this kind of truck is 2.6 ton per vehicle.

$(3.5 + 1.6) / 2 = 2.6$ (ton/vehicle)

It is also assumed that the pick-up/delivery activities would be conducted twice a day (cycle ratio = 2).

Truck's number necessary to handle inbound cargo (N_1);

N_1 = (Inbound Cargo Volume)
(ton/vehicle) / 2.6 x 2 (cycle)

Truck's number necessary to handle outbound cargo (N_2);

N_2 = (Outbound Cargo Volume)
(ton/vehicle) / 2.6 x 2 (cycle)

With the assumptions that a half of N1 and $(N_2 - N_1) \times 1/2$ will use the parking space, number of pick-up/delivery truck in need of parking space is calculated as follows;

$$N_{P/D} = (N_2 - N_1) + N_1/2$$

Thus, necessary parking space ($A_{P/D}$) is set as follows;

Necessary Parking Space ($A_{P/D}$)
= 3 (meter) x 10 (meter)
x $N_{P/D}$ (sq. meter)

c) Staff Use Parking Space;

This staff use parking spaces allocate in front of the gate, and at the both ends of the platform for the commuting cars of staff, guests and official works.

Number of staff's vehicles in need of parking (N_P) is obtained by the following function;

N_P =(Number of Staff Working at Administration Building + Number of Staff Working at the platform) x 0.3 + **a**

(Note) 0.3; This is driven from the Japanese experience.
a This is effective only the case that the land is available.

Thus, necessary parking space (A_P) is obtained as follows;

Necessary Parking Space (A_P)
= 3 (meter) x 5 (meter) x N_P
(sq. meter)
= 15 x N_P (sq. meter)

Finally, by aggregating three kinds of parking spaces (A_L, $A_{P/D}$ and A_P) into one, total parking space in the public truck terminal (A) are obtained, which are;

$$A = A_L + A_{P/D} + A_P \text{ (sq. meter)}$$

4. Administration Building

In this administration building, all the management staff and related sections locate. Major facilities in the administration building are as follows;

- Administration office
- Meeting rooms
- Training rooms
- Canteen
- Doze rooms
- Shower rooms
- Medical care room

In many cases, lodging facility locates in the administration building. However, in this design standard, it locates in a different independent building.

Staff requirement gives a basic framework to estimate necessary space for facilities above in the administration building. Thus, first these are estimated, then necessary spaces are calculated by multiplying the number of staff with the unit space per person.

C. Staff Requirement for Each Facility

1 Administration Office Staff (P_1);

This is according to the size of terminal.

2. Platform Worker (P_2);

P_2 = (Daily handled cargo volume) (ton/day) / 15* (ton/worker/day)

(Note) Figure with star (*) is obtained from the field survey and hearing with the truck companies.

3. Driver and Assistant (P_3):

Line-haul truck (P_{3-1}) = (Outbound or Inbound Cargo Volume) (ton/day) / 10.5 (ton/vehicle) x 1.8

Pick-up/delivery truck (P_{3-2}) = (Outbound or Inbound Cargo Volume) (ton/day) / 2.6 x 2 (ton/vehicle)

(Note) Pick-up/delivery trucks are assumed to operate two times a day.

Thus, by aggregating P_{3-1} and P_{3-2}, P_3 is obtained.

$$P_3 = P_{3-1} + P_{3-2}$$

Thus, the total number of staff (P) is obtained as follows;

$$P = P_1 + P_2 + P_3$$

D. Necessary Space for Each Facilities

Based upon these staff requirement, the size of each facility is calculated as follow;

1. Administration Space (A_1):

$A_1 = P_1 \times 10^*$ (m^2/person)

(Note) Figure with star (*) is determined based on the data on public truck terminal in Japan.

2. Meeting Rooms (A_2);

A_2 = 80 to 100 (m^2) x 2 (room)

(Note) This is determined based on the data of the public truck terminal in Japan.

3. Training Rooms (A_3);

This is set in a same manner as the meeting room.

4. Canteen (A_4);

It is assumed that sixty (60) per cent of total staff use the canteen and that space for one person is 1.25 sq. meter (according to the data of the public truck terminal in Japan).

$A4 = P \times 0.6 \times 1/6 \times 1.25\ (m^2)$

5. Doze Rooms (A_5);

It is assumed that a half of line-haul truck's crew would use this facility. (Remaining half is to stay at the lodging facility.) Space per one person is 3.3 sq. meter according to the Japanese standard.

$A_5 = P_{2\text{-}1} \times 1/2 \times 3.3\ (m^2/person)$
$\times 1/2$ (2-story bed)
$\times 1/2$ (cycle ratio) (m^2)

6. Shower Rooms (A_6);

It is assumed that sixty (60) per cent of the total workers would use this facility, and cycle ratio is 10 times a day. In addition, necessary space per one person is set 1 sq. meter according to the truck terminal in Japan.

$A_6 = P \times 0.6 \times 1/10 \times 1\ (m^2/person)$
(m^2)

7. Medical Care Room (A_7):

$A_7 =$ (same as Meeting room) (m^2)

Thus, minimum requirement of physical space for administration building (A) is obtained by aggregating all the factors from A1 to A7 as follows;

$$A = \sum_{i=1}^{7} A_i \ (m^2)$$

8. Lodging Facility

This facility consists of two sections; lodging rooms and shower rooms.

It is assumed that the number of users is a half of the line-haul trucks' crew and one-tenth of pick-up/delivery trucks' crew.

a) Lodging Room

Larger figure of either of the numbers of line-haul crew or of pick-up/delivery crew will be adopted as a maximum capacity for lodging facility. The space per one person is 7.5 sq. meter per person according to the data of the public truck terminal in Japan.

b) Shower Room

This is obtained in the same manner as in the shower room in the administration building.

7.3.2 Topographic Map

Topographic maps are necessary to design the truck terminal since this map provides the basic data of geographic conditions of the site and its surrounding area. Especially, this is indispensable in deciding the alignment of approach road to the terminal site, drainage plan, road improvement plan, and layout plan of facilities in a frame of land shape.

In case that the map is not available, a careful land inspection should be conducted by the designer himself.

7.3.3 Layout Plan

A. Simple Locus of Vehicle's Flow

Layout of platform and parking space should be arranged in that manner that the flow locus of various vehicles should not cross each other since there move around many kinds of vehicles in the terminal such as line-haul trucks, pick-up/delivery trucks and staff cars, and a crossing of these vehicle loci causes accidents, inefficient cargo handing and so on.

Facility layout is designed based on the vehicle's dimensions as shown in Fig. 7.3.1 in section 7.3.1 B.

B. Overall Layout

Same kinds of facilities and the closely related facilities should be agglomerated at the same part of the terminal to improve an efficiency with an easy access and to save the cost by reducing the duplication of facilities.

C. Security Device

Administration building should locate at the nearest part from the entrance to secure cargo.

In addition, a temporary warehouse should locate at the nearest part to the platform to minimize the cost and time to remove the cargo to the warehouse, and vice versa.

D. Environmental Device

For the environmental conservation, a green belt should locate around the terminal site. This should be paid attention to guarantee the quiet living circumstance, and commercial activities. Especially this should be strictly conducted if the educational institution locates around the terminal site.

E. Applicability to Any Shape of Land

As for the layout procedure, a platform and a parking space should be allocated first prior to any of facilities, and other facilities should be planed in the most efficient way.

7.3.4 Date Collection

More detail information is to be collected at this stage after the location spot is fixed and after the layout of major facilities is completed. Major data to be collected are shown below:

A. Ground and Soil Related;

This provides the basic date to decide the foundation structure and its construction method.

B. Underground Water Related;

Data about level of underground water and water volume is to be collected.

C. Rainfall Related;

Rainfall data is to be collected by daily, monthly and annually to decide the discharge volume and to design drainage system.

D. Flood Related;

Flooding data in the past is to be collected to decide the level of land filling.

In case that the indispensable data is not available, inspection of similar facility or related government authority is to be interviewed.

7.3.5 Preliminary Design of Facilities

A. Earth Works and Pavement Structure

In conducting earth works, the following conditions should be checked and then the height of land filling is decided;

1. Ground level of the roads around the terminal,
2. Maximum height of the road surface level, and
3. Subsidence of the ground.

At this preliminary design stage, pavement structure is set to be the same as the similar structures such those in the industrial estates and residential estates around the terminal

B. Platform

The following aspects should be decided in designing the platform.

1. Roof Load;

   Kind of material and its weight. Weight of truss to support the roof.

2. Material of Strut;

3. Span between Struts;

   This span should be a multiple of the width of the berth. However it is dependent of the soil condition.

4. Type of Foundation;

   Type of foundation and its construction method would be decided according to the soil conditions and load of roof. With the conditions of loose soil and heavy load of roof, pile foundation method is suggested. With other conditions, footing foundation is suggested. In case of pile foundation, a bearing pile or a friction pile should be selected.

C. Structure of building should be a rigid frame structure with the reinforced concrete (RC). With the loose ground, a type of foundation should be decided carefully.

D. Drainage facilities contain storm water drainage and sanitary water system.

1. Storm Water Drainage

a) Rainfall Intensity

Each administration unit has its standard. Therefore this data should be collected and adopted in the designing.

b) Discharge Volume

This is decided based on the following function;

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

(Rational Formula)

where,

Q ; Discharge (m^3/s)
C ; Coefficient of discharge
R ; rainfall intensity (mm/hour)
A ; discharge area (ha)

c) Establishment of Drainage Network

This drainage network should be established with due considerations on level of drainage outlet, its gradient and sizes etc.

In some cases, the gradients of drainage outlet have to be set small in case that the height of land filling is not high. Some cases are found that the ground is too flat to guarantee the gravity drainage. In order to avoid such cases, the drainage zone should be carefully set.

d) Setting of sizes of drainage facilities

This is decided according to the discharge volume.

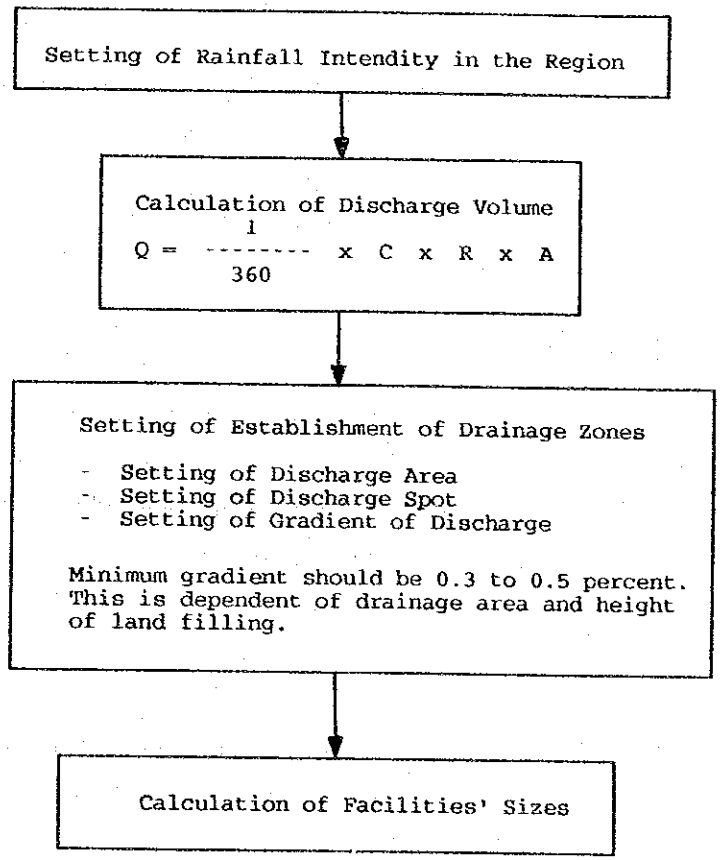


Fig. 7.3.4 Flowchart of Drainage Planning

1. Sanitary Water

Unit of sanitary waste water is set 90 liter/day according to the following function;

Unit of sanitary waste water
= 100 (liter/day) x 0.8 (discharge rate) x 1.1 (Ground water)

Then, the total sanitary water discharge (Q) is obtained. Function is shown below;

$Q = P \times 90$ (liter/day) (m3/day)

where;

P: Number of workers and staff in the terminal

This sanitary water drainage system should be designed separately from the storm water drainage system.

E. Water Supply

Water necessary in the truck terminal should be supplied by water services since the law prohibits any institution to draw the ground water to prevent further subsidence of the ground.

Demand of water consumption is calculated as follow;

Water requirement for daily consumption ;
100 *1 liter/person/day

Water requirement for car washing;
1,000 *2 liter/vehicle

(Note) *1; Based on the data of Laen Chabang Industrial Estate

*2; Based on the Report of the Regional Truck Terminal in Thailand (1988, JICA)

Necessary volume of water supply is calculated by the following function;

$$Q = P \times 100 \text{ (liter)} + C \times 1{,}000 \text{ (liter)} \text{ (m3/day)}$$

where,

P ; Number of workers and staff in the terminal
C : Number of vehicles requiring car washing

CHAPTER 8

PRELIMINARY DESIGN

CHAPTER 8 PRELIMINARY DESIGN

8.1 Outline of the Highest Priority of Truck Terminal

This preliminary design is prepared according to two principles;

A. It should be applicable for any shape of land.

B. With difficulty of land acquisition for the truck terminal, two cases of implementation are set up: one is to allocate all the facilities in one place, the other is to separately allocate necessary facilities in different two places.

This treatment is attributable to the status quo of truck terminal promotion. There are two schools in selecting the land for the truck terminal among the governmental authorities. One school is seeking for the public land for its construction. The other has been requesting the private investors to provide its own land for the truck terminal project. And as for the latter case, the review works of proposals from the private investors has been in progress. At present, no co-ordinations among these two schools are anticipated. Three sites in total are listed as a candidate site for the North Ideal Public Truck Terminal by these two schools. Thus two principles are prepared to make the design applicable for any of the site for Ideal North Public Truck Terminal.

As for the demand towards the cargo freight, the demand in 1995 is estimated to be less than that in 2000. Thus two cases of construction method is set for analysis as shown below;

Case 1; 500 berth in one place
Case 2; 500 berth in total in two places
(at least).

Case 2 is further divided into two ramifications;

Case 2-1; 350 berth in one place
(at the year 1995)

Case 2-2; 150 berth in one place
(at the year 2000)

All the analyses in the feasibility study are conducted based on these case settings.

8.2 Formulation of Facilities and their Sizes

8.2.1 General

Any truck terminal should have four basic functions as explained in Chapter 6, which are listed here again;

A. truck terminal
B. truck center
C. warehouse
D. others

Of the four functions above, the truck terminal alone forms a core facility of the truck terminal complex and is in an urgent need in the Greater Bangkok Metropolitan area. This truck terminal is a subject of preliminary design in this study.

8.2.2 Basic Concepts for Truck Terminal Planning

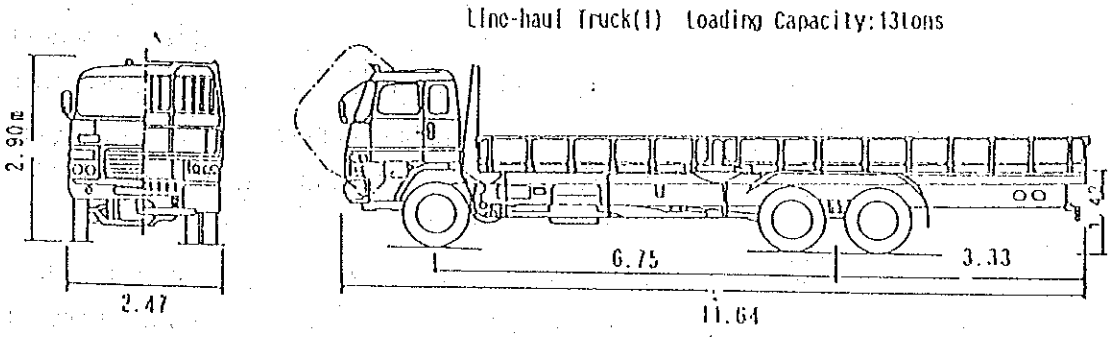
Preliminary designs are prepared for the following three cases;

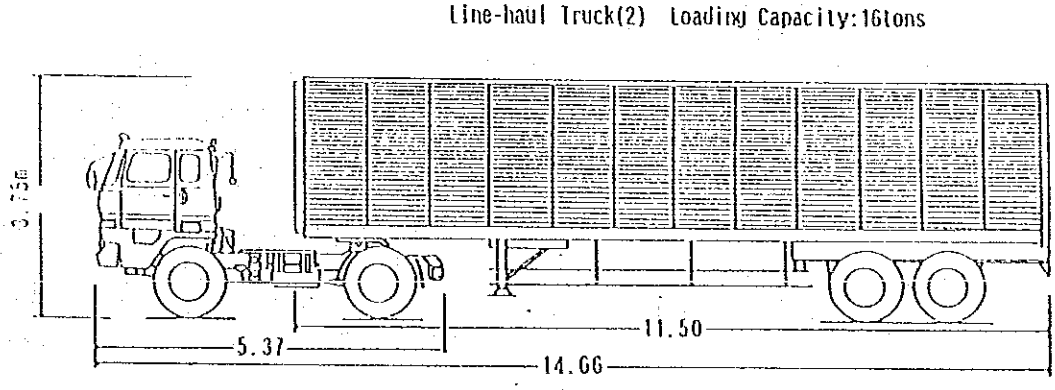
500 berth truck terminal;	Case 1
350 berth truck terminal;	Case 2-1
150 berth truck terminal;	Case 2-2

8.2.3 Basic Design Conditions

A. Main Features of Trucks

The representative types of truck adopted in planning of the Ideal North Truck Terminal are selected based on the most probably popular type of truck in the future. Those are illustrated in Fig. 8.2.1.





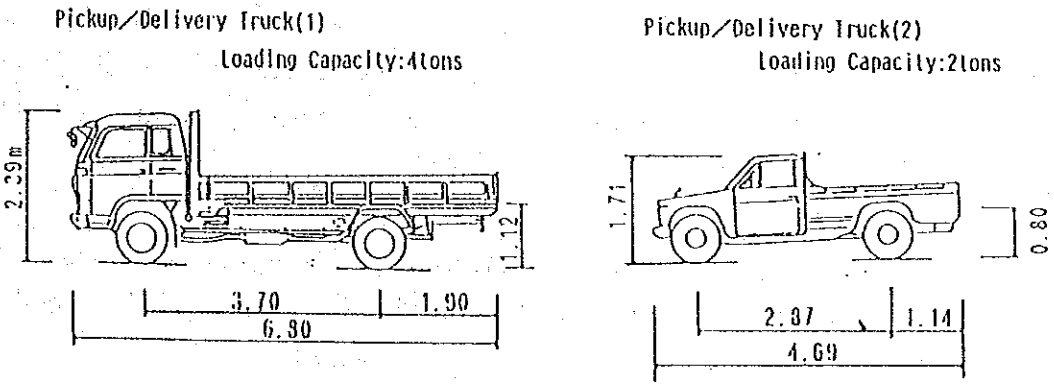


Fig. 8.2.1 Dimensions of Representative Trucks

B. Consideration for Facility Layout

1. Primary consideration lies on how to separate loci of different types of traffic, particularly how to keep locus of line-haul trucks apart from flows of pick-up and delivery trucks.

2. Layout of facilities should be designed easy for the truck companies to transit their operational system, and thus it should not drastically differ from the present layout. The working customs of present truck terminal workers should be in the largest extent incorporated in a new layout of a public truck terminal.

3. The proposed layout of facilities should guarantee efficient connections with other facilities in and/or around the truck terminal since various facilities will be established around the terminals in the future.

4. The sites should have and/or guarantee enough physical space for a further expansion of the terminal and the related facilities in the future.

5. The administration building should locate near the main gate of the terminal to ensure a security of cargoes and an effective facilities' management. In addition, the gates and fences should be installed around the truck terminals.

6. Green belt should locate around the truck terminals to minimize environmental impacts to the surrounding areas. Especially this is worthy of attention if the public spaces such as educational facilities and residences locate around the planned spot for the terminal.

7. Platforms should be designed to avoid any kinds of accidents and its management methods should be formulated with due attentions on safety operation.

8. Layout should be most effective to save the energy and to conserve the environment of the surrounding area. In this context,

various devices are should be adopted such as a usage of storm water and so on.

C. Consideration for Designing

1. Finished ground level

A finished grand level of the terminal site should be kept same as high as those of roads near the truck terminal site. This level is a minimum condition to eliminate the risk of flooding which occurs in and around the proposed site, and to guarantee easy access to the terminal from the approach roads.

Actual finished grade levels should be determined based on the results of soil investigation of the existing grand and fills.

Design standards adopted by the Industrial Estate Authority of Thailand are also taken into considerations in planning the truck terminal.

8.2.4 Design Conditions

A. Cargo handling Volume

Cargo volume handled at the Ideal North Public Truck Terminal was estimated in section 4.3.1 (Case 2-b) and is shown again below. The truck terminal is designed to handle this cargo volume effectively and efficiently.

Table 8.2.1 Estimated Cargo Handling Volume (Case 2-b)

	1995	2000
Inbound Cargo Volume	2,000	2,806
Outbound Cargo Volume	4,795	6,724
Total Volume (ton/day)	6,795	9,530

(Note) Annual operation days are 300 days. Figures in 1995 are obtained by multiplying 0.713 with figures in 2000.

B. Berth Dimensions

General dimensions of berths for line-haul trucks and pick-up/delivery trucks were determined as follows;

1. Berth for line-haul trucks

General dimensions of berths for line-haul trucks were set to be applicable for semi-trailer trucks.

2. Berth for pick-up/delivery trucks

This berth is designed to be applicable for 4-tons trucks.

C. Space Between Platforms

Space between platform is called apron.

The platforms were arranged in such a manner that a line-haul truck does not face to a pick-up/delivery trucks in the same apron, which would

result in the crossing of traffic loci. Those are illustrated in Figs. 8.2.2 and 8.2.3, and followed by the explanations.

1. Line-haul Trucks

Space between the two platforms along which the line-haul trucks park face to face, was set to be 50 meters.

2. Pick-up/Delivery Trucks

Space between the two platforms along which the pick-up/delivery trucks park face to face,

has a diameter of 32 meters as shown in the same figure for the line-haul trucks.

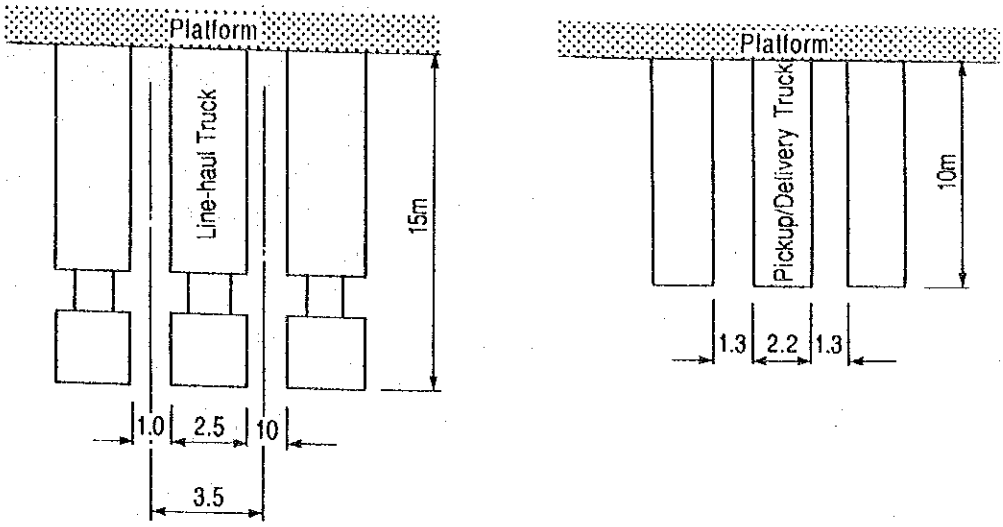


Fig 8.2.2 General Dimensions of Berths for Trucks

D. Shape and Width of Platform

Platform provides the space for storing and sorting out the cargoes and the space for service path.

Shape of platform should be preferably rectangular type to ensure efficient operation of storing and sorting out cargoes. In this study, the rectangular shape is employed for the platforms since the site has no spatial restriction in terms of shape and physical acreage.

Width of the platform is set to be 20 to 25 meters. It was judged that 20 meters would be sufficient for the estimated cargo volumes in the year 2000. However, 25 meter is desirable if cargo handling machines are to be introduced.

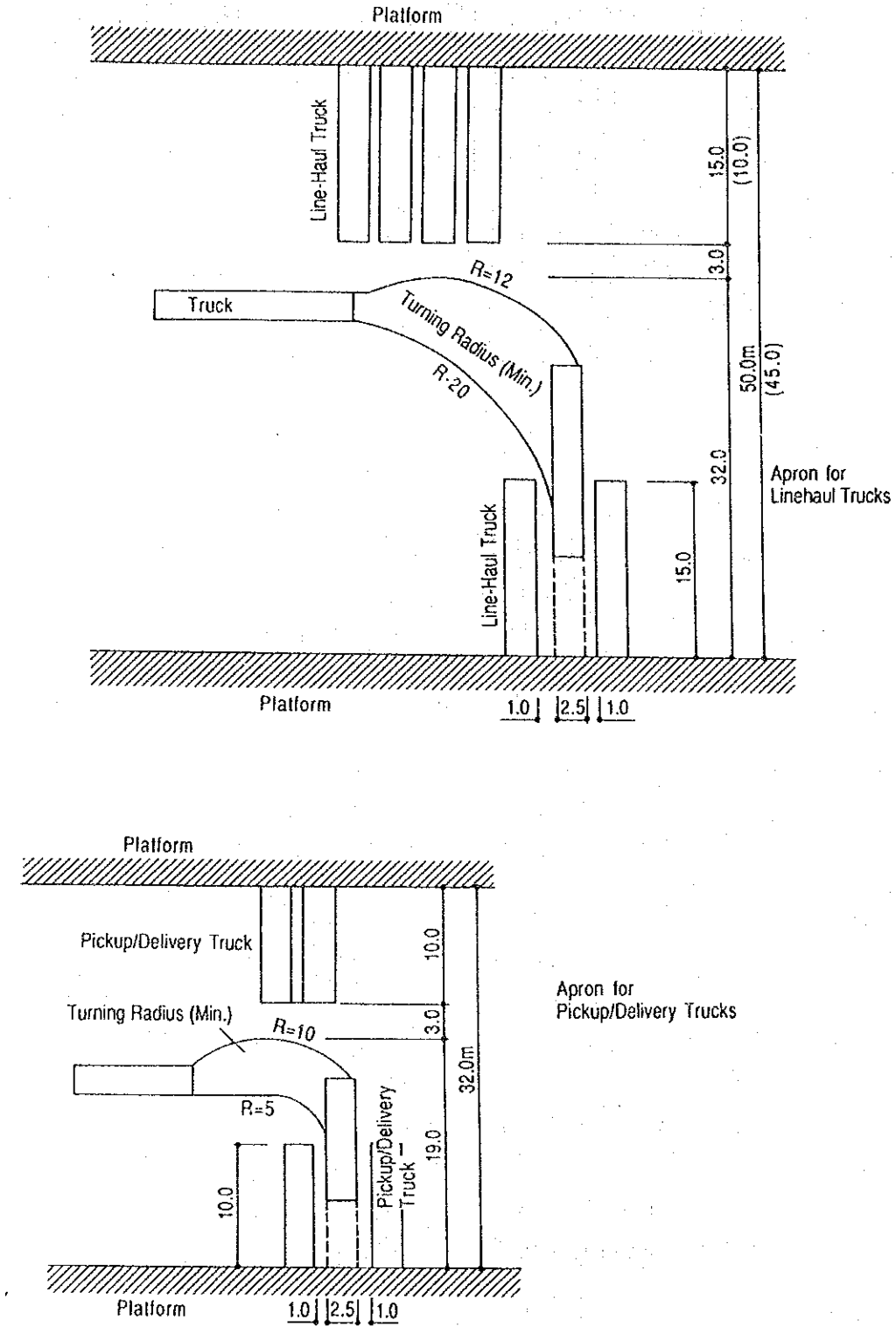


Fig 8.2.3 General Apron and Turning Radius

Platform level was set at the same level as truck bed is to minimize personnel requirements for loading and unloading operations and to minimize the risk of damages to the cargoes during loading and unloading operation. Cross-sectional dimensions of the platform are illustrated in Fig. 8.2.4.

It should be noted that H_1 and H_2 are set according to Japanese vehicle specifications

H_1 = 1.1 meter (4-ton truck)
H_2 = 1.4 meter (10-ton truck)

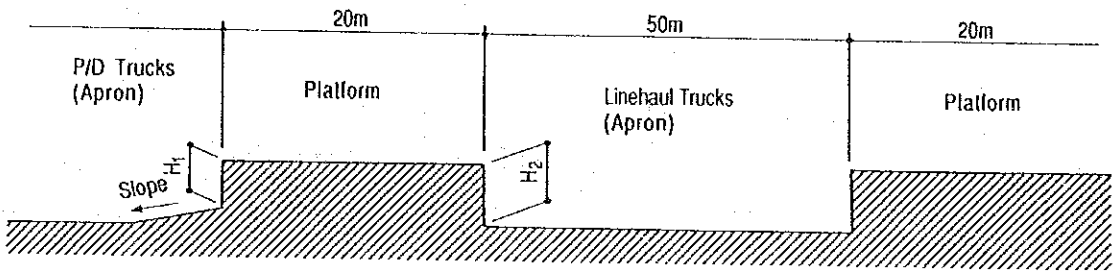


Fig. 8.2.4 Cross-sectional Dimensions of Platform

E. Parking Space

Space of parking is set according to the dimensions of representative trucks as described in Fig. 8.2.2 and the details are explained below;

1. Parking space for line-haul trucks;
   3.0 (meter) x 15 (meter)
   = 45 (sq. meter/vehicle)

2. Parking space for pick-up/delivery trucks; 3.0 (meter)
   x 10 (meter)
   = 30 (sq. meter/vehicle)

F. Daily Cargo Volume

This daily cargo volume handled by platform worker were assumed to be 20 tons/day/worker

8.2.5 Facility Formulation and Their Sizes

Major components of the truck terminal are berth (cargo handling area) and parking space. Other necessary facilities are administration building, operation office, and vehicle service facilities (gas station, repair shop, car washing shop, truck scale. and so on).

Lodging facilities for the drivers and assistants of pick-up/delivery trucks are separately designed from the administration building. In addition, the warehouse for temporary use is also planned since the forwarders have a strong demand to have the temporary warehouse in the truck terminal, and the cargo handling capacity of the berth.

A. Berth space

Necessary number of berths is calculated based on the estimated cargo demand of the truck terminal in the year 2000.

Section 7.2.4 described the estimated cargo handling volume as follows;

Table 8.2.2 Estimated Cargo Volume

(unit; ton/day)

Year	1995	2000
Inbound Cargo Volume	2,000	2,806
Outbound Cargo Volume	4,795	6,724
Total Cargo Volumes (ton/day)	6,795	9,530

Thus, the required number of truck berths is calculated as follows;

Year 2000;

9,530 / 20 (ton/day)

= 477 (berth)

= approximately 500 (berth)

Year 1995;

6,795 / 20 (ton/day)
= 340 (berth)
= approximately 350 (berth)

Daily cargo handling volume provides the basic data to reckon a necessary number of berth. By dividing daily cargo handling volume (= outbound cargo volume + inbound cargo volume) by cargo handling capacity per berth (25 ton/day/berth for Japanese case), it arrives at the necessary number of berth.

Cargo handling capacity is determined according to the working hours of labors, working efficiency, mechanized level of the cargo handling operation. In this study, it is set a little bit lower than the Japanese standard, 20 ton/day/berth.

Number of berth reckoned above is enough to cope with a stagnating cargo volume and a peak hour cargo volume.

B. Platform area

Area for platform is estimated by multiplying the total length of platform with its width. First, the total platform length is estimated in two cases.

Platform length (500 berth case) ;

500 (berth) x 3.5 (m/berth)
= 1,750 (meter)

Platform length (350 berth case) ;
350 (berth) x 3.5 (m/berth)
= 1,225 (meter)

Platform's width is set 20 meters for both the 500 berth terminal and the 350 berth terminal.

Thus, the total area for the platform is obtained as shown below;

Total platform area (500 berth)

= Platform Length x Platform Width

= 1,750 (meter) x 20 (meter)
= 35,000 (sq. meter)

Total platform area (350 berth)
= 1,225 (meter) x 20 (meter)
= 24,500 (sq. meter)

C. Apron area

Sizes of apron are set in section 7.3.1. (2), which are again shown below;

Apron for line-haul truck:
= 3.5 (meter) x 15 (meter)

Apron for pick-up/delivery truck;
= 3.5 (meter) x 10 (meter)

Thus, area for apron is obtained by adding the original area of the apron alone and the extra space, which are as shown below;

Apron area (500 berth case)
= 3.5 (meter) x (15 + 10) (meter)
x 500 (berth)
= 43,750 (sq. meter)

Apron area (350 berth case)
= 3.5 (meter) x (15+10) (meter)
x 350 (berth)
= 30,625 (sq. meter)

D. Parking area

First, areas of (1) line-haul trucks, (2) pick-up/delivery truck, and (3) staff use parking area are separately calculated. Lastly, by aggregating three areas, the total area for parking is obtained.

1. Line-haul Trucks

Parking area is calculated based on the outbound cargo volume since the outbound cargo volume of 6,724 ton per day exceeds far that of inbound cargoes of 2,806 ton per day.

Loading capacity of line-haul truck is to be 10.5 ton per vehicle.

6,724 (ton/day) / 10.5 (ton/vehicle)
= 640 (vehicles/day)

It is assumed that drivers and assistants of 270 vehicles per day in total (= 2,806 (ton/day)/10.5 (ton/vehicle)) are apt to take a sleep in the parking. Thus vehicles park for the same hours in the parking space of the truck terminal.

For the remaining vehicles (=370 vehicles), two-third of the remaining hours is assigned to the parking hours at the berth, while one-third is assigned to the parking hours in the park area.

Number of line-haul trucks in the park area
= 270 + 120 = 390
= approximately 400 (vehicles)

Necessary space for park area
= 45 (sq. meter/vehicle) x 400 (vehicle)
= 18,000 (sq. meter)

2. Pick-up/delivery trucks

Loading capacity of pick-up/delivery truck is assumed to be 2.6 ton/vehicle
(= (3.5 + 1.6)/2).

So, the number of pick-up/delivery trucks in need of the parking space is obtained as follow;

The number of pick-up/delivery trucks in need of the parking space (500 berth case)

= 6,724 (ton/day) / 2.6 (ton/vehicle) / 2 (times/day)

= 1,300 (vehicles/day)

The number of pick-up/delivery trucks in need of the parking space (350 berth case)

= 4,795 (ton/day) / 2.6 (ton/vehicle) / 2 (times/day)

= 540 (vehicles/day)

It is also assumed that a half of 540 vehicles (= 270) is apt to park in the parking space in the truck terminal and at least 300 vehicles of 760 vehicle (= 1,300 - 540) is apt to park in the parking space.

Number of parking space

= 270 + 300 = 570 vehicles

= approximately 650 vehicles

Parking area

= 30* (sq. meter/vehicle) x 650 (vehicles)

= 19,500 (sq. meter)

(As for *, see section 8.2.4 5))

3. Staff use parking area

This private parking space locates close to the administration building and operation building. It offers spaces for the vehicles of staff and office use only.

Number of vehicles in need of staff use parking area

= 20 (vehicles/platform) x 10 (platform) + 70

= 270 (vehicles)

Parking area

= 3 (meter, W) x 5 (meter, L) x 270 (vehicles)

= 4,050 (sq. meter)

Corresponding figures for the 350 berth case are arrived by multiplying 0.713 with this figure.

E. Administration building

Facilities required in the administration building are as follows;

1. administration office
2. Meeting room
3. Training room
4. Canteen
5. Rest room
6. Shower room
7. Medical care room

F. Office Building

This office is designed to carry out all the registration works in the cargo handling processes. For this purpose, these locate at the both ends of the platform in principle.

A = 10 (meter) x 30 (meter) x 2 (floors)
= 600 (sq. meter/office)

G. Lodging

This lodging is designed to facilitate the place where the drivers and assistants of the line-haul and pick-up/delivery trucks would sleep and/or take a rest for the time being.

H. Warehouse

This warehouse is designed for storing the cargo for a short time. Interview survey indicated that almost all the cargo can be handled within one day but that some have to be stored at the terminal until the clients come to pick them up. This warehouse is also necessary where the training of the workers at the truck terminal takes a long time to be trained to the proficient level. It is expected that unskilled workers cannot handle all the cargo, especially at the early stage of the operation, and this condition requires the warehouse in the truck terminal area.

Necessary space for this warehouse to keep the cargo for a short time is assumed as follows;

Necessary Space of warehouse
= necessary number of berth x (10 to 20 %)

I Service station

This station covers the following facilities;

1. gas station
2. Repair shop
3. Car washing facility
4. Truck scale

J. Environmental conservation policy, energy conservation policy, and safety improvement policy

First, environmental conservation measure is reflected in the green belt. This contributes to prevent the noise from spreading to the surrounding area and to soften the magnitude of vibration by keeping the distance from the residential and other quiet circumstance.

Secondly, safety measures reflect the installation of fence along the fringe of the terminal and contribute to prevent the good form being stolen.

Thirdly, energy saving measure is reflected in the recycle use of the rain water. Roof of the truck terminal is designed to collect the rainfall and to be used for the car washing.

Lastly, the sewage facility is designed to meet the "General Standard in Thailand."

K. Road, etc.

Structures of roads and land-filings are designed based upon the example of the industrial estate such as Band-pain Industrial Estate.

8.3 Layout Plan of Each Facility

8.3.1 Basic Concept

The following seven (7) aspects are taken into considerations in arranging the facilities in the truck terminal;

A. Locus of vehicle

In allocating the gate to the truck terminal, the loci of vehicles are paid attention to improve the efficiency. It is arranged that the layout of facilities should keep the flow line of one type of vehicle apart from those of others and never cross each other. The loci of vehicle are also arranged in planning the facilities to guarantee easy and short access from the gate to the berth, and vice versa.

B. Platform and parking

Two allocating plans are studied: first is to agglomerate the platform and the parking space together in one section, and second is to allocate them separately. Both are examined in terms of efficiency.

C. Usage of platform

Best applicable method of platform's usage to Thailand is studies beside the orthodox design pattern. Space of platform is generally wide enough to be shared by various companies and, at the actual operational stage, this wide space is divided into various segments according to the size of the company. Different pattern, which is more applicable to Thailand, is also prepared.

D. Location of administration office

Administration building locates close to the gate to secure the safety of cargoes and to prevent the cargo from being stolen.

E. Lodging

Lodging house locates at the quiet part in the terminal and near the parking space. Thus the lodging is far from the administration building where it is installed in general cases.

G. Service facilities

Service facilities allocate in two lots to equally serve every user in terms of service quality and accessibility.

H Warehouse

Warehouse is planned to store cargoes that cannot be handled on the same day they arrived at the terminal. For this purpose, it is allocated at the nearest place to the platform. This is convenient so that the workers can save the time and energy to remove the cargoes.

8.3.2 Standard Layout Plan

Three layout plans are prepared in arranging the terminal facilities by taking into the above seven (7) conditions.

Each is illustrated in Figs. 8.3.1 through 8.3.3.

Type 1

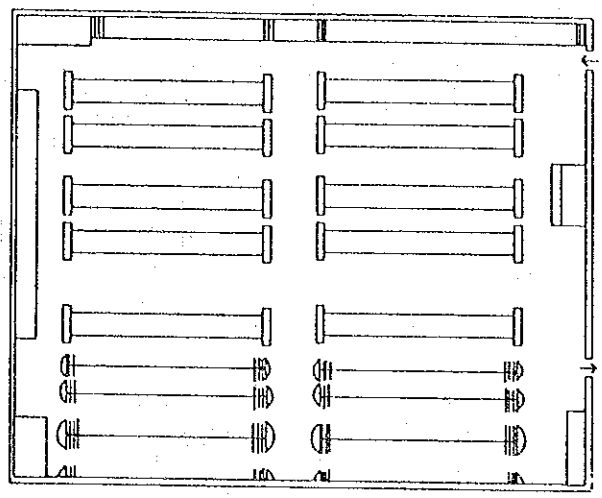


Figure 8.3.1 Function Agglomeration Type

Type 2

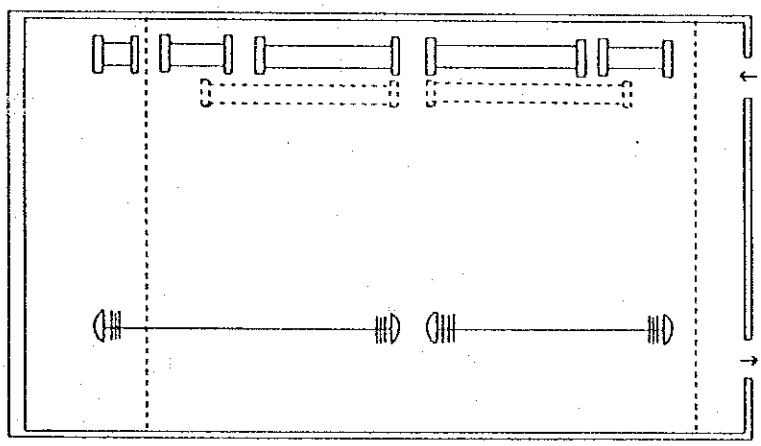


Figure 8.3.2 Small-scale Independent Type

Type 3

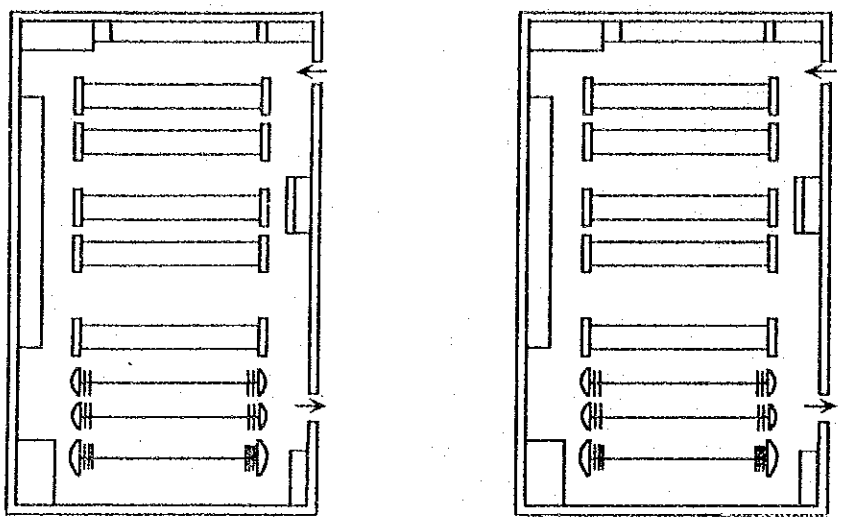


Figure 8.3.3 Shotgun Type

In comparing three types of terminal, the following conditions are set;

First condition ; Terminal has a 350 berth.

Second condition ; Daily cargo handling volume is set 6,795 ton/day.

Based on these conditions, following items are compared and suitability to Bangkok is evaluated.

Terminal area ; Total area and berth area

Land area ; Terminal area and shoulder area at the edge of the terminal

Construction cost ; Total cost excluding land acquisition cost, and construction cost per berth

Table 8.3.1 summarizes the results of comparison and major findings are as follows;

Table 8.3.1 Comparison of Three Terminal Types

Items	Type 1 (Function Agglomeration type)	Type 2 (Small-Scale Independent Type)	Type 3 (Shotgun Type)
Ease of Construction	Easy since whole structures are constructed in one time	Time lag in construction of common spaces (corridor, roof, partitions) and problems in cost sharing are expected. Difficulty to guarantee equal construction quality is expected.	Same as Type 1
Ease of Maintenance	Very easy to Easy to carry out the periodical maintenance and repair works	Difficult to maintain the whole facilities systematically since each contractor carries out the maintenance works at different time Low reliability on the maintenance work quality	Same as Type 1
Efficiency of Cargo Handling on Berth	Highly efficient to divide the berth according to the needs. Easy to guarantee the high working efficiency since berths spread continuously.	Highly efficient if large volume is handled at a small number of berths. Low efficient if much berths are used simultaneously. Lower efficient at around the office on the platform since smaller spaces are available for handling the cargo.	Same as Type 1.
Others	No specific item is expected.	Management manual agreed by all the users are indispensable.	Same as Type 1.

A. As for terminal area, Type 2 requires larger area by 20 per cent than Type 2 and Type 3 since larger corridors are necessary.

B. As for land acquisition area necessary, Type 2 is larger by 20 per cent than other two types.

C. As for construction cost, Type 2 is the highest among three and it requires higher cost by 20 per cent than Types 1 and 3.

Other items are also adopted to evaluate three types of terminal and Table 8.3.2 summarizes merits and demerits in terms of those items.

The best layout plan should guarantee (1) the smallest physical space, (2) smooth and simple loci of vehicles, and (3) easy of operation and management of the terminal.

Thus criteria in evaluating three layout plans are summarized as follows;

Criteria 1; Least physical acreage;

This results in least cost of construction cost.

Criteria 2; Simple moving line of vehicle;

This results in high efficiency in operation.

Criteria 3; Easy in operation and management;

This results in high efficiency and reliable handling of cargoes.

In terms of criteria 1, it is judged that Type 1 is the most advantageous, and followed by Type 3.

Table 8.3.2 Comparison of Three Management Forms

Type	Merits	Demerits
Type 1	- Each zone has a clear-cut function so that it minimizes the troubles. - Moving lines are simple and clear so that it is effective to guarantee smooth move and efficient operation.	- Some troubles can be expected such as sorting mistakes and stolen goods if many companies have to operate together on one platform.
Type 2	- Most user friendly layout. - The much the numbers of the platform segments are, the more the area for platform expands.	- Most difficult plan in management of the platform because the scale merit is not used in depth.
Type 3	- Necessary space is same as Type 1	- Moving line, i.e., locus of the vehicle gets more complicated. - Service facilities cannot locate together since parking spaces are divided into two lots or more.

In terms of criteria 2, it is judged that Type 1 and Type 3 ranked at the top of the list. Type 2 follows these two types.

In terms of criteria 3, it is judged that Type 1 and Type 3 are preferable to Type 2.

However, it is noted that Type 2 is least applicable to the present Thai conditions where almost all the truck companies are managed by a family or small organizations. If platform of truck terminal is divided into small segments of large numbers, its operation and management will require higher management skills. In other words, the smaller one company's platform is, the more difficult the operation and management of the terminal are. This raise other problems.

In addition, in terms of user's benefit, a co-operative management of platform by the multiple companies is preferable to the single user for single management.

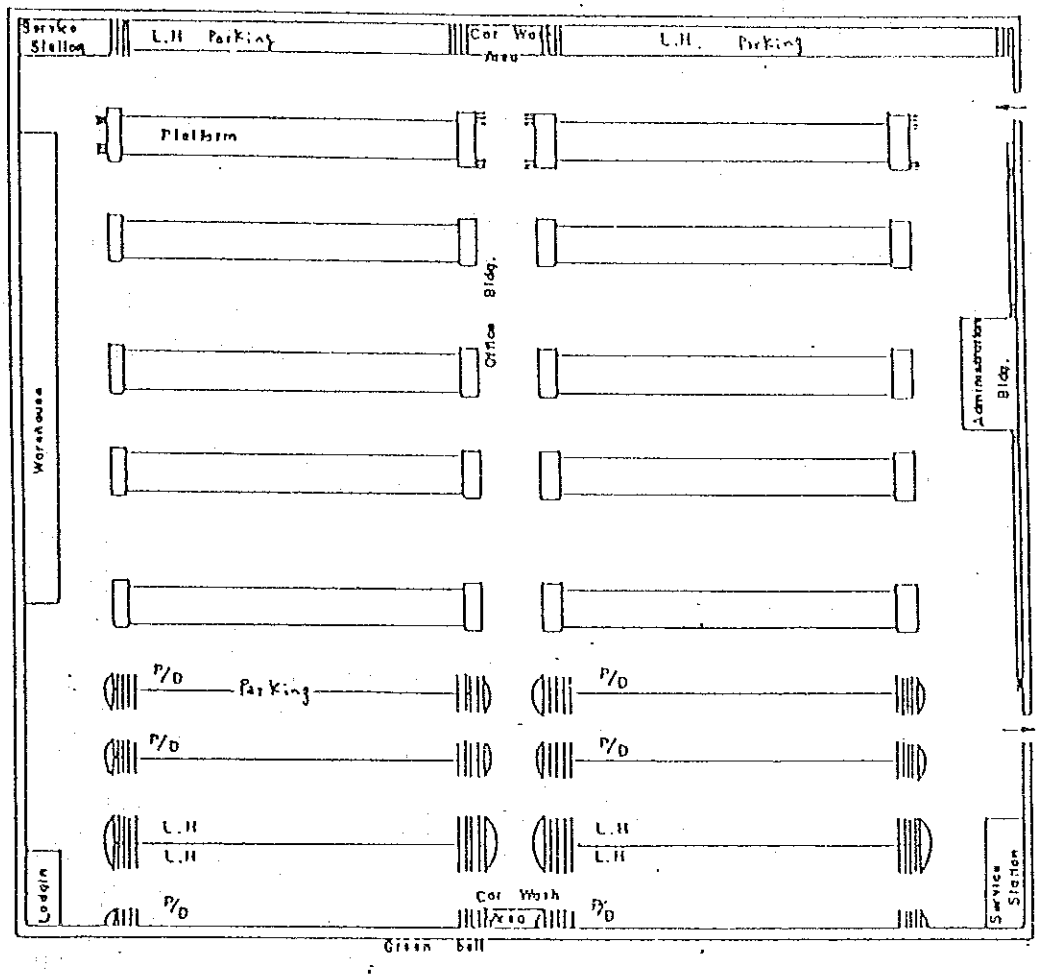
Two kinds of considerations above suggest that the whole in one system is preferable to the multi-segments with the same components.

It is judged in this study that;

Type 1 is the Best Plan.

It is noteworthy that implementation of Type 1 requires training of workers, and an installation of some device to prevent the cargoes from being stolen. This is attributable to the characteristics that many companies work on the same platform together and risk of goods stolen and handling mistakes may occur, especially if sufficient counter-measures are not taken appropriately.

Standard layout plan of the truck terminal is presented in Fig. 8.3.4.



NOTES : L.H ..... Like-haul Truck
P/D..... Pickup / Delivery Truck

Fig. 8.3.4 Standard Layout Plan

8.3.3 Facility Allocation Plans for Each Case

Three cases are set in reviewing the facility allocation plans.

Case 1 Land for 500 berth in one terminal will be acquainted. Construction stage will be segmented into two stages.

First stage ; 350 berth
Second stage ; 150 berth

Case 2-1 500 berth will be dispersed to two places. This case is the first ramifications of the two. Three hundred and fifty (350) berth of the 500 berth in total will be constructed.

Case 2-2; This supplement Case 2-1 and remaining 150 berth will be constructed in the different place from the first terminal with 350 berth later than the first terminal.

Facility layout plans will be prepared for these three cases and shown in Figs. 8.3.5 through 8.3.7.

Staged construction is explained in the following two paragraphs based on Case 1.

The total number of berths was divided into two groups and was supposed to be separately constructed in Stages 1 and 2. A ratio is decided according to the cargo volumes in 1995 against those in 2000.

In Stage 1, platforms and corresponding to the number of berths will be constructed, and in Stage 2, the remaining portion will be completed. Two construction stages are illustrated in Fig. 8.3.8.

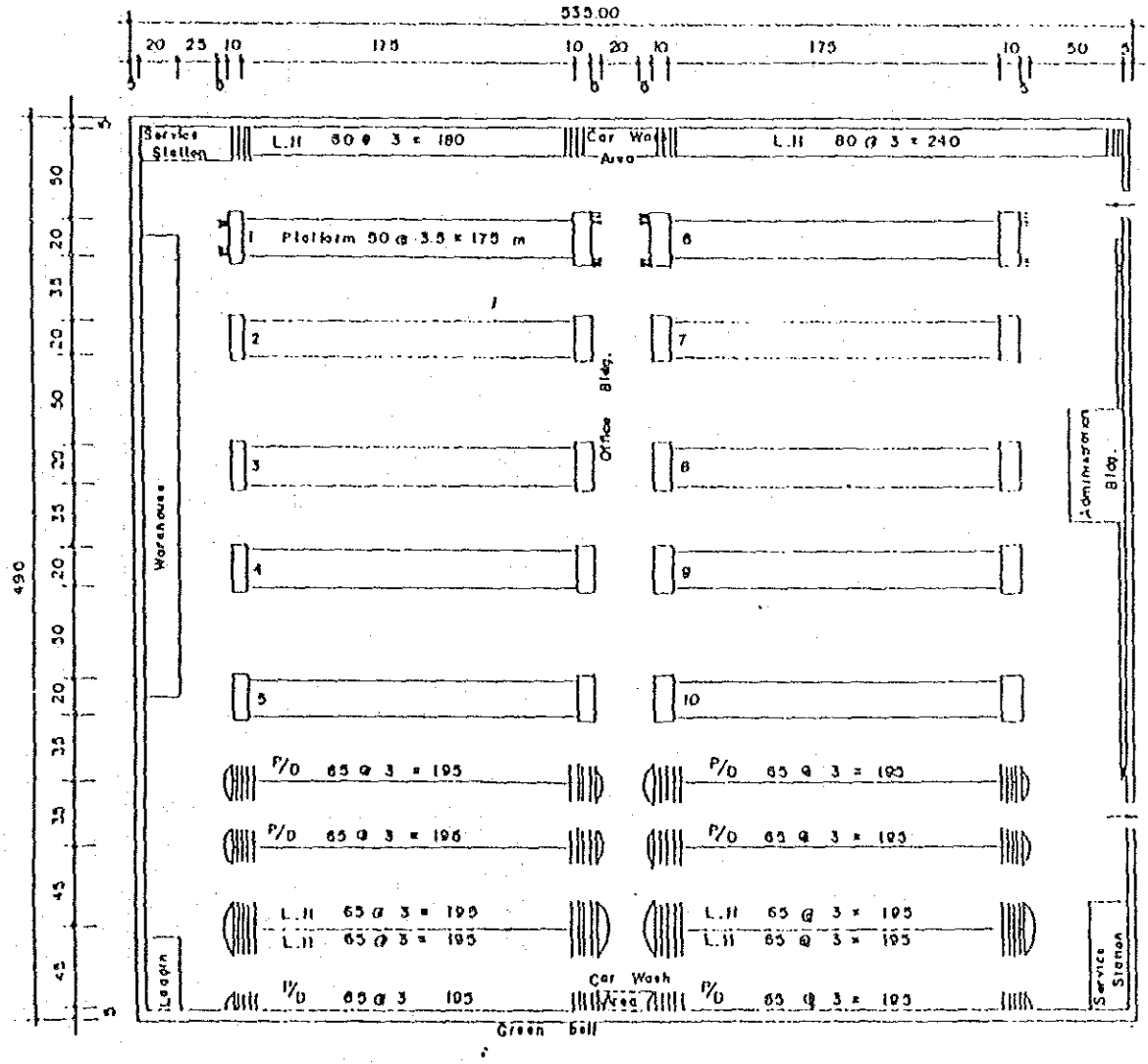
Lay Out Of Truck Terminal (1/4000)
(Alternative - 1)

Number Of Berth 600

Total Area = 538 x 490 = 262,150 m^2 (164 Rai)

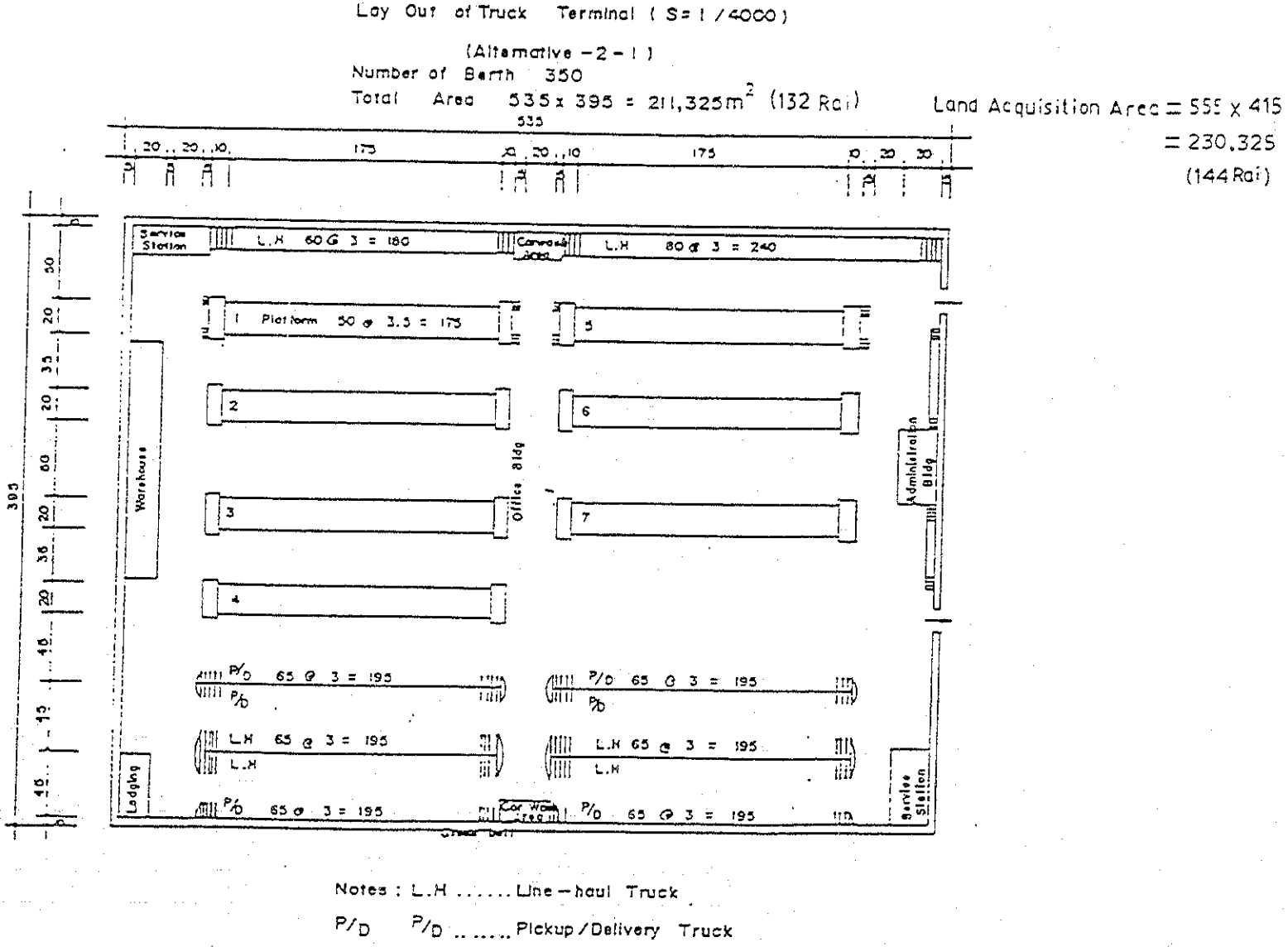
Land Acquisition Area = 555 × 510

= 283,050 m^2 (177 Rai)



NOTES : L.H..... Line - haul Truck
P/D..... Pickup / Delivery Truck

Figure 8.3.5 Facility Layout Plan (Case 1)



Notes : L.H ..... Line-haul Truck

P/D P/D ..... Pickup / Delivery Truck

Figure 8.3.6 Facility Layout Plan (Case 2-1)

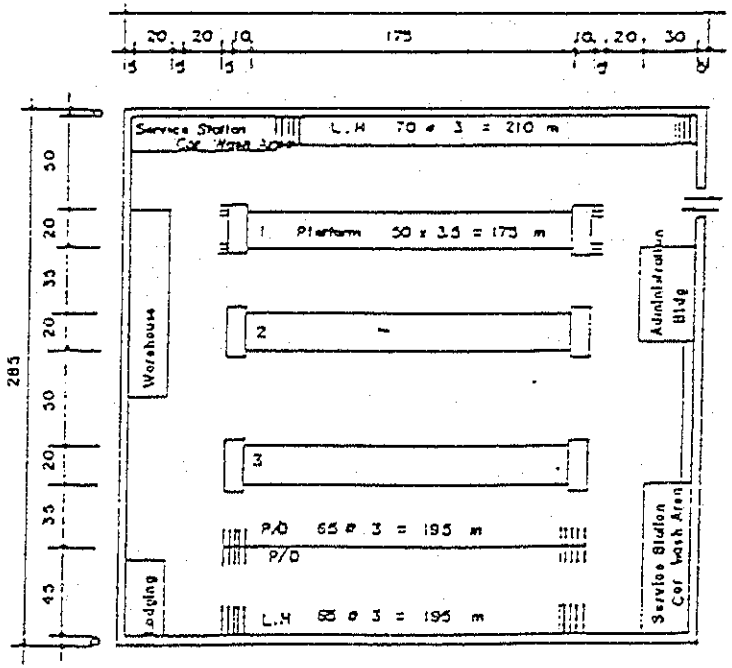
Lay Out of Truck Terminal (S = 1/4,000)

(Alternative - 2 - 2)

Number of Berth 150

Total Area 310 x 285 = 88,350 m^2 (55 Rai)

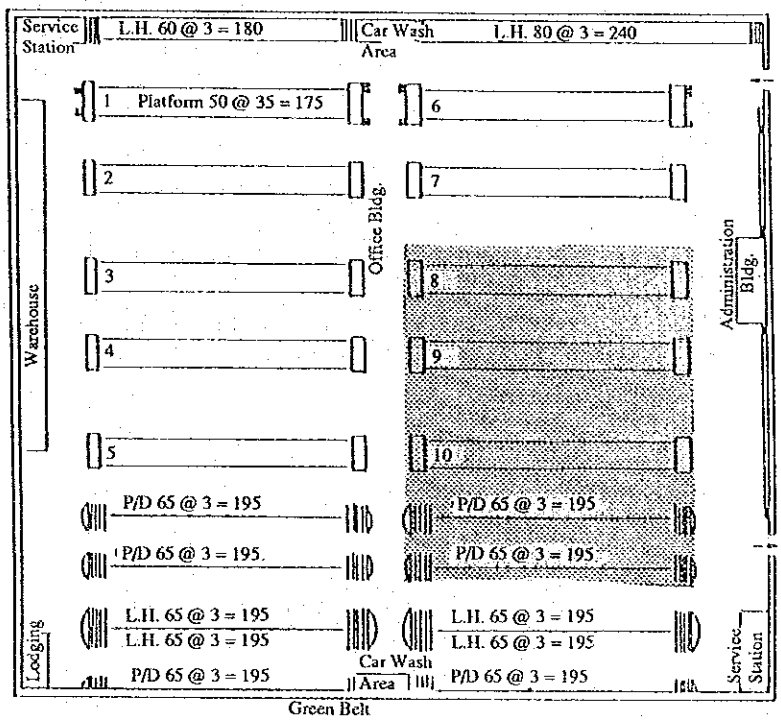
Land Acquisition Area = 330 x 305 = 100,650m^2 (63 Rai)



Notes : LH..... Linehaul Truck

P/D ..... Pickup / Delivery Truck

Figure 8.3.7 Facility Layout Plan (Case 2-2)



NOTES : L.H. Line Haul Truck
P/D. Pick-up / Delivery Truck

..... Stage 1

..... Stage 2

Figure 8.3.8 Two Construction Stages

8.3.4 Estimated Spaces for Each Case

Necessary space in total in summarized in Table 8.3.3 with a break-down into each facility.

Table 8.3.3 Estimated Spaces for Each Facilities

(unit; sq. meter)

Case	Case 1	Case 2-1	Case 2-2
Platform	35,000	24,500	10,500
Apron	43,750	30,625	13,125
Parking	41,550	32,430	11,325
Linehaul Truck	(18,000)	(18,000)	(6,075)
Pick-up/Delivery Truck	(19,500)	(11,700)	(3,900)
Staff Use	(4,050)	(2,730)	(1,350)
Administration Bldg.	1,500	1,000	600
Office Bldg	6,000	4,200	1,800
Warehouse	5,000	3,000	2,000
Lodging	1,120	800	640
Service Station	4,000	2,800	2,000
Repair Shop	(1,600)	(800)	(800)
Petrol Station	(1,600)	(1,200)	(800)
Car Wash Station	(800)	(800)	(400)
Green Belt	10,150	9,200	5,850
Road & Others	114,080	102,770	40,510
Total	262,150 (164 Rai)	211,325 (132 Rai)	88,350 (55 Rai)
Land Acquisition Area	283,050 m^2 (177 Rai)	230,325 m^2 (144 Rai)	100,650 m^2 (63 Rai)

(Note)
- Figures related to the building indicate the floor area.
- Road area does not include that of access roads.
- Construction requires the right of way with width of 10 meters around the terminal site.

8.4 Preliminary Design of Facilities

8.4.1 General

Preliminary design is an art work supported by the data analysis on soil, underground water, subsidence and so on. The Study team could obtain all the necessary data with a help of Industrial Estate Authority of Thailand. Of the various industrial estates, the data of Bang-Pain Industrial Estate were adopted in the design works of the Ideal North Public Truck Terminal.

Major features of the Bang-Pain Industrial Estate are listed below;

A. The ground is loose and thus all the structures are supported with the piles (p = 21 meter PC pile).

B. Level of ground subsidence was twenty (20) to twenty-five (25) centimeters for the first year after the construction, and five (5) centimeters per year from then on. This suggests that the overlay be necessary by every three or five years.

C. Maximum height of the land filling is approximately 1.5 meters. This sets the framework that the maximum height of land filling should be less than 1.5 meters from the present land level. (No problem will be expected if the ground level is kept at the same level as that of the surrounding roads' surfaces. However, flood prevention measures and storm water drainage should be taken considerations at the actual construction stage.)

D. Water should be provided by the water supply system since the law prohibits any company to draw the underground water.

8.4.2 Design of Major Facilities

A. Earth work and pavement

The finished ground level is set to be 1.5 meter from the present ground.

Pavement structure is set same as high as that in the Bang-Pain Industrial Estate, and shown in Fig. 8.4.1.

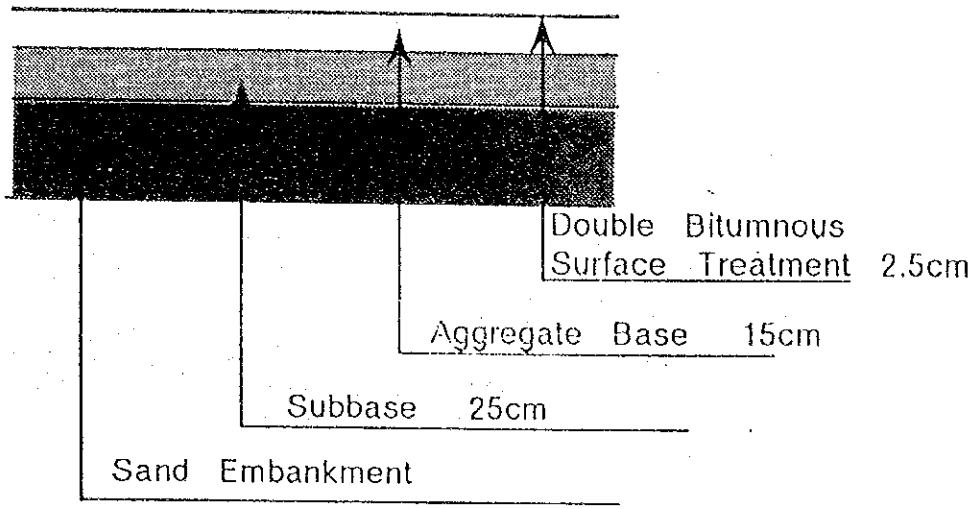


Fig. 8.4.1 Earth Work and Pavement

B. Platform

Platform is a structure to sustain roof and wind loads with truss, which are supported by two RC columns (ø900). These RC columns are supported by the RC piles underground through footing.

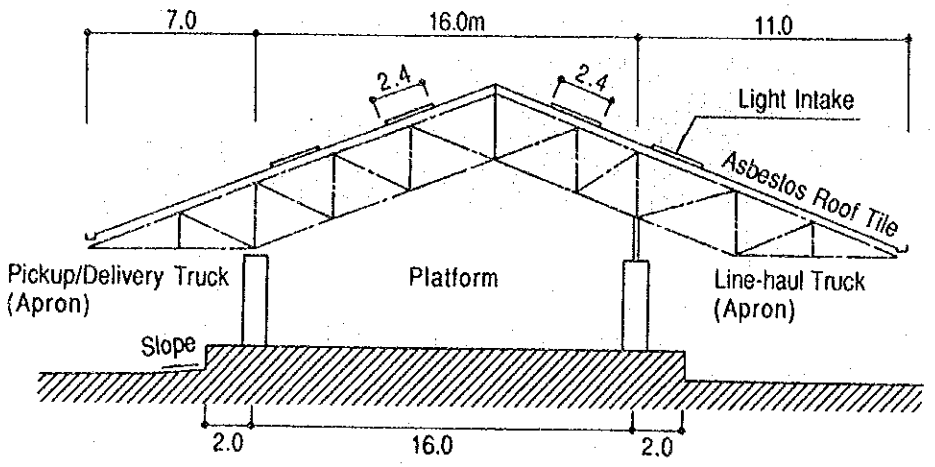
Sizes of these members are determined as follows;

Spacing of main trusses is set 3.5 meter, with main members being ø60.5 x 3.2. RC columns are ø900 with a spacing of 10.5 meter lengthwise. RC piles are 22 centimeter square and 20 meter long.

Detail of roof truss and platform are illustrated in Figs. 8.4.2 and 8.4.3.

Device to temporarily store rain water and utilize it to wash the vehicles, is designed as follows;

Section



Side View

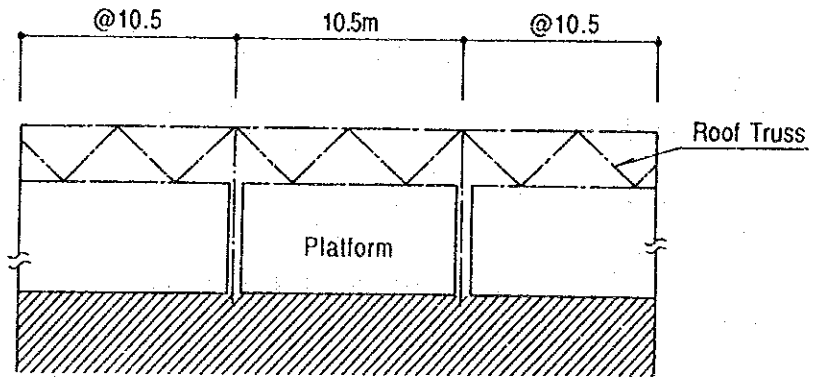


Fig. 8.4.2 Cross Section and Side View of Platform

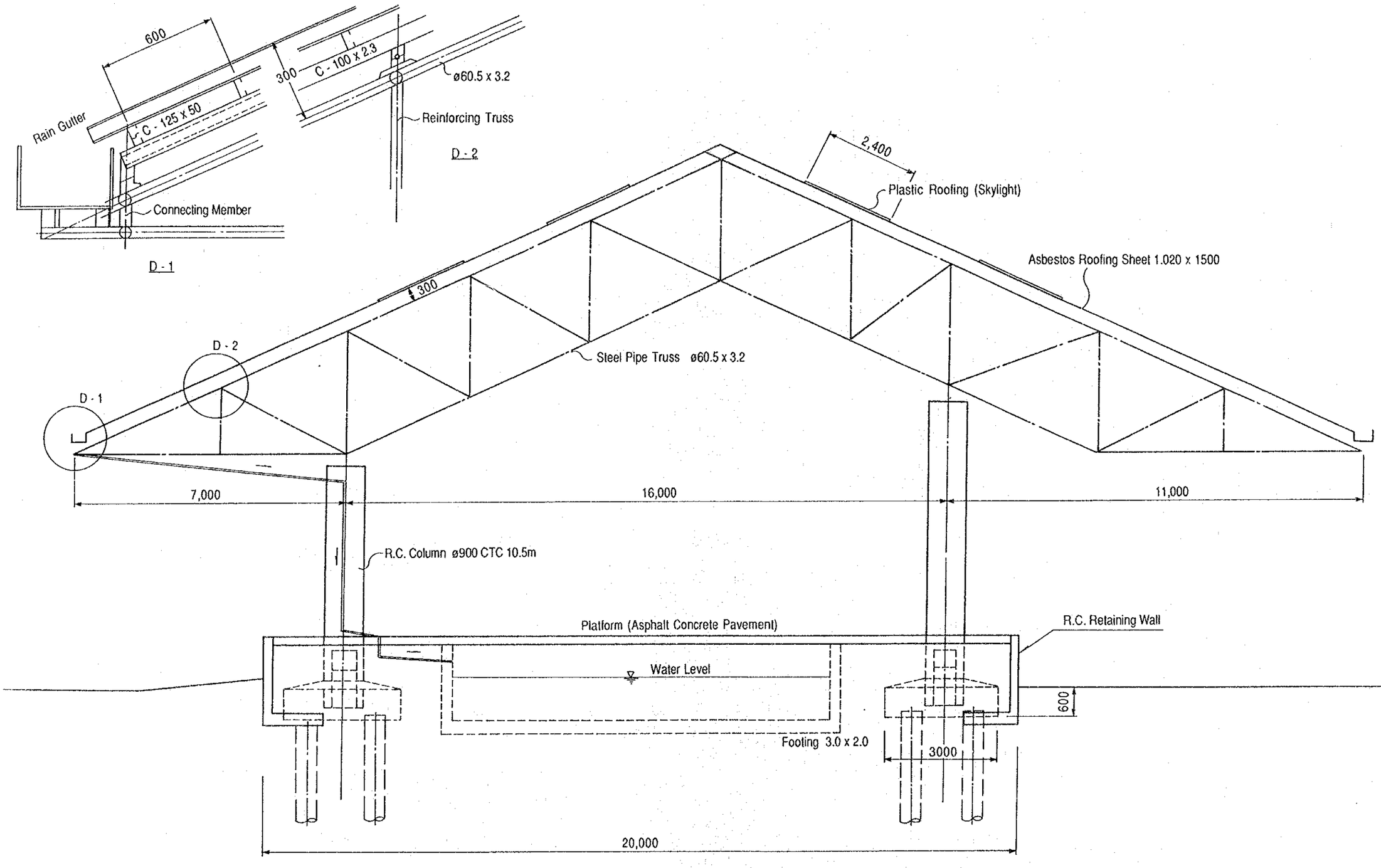


Fig. 8.4.3 Details of Roof Terrace and Platform

Water demand for car washing:

First, unit demand of water for car washing is set as shown below:

Line-haul truck	;	640	vehicles
Pick-up/delivery truck	;	1,300	vehicles
Total	;	1,940	vehicles

Secondly, the number of vehicles in need of car washing is derived from the following functions:

Number of trucks requiring car washing;
= 1,940 x 0.05 *
= 97 (vehicles)

(Note) Star sign (*) indicates that the figures are extracted from the Regional Truck Terminal (JICA, 1988).

Thirdly, the number of trucks requiring car washing is multiplied by the unit demand for the water and arrived at the total water demand for car washing, which is 100 cubic meter. Function is shown below;

Total water demand for car washing
= 97 (vehicles) x 1,000* (litter/vehicle)
= 100 (m^3/day)

(Note) Star sign (*) indicates that the figures are extracted from the Regional Truck Terminal (JICA, 1987).

Water demand for toilet facilities:

Number of workers at the truck terminal is set to be 4,320 persons.

Necessary water
= 4,320 (person) x 50* (litters)
= 215 (m^3/day)

(Note) Star sign (*) indicates that the figures are extracted from the Regional Truck Terminal (JICA, 1988).

Therefore, water volume to be stored is obtained by aggregating water demand of car washing and toilet water.

Total water demand
= 100 (m^3/day) + 215 (m^3/day)
= 315 (m^3/day)

Water storage facility is installed beneath the platform and the water is send to each facility with a pressure of the buster. However, this measure is effective only for a limited period of rainy season, i.e., from May to October when there is heavy rainfall.

The net and shutter should be installed at the platform to prevent the burglary since many companies and labors work on the same platform (see Fig. 8.4.4). In case that the platform is divided into many companies, the boundary should be clearly set to avoid unnecessary confusion.

C. Buildings

Major buildings for which the preliminary design works are conducted, are listed below;

1. Administration building
2. Lodging
3. Office building
4. Warehouse

Any building has a RC structure and supported with the pile foundations (RC Pile) since the ground is loose.

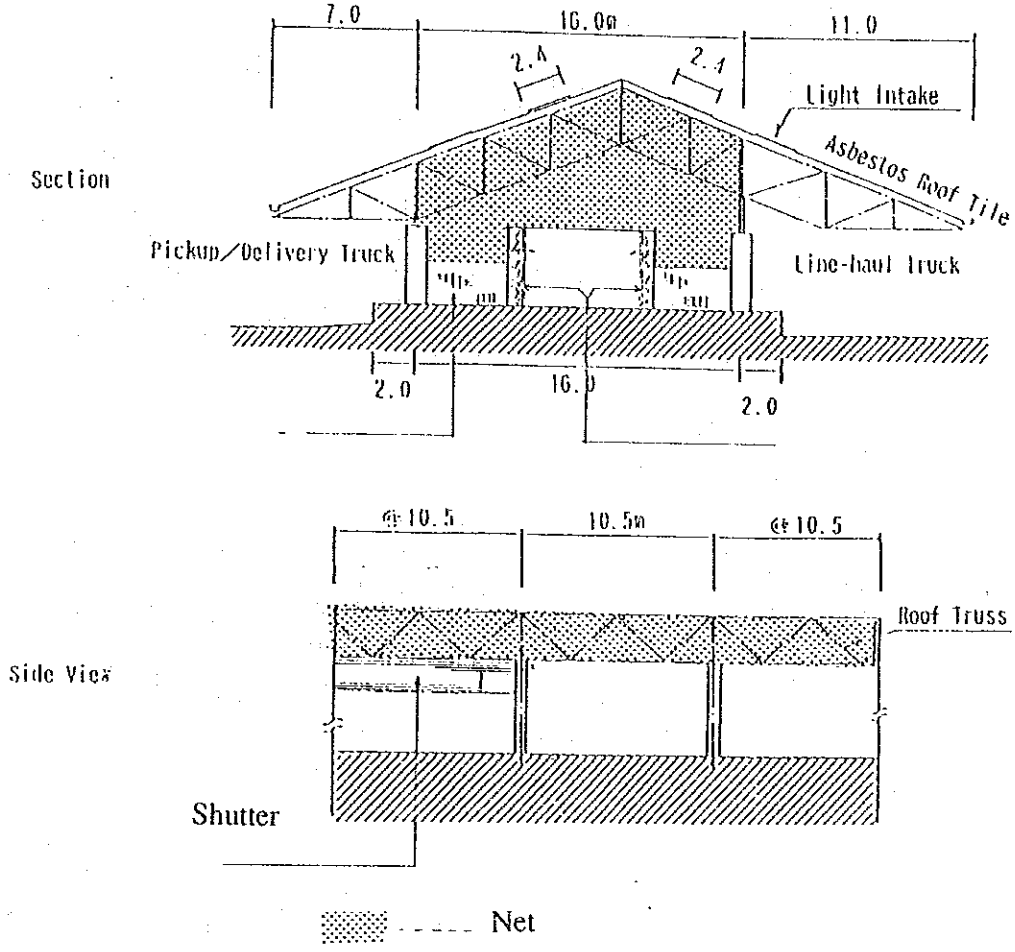


Fig. 8.4.4 Layout of Net and Shutter

Sizes of the buildings are decided according to the staffing requirement. Those are set as follows;

Staffing schedule of the terminal

Pre-conditions of preliminary design

Office workers	:	20 persons
Capacity of cargo handling	:	15 ton/person/day

Crew ratio:

Line-haul truck	:	about 1.8 (persons/vehicle)
Pick-up/delivery truck	:	2.0 (persons/vehicle)

Table 8.4.1 Number of Necessary Staff

Case	Number of Necessary Staff				Total
	Daily Cargo Volume (tons) *1	Office Worker	Plat-form Worker (per-sons)	Driver & Ass (per-sons) *2	
Case 1	2,806 6,724 9,530	20	450	1,150 2,700 3,850	4,320
Case 2-1	2,000 4,790 6,790	15	320	820 1,920 2,740	3,075
Case 2-2	806 1,930 2,736	10	130	330 770 1,110	1,250

(Note) *1 (Inbound)
(Outbound)
(Total)

*2 (Line-haul)
(Pick-up/delivery Truck)
(Total)