v) New demand for Bangkok bound consolidated cargo transport may rise out of the agricultural diversification into high value produces in the provinces, and the overall development of regional manufacturing industries.

vi) In the long run, a coordinated system of nationwide consolidation transport network will be formed at two levels: Bangkok and regional core cities, and areas of their influences. For the nationwide network, a large scale fixed route operation will be instituted, while smaller scale fixed route operation will be sought at desirable future regional feeder network.

The two levels of nationwide network will be needed following the sophistication of production and distribution in Thailand.

## 5.3 Existing and Future Conditions of Trucking Industry

### 5.3.1 Present Situation of the Trucking Industry

1) Types of Trucking Companies

There are several types of trucking companies providing truck transport services in Thailand. However, they can be conveniently grouped into three basic categories:

- line-haul services based in Bangkok
- semi-line haul and delivery services in the provinces
- industrial carriers

a) Line-haul Services Based in Bangkok

Trucking companies are mainly engaged in general cargo line-haul transport by heavy trucks. Main items of the general cargo produced by manufacturers in Bangkok or nearby areas are consumer goods, vehicle parts, electrical appliances, beverages and construction materials. A few trucking companies maintain their branches in the provinces and none of them offer or are engaged in nationwide transportation services. Their service networks are limited to specific areas or regions, e.g. North, Northeast, South or Central, as their return-haul trucks usually carry agricultural commodities from provinces to Bangkok or to destinations around Bangkok Area.

b) Semi-line Haul and Delivery Services in the Provinces

Trucking companies engaged in provincial distribution of cargo or countryside cargo transport carry mainly agricultural products such as maize, rice, sugar cane, cassava, jute and kenaf, and semi-processed agricultural products such as tapioca and sugar, destined primarily for Bangkok for domestic consumption and export. Some of these upcountry trucking companies maintain their agents or associates in Bangkok and carry break-bulk cargo from Bangkok to the provinces as their return-haul cargo.

However, it is rather difficult for trucks from provinces to find cargo in Bangkok for their return-haul, because there is a large disparity between cargo into Bangkok and out of Bangkok. As a result, the number of empty trucks leaving Bangkok is much greater than those arriving.

c) Industrial Carriers

While line-haul trucking companies are engaged in carrying mixed cargo for a number of shippers, industrial carriers operate under an exclusive contract with large-scale producers/shippers, such as cement factories and sugar mills.

2) Forwarding Function

Trucking companies operate not only with their own trucks, but also with chartered trucks. Many trucking companies maintain a truck fleet with a fewer number of their own trucks than chartered ones. In practice, almost all trucking companies play the role of forwarding agent.

For example, after unloading agricultural commodities in Bangkok or at a destination nearby, truck drivers from the provinces go to trucking companies in Bangkok in order to find return-haul cargo. The truck driver is introduced to or given break-bulk cargo to be transported back to the provinces, when such cargo are available.

The same pattern can be found in the provinces for truck drivers who carry break-bulk cargo from Bangkok for delivery to the provinces.

Forwarding is therefore an important business for trucking companies as well.

Chartered trucks which make up a substantial part of the trucking company's fleet either belong to other trucking companies or private owners. In actual practice, numerous private trucks do provide the common carrier function for trucking companies by carrying cargo on the latter's behalf.

As shown in Fig. 5.3.1 the number of private trucks increased rapidly in marked contrast with the non-fixed route trucks.

Although it is very difficult to obtain the actual number of private trucks entrusted with carrying other companies' cargoes, the increasing number of private truck registrations can indicate somewhat the increasing use of private trucks by regular trucking companies.

3) Size of Trucking Companies

The size of trucking companies in Thailand is generally small. Table 5.3.1 explains the size of trucking companies in Thailand.

Fig. 5.3.1 Number of Trucks

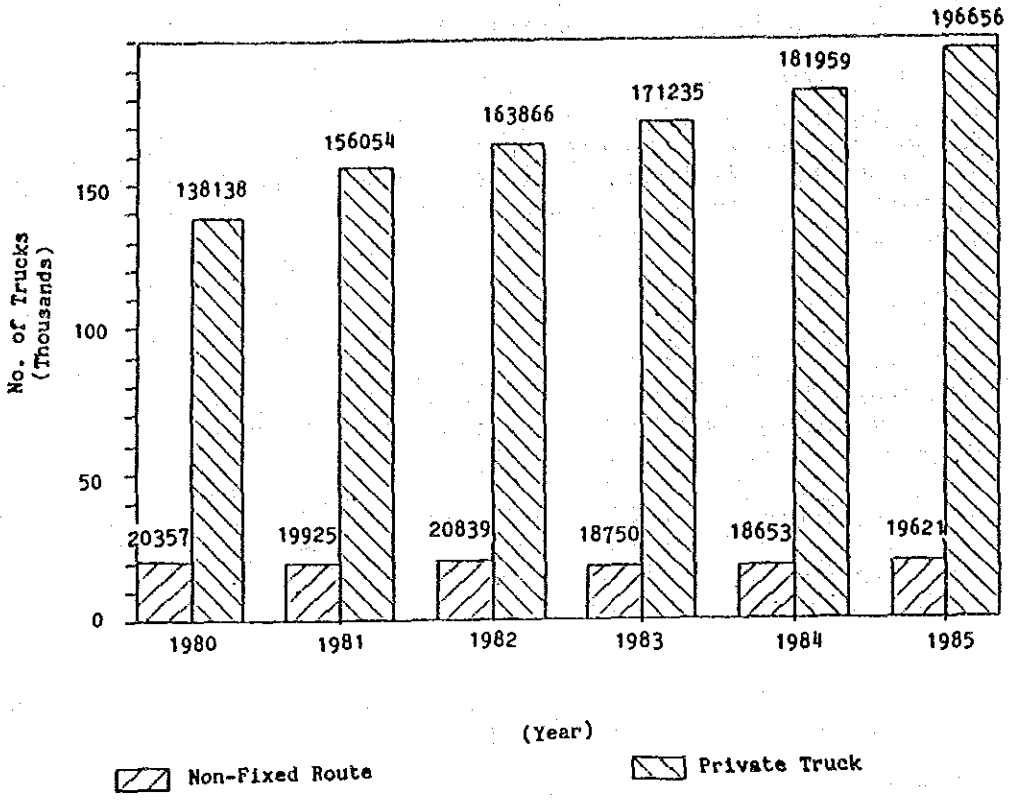



Table 5.3.1 Size of Non-Fixed Route Operator

| Number of Operators | Trucks | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1-5 | 6-10 | 11-20 | 21-30 | 31-50 | 51-100 | 101-200 | 201-500 | 500 | Total |
| Thailand | 77 | 42 | 80 | 44 | 43 | 47 | 26 | 15 | 1 | 375 |
| % | 20.5 | 11.2 | 21.3 | 11.3 | 11.5 | 12.5 | 6.9 | 4.0 | 0.3 | 100.0 |
| Bangkok | 68 | 32 | 24 | 11 | 9 | 10 | 3 | 3 | 0 | 160 |
| % | 42.5 | 20.0 | 15.0 | 6.9 | 5.6 | 6.3 | 1.9 | 1.9 | 0 | 100.0 |

Note: Thailand figures are for 1982, and Bangkok figures are for 1979
Source: LTD

Many truck operators with private licenses manage trucking companies, as do the non-fixed route licensed operators. Non-fixed route licence is very difficult to apply for, because a certain set of conditions is required to be met for a license to operate trucking business. In addition, the license fee is more expensive than for private ones. Therefore, in practice, many trucking companies avoid non-fixed route operation and operate trucking

business, though illegally, with private licenses. It is very difficult to obtain the actual number of the operators of this type, but one can assume that the business size of most trucking operators under this license may be small. Table 5.3.2 shows this characteristics to some extent.

**Table 5.3.2 Size of Private Operator**

| Number of Operators | Trucks | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1-5 | 6-10 | 11-20 | 21-30 | 31-50 | 51-100 | 101-200 | 201-500 | 500 | Total |
| Thailand | 46,258 | 2,074 | 414 | 90 | 66 | 29 | 15 | 4 | 1 | 48,951 |
| % | 94.5 | 4.2 | 0.9 | 0.2 | 0.1 | 0.1 | 0.0 | 0.0 | 0.0 | 100.0 |
| Bangkok | 4,172 | 250 | 93 | 30 | 18 | 12 | 1 | 1 | 1 | 4,578 |
| % | 91.1 | 5.5 | 2.0 | 0.7 | 0.4 | 0.3 | 0.0 | 0.0 | 0.0 | 100.0 |

Note: Thailand figures are for 1982, and Bangkok figures are for 1979
Source: LTD

a) Some Characteristics of the Trucking Industry in Thailand

The trucking industry is generally made up of a large number of small scale operators. It is easy for newcomers to begin their trucking business since a small amount of investment is needed.

In developed countries, there is a dual structure in the industry where some large-scale trucking companies grow out from small businesses and provide nationwide services, while small-scale trucking companies serve the needs of local communities within a relatively shorter radius. As a result, coexistence of a few large-scale trucking companies and numerous small ones is maintained.

However, in the case of Thailand, there are hardly any large-scale trucking companies except the Express Transportation Organization (ETO), which is a state-owned enterprise. Almost all trucking companies in this country are relatively small.

b) Express Transportation Organization (ETO)

ETO is the only trucking company engaged in nationwide transportation services. It is the biggest trucking company in Thailand and is owned by the government. It is given the monopoly of transporting imported cargo and the Central Government goods.

c) Family Managed Trucking Firms

Small trucking companies, as those in other areas of business enterprises, are usually under family management. Almost all trucking companies are owned by the respective families and managed by members of the family.

Hence, they have only a few branches in other places, which are operated by their family members or relatives.

d) Scope of Operation

As the size of the business dictates the scope of operation, these small-scale trucking companies are confined to a limited area of operation.

For example, an average trucking company in Bangkok maintains only a few branches in the provinces and limits their transportation network to specific areas, e.g. North, Northeast, South, Central or any subdivision of such areas.

In a similar manner, some trucking companies in the provinces also maintain their branch offices in Bangkok, but have very few offices in other provincial cities as they generally concentrate their business network with the Bangkok trucking connections.

4) Truck Operation

There are several specific features of trucking operations in Thailand:

- Use of old trucks
- Overloading
- Loading and unloading problems
- Truck traffic restriction in urban areas.

a) Use of Old Trucks

The age of trucks is shown in Table 5.3.3. As shown in the statistics, the average age is 10.1 years for 6-wheel trucks and 9.5 years for 10-wheel trucks. In developed countries the effective life of trucks is normally 7 years, and so the average age of trucks in Thailand surpasses the effective service life.

**Table 5.3.3 Average Age of Trucks Out of Bangkok**

| Type of Truck | Number of Trucks | Total Age | Average Age |
|---|---|---|---|
| 6 wheel | 29,669 | 300,591 | 10.1 |
| 10 wheel | 25,135 | 238,400 | 9.5 |

Source: LTD

The trucking companies are forced to make use of old trucks beyond their normal service life on account of low profit insufficient to make new investment for replacement of the old trucks. Such small profits are due to the small-scale operation network and severe competition among trucking operators.

The use of old trucks, of course, raises several problems such as low speed, frequent breakdowns, fuel waste and increasing maintenance cost.

b) Overloading

Another feature of trucking operation is overloading. 10-wheel trucks carrying bulk cargoes such as rice, maize, tapioca, jute, and sugar cane are generally overloaded. In the case of carrying weight or low-value cargoes, the practice of overloading is almost always employed. However, in the case of break-bulk cargoes, trucks usually carry loads within their legal weight limit.

c) Loading and Unloading Problems

There are some peculiar features in loading and unloading of cargoes. The space for loading and unloading cargoes in most cases is very small. Sometimes, loading and unloading are done on the street-side in front of the trucking company. By and large, manual labor is employed in the loading and unloading operations. Depending upon the availability of cheap labor, mechanization of cargo loading and unloading hardly makes its way into the trucking business.

d) Truck Traffic Restrictions in the Urban Areas

Bangkok and some core cities in the provinces have imposed restricted truck operating hours to heavy trucks in order to alleviate traffic congestion during rush hours. Restricted truck operating hours in the cities are shown in Table 5.3.4.

**Table 5.3.4 Restricted Truck Operating Hours**

| Bangkok | Chiang Mai | Khon Kaen | Hat Yai |
|---|---|---|---|
| - 6 wheel trucks<br>7.00 - 9.00 a.m.<br>4.00 - 8.00 p.m.<br><br>-10 whhel trucks<br>6.00 - 10.00 a.m.<br>3.00 - 9.00 p.m. | Heavy Trucks<br>6.00 - 9.00 a.m.<br>3.00 - 6.00 p.m. | Heavy Trucks<br>7.00-8.30 a.m.<br>3.00 - 5.00 p.m. | Heavy Trucks<br>6.00 - 8.00 a.m.<br>4.00 - 6.00 p.m. |

During the restricted hours, heavy trucks are prohibited from operating in the cities. As a matter of course, truck operation is greatly affected by this regulation. Trucking companies are required to set their operation schedules of line-haul to avoid the restricted hours. It severely constrains the flexibility of truck operation.

### 5.3.2 Problems in Trucking Industry

In the study of trucking industry in Thailand, the Study Team was repeatedly informed of the following problems facing the trucking industry:

- excessive competition in the trucking industry;
- small scale of trucking companies' operation network;
- confined or restricted to single line-haul operation rather than of nationwide scope.

1) Excessive Competition

Severe competition exists among the country's numerous trucking operators.

Private trucks in particular are mainly responsible for intensifying competition among trucking operators. As mentioned above, there are two distinctive categories of trucks registered and licensed by the Department of Land Transport (LTD); they are private trucks for private transport and trucks for hire for commercial trucking purposes. But, in reality, a large number of private trucks have made an entry into the truck transport market in competition with the legally registered trucks for hire as commercial carriers.

Such practices are particularly prevalent in rural areas, where middlemen and some farmers own private trucks but use them as trucks for hire. The increasing number of private trucks can be justified by the increasing demand for transport of agricultural products during the harvest season. However, their operations are not limited or confined to transport of agricultural commodities, but are used to carry other cargoes such as consumer goods and construction materials as their return-haul. Because Bangkok bound cargoes, mostly consists of heavy agricultural bulk cargoes, an oversupply of truck transport ability exists for Bangkok outbound cargoes.

To make use of their return trip, private trucks are often satisfied with a very low freight rate for carrying the return-haul rather than going back empty. In doing so, freight rates for the whole industry tend to decline. The practice of rate cutting and excessive competition makes trucking operation less profitable.

2) Small Scales of Trucking Companies

While small-scale trucking companies are so prevalent in Thailand, there are a few large-scale industrial carriers. Almost all line-haul trucking companies are small ones from a viewpoint of international level.

As earlier mentioned, the impact of excessive competition by private trucks in the overall trucking industry makes the business less profitable to the point that it discourages and sometimes completely curtails new investments for replacement of old and wornout trucks.

If the number of large scale trucking companies having the wide networks gradually increased, their expanded operation scales would merit the reduction of operating cost and do away with unnecessary wastages, thus would give favorable effects to the Thai economy as a whole.

In reality, however, most trucking companies still remain as small-scale operators.

3) Confined Line-haul Network

Under the small-scale of operation, trucking companies have to confine their line-haul network to specific areas. At present, each trucking company specializes in limited line-haul operations; a nationwide line-haul network under a single roof has not yet made its entry into the trucking industry in Thailand.

Major manufacturers and wholesalers in Bangkok who produce and market mainly consumer goods, would like, of course, to have the market of their commodities expanded and firmly established on a nationwide scale. Naturally, this type of shippers are constantly making an effort to improve their physical distribution and to save transport costs. As their business expands, the need for increasing physical distribution coverage and greater volume of cargoes to be distributed throughout the country will make possible the development of the nationwide line-haul and distribution network under a single roof with greater efficiency.

The companies that provide transport services with a nationwide line-haul network under a single management will be in great demand among major shippers. The present small scale operation by numerous trucking companies cannot satisfy the needs of the country's growing industrialization.

### 5.3.3 Trucking Industry in the Future

Transport demand for cargoes in Thailand will definitely increase in the future as shown in Chapter 4.

In this situation, there is a possibility for structural changes in the trucking industry to take place.

1) Structural Changes in the Trucking Industry

a) In the first place, a few big-sized trucking companies in Bangkok with nationwide line-haul network may become a reality. Increasing transport demands for consumer goods from Bangkok to the provinces would enable some trucking companies to grow rapidly. Some well-managed trucking companies with superior services would be in a better position to expand their scale and line-haul networks, while the rest would remain as the small-scale operators, or may go out of business.

These large-scale trucking companies would be able to satisfy the transport needs of shippers in the future who want fast and reliable nationwide distribution of their products.

b) Secondly, in the same manner as their counterparts in Bangkok, some trucking companies in the provinces may expand their network to become middle or large-scale operators. The trucking companies in this category would be likely the ones that carry exclusively high-value agricultural commodities such as fruits and vegetables, and general cargoes produced in the provinces.

c) While some trucking companies, both in Bangkok and the provinces, are to grow to become middle and large-scale operators, small trucking companies by which the present trucking industry is characterized will continue to operate in the future by specializing in specific services or markets.

2) Necessity of Regional Truck Terminal

The analysis of the future transport needs suggests the growth of large-scale trucking companies with nationwide line-haul network. However, a large number of small trucking companies with specific line-haul network may continue to operate. This dual structure system may be one of the most important factors for the improvement of transport efficiency as a whole.

A number of measures of courses of action would help this developing process. One of them is to set up regional truck terminals to facilitate better use of trucks and provide efficient and economical cargo handling. A regional truck terminal will provide loading and unloading space large enough to make cargo handling much more efficient and economical in comparison with small-scale trucking companies with narrow, small handling space and low handling efficiency. A regional truck terminal could provide small trucking companies with efficient facilities without much individual burden and risk.

### 5.3.4 Shipper's Distribution System

1) Characteristics of the Distribution System

The Study Team conducted interviews of shippers in Bangkok in order to get information on the distribution pattern of general cargo to the provinces. Subjects of the interview were seven large scale shippers who produced or dealt with consumer goods and distributed them nationwide.

It is rather difficult to generalize the shipper's distribution pattern in Thailand with such a rather limited scope of interview survey conducted in this phase. However, the Study Team delineated some characteristics of distribution in this country through this interview survey.

a) A typical distribution pattern to the provinces is shown in Fig. 5.3.2. Commodities are carried by trucking operators directly from central warehouse to wholesalers and retailers in the provinces.

In this case, the Greater Bangkok Area is the most important market for their products and goods as approximately half of their goods are absorbed in Bangkok. Conversely, provincial markets are less important than the Greater Bangkok Area for shippers in Bangkok. Shipment volumes for the provinces are not large enough to justify the maintenance of their local depot facility even in the center of each region under the study.

b) However, one shipper was found to follow another distribution pattern as shown in Fig. 5.3.3. The shipper maintains local depots in the center of each region. Trucking operators, under contract, carry goods from the central warehouse to local depots. Goods are stored there temporarily before being delivered to retailers in response to their order.

Fig. 5.3.2 Distribution Pattern (1)

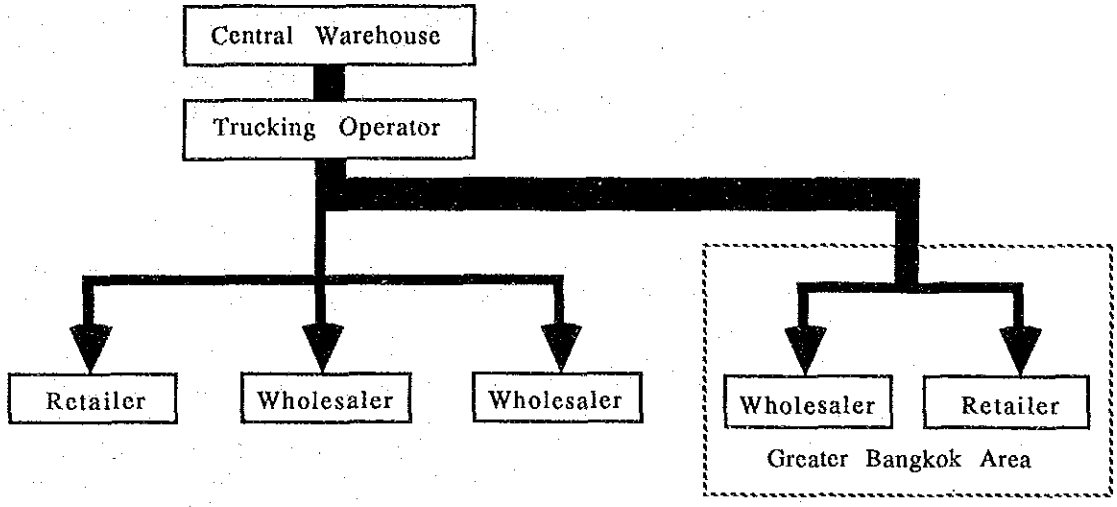
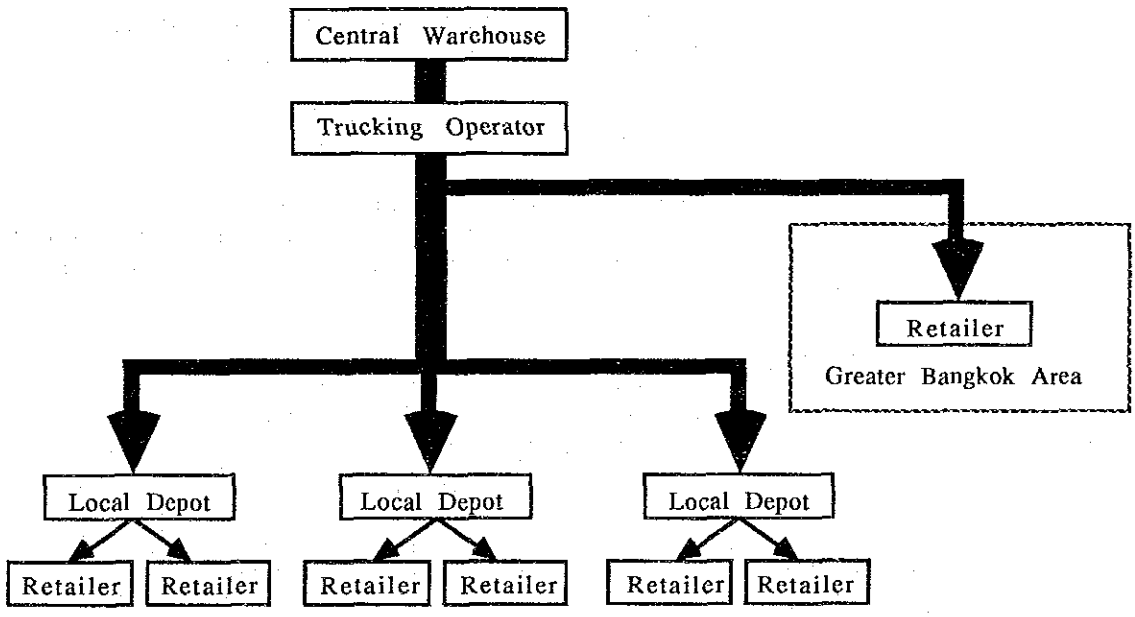



Fig. 5.3.3 Distribution Pattern (2)




In this case, the share of provinces is relatively high and much greater volume is destined for the provinces. It is therefore necessary for the shipper adapting this type of commodity flow to maintain local depots in the center of each region. The distribution pattern through maintaining local depots is thus suitable for distributing large volume of goods nationwide.

c) With regard to the shippers' relationship with trucking companies, it was found that the shippers tended to rely on the contracts with several trucking companies simply because there were no single commercial carriers providing nationwide network services.

Each trucking company concentrates their operation network in one region only, thus making nationwide distribution by Bangkok consignors dependent upon a number of trucking companies for line-haul services. Even in the same routing of cargo delivery shippers tend to divide their shipping contracts to several trucking operators so that truckers compete with one another for the benefit of the shippers, cost-wise and quality-wise.

2) Shipper's Distribution Pattern in the Future

As mentioned earlier, the demand for consumer goods are likely to increase rapidly in the future as personal income is on a steady rise following the economic development.

In this situation, there will certainly be a problem in distribution for shippers who will have to distribute their commodities nationwide in increasingly greater volume. Consequently, the shippers will have to maintain or expand their local depot facilities in the centers of the regions to accommodate the increasing shipment volume. The burden to be shouldered by shippers in setting up or expansion of local depot facilities will become excessive for individual companies to bear.

The proposed regional truck terminal would relieve the shippers of such a burden of setting up their local depots by providing fast and efficient transport services which negate the necessity for intermediate depots.

## 5.4 Related Laws and Truck Terminals

In this Section, the outline of major laws governing the trucking business are first mentioned; secondly, the legal systems of Thailand and Japan for truck terminals are compared; and finally, the problems for promotion of truck terminals are stated.

### 5.4.1 Present Major Laws Governing Trucking Business

Among the many laws related to the trucking business, the followings are the laws that directly control the trucking business.

1) Land Transport Act (1979)

By virtue of the Act, the Department of Land Transport of the Ministry of Communications is entrusted with the jurisdiction over the control of land transport businesses, vehicle inspection and vehicle tax administration, vehicle personnel and their activities, including issuance of driving license and other related administrative functions in land transport undertakings. Under the present law controlling gainful land transport activities, provisions for classification of land transport operation affecting commodity flow of animals and things are given in four categories. In all of the four categories provided by the law, a license is required for operation, and freight charges (except in the case of iv as given below) are fixed by the authority.

i) Fixed Route Transport: Transport for gainful reward on fixed routes;

ii) Non-fixed Route Transport: Transport for gainful reward on routes not-fixed (Competition with fixed route transport is not legally allowed);

iii) Small Vehicle Transport: Transport of passengers and things for gainful reward on routes by a vehicle of which loaded weight does not exceed 4,000 kgs;

iv) Private Transport: Transport for one's own trading or business, in which competition with commercial carriers for gainful reward is forbidden by the law.

Under the present system of gainful transport undertaking, there are two categories of business operations connected with actual land transport activities. In both categories, business operation is permitted under the licensing system, in which changes and renewals thereof are subject to approval by the authority.

v) Forwarding Agency: Undertaking of collecting animals and things as forwarding agent for another party licensed to transport them from one place to another.

vi) Transport Station of Animals and/or Things: The concept is not stipulated as such. However, by careful reading of the law, the following can be assumed: A public place open within the jurisdiction of the Department of Land Transport with vehicle stopping and parking facilities where the vehicles on fixed route stop and park for loading animals and/or things and unloading them. It is the public truck terminal which does not belong to an individual truck operator.

Among the land transport licensing provided by the law, those actually issued are in three categories: Non-fixed route, small vehicle, and private transport. So far, no license has been issued on fixed route transport. It seems, however, that the government is in the process of taking up the matter in initiating and fostering fixed route operation (as in the case passenger transport now in operation, under the Ministerial Regulation No. 4 issued on November 2, 1981, which governs both types of transport), as the issuance of the license is said to be in preparation.

As for the field of businesses connected with land transport, licenses are not issued for forwarding agencies, though in reality they do exist. This category seems to be in the process of preparation, too. Transport stations for trucks are stipulated, but do not exist in reality. This could not be understood in connection with the fact that fixed route transport is under preparation. Without well-developed fixed route transport system, transport stations cannot function.

Although there have been no issuance of licenses to fixed route transport and forwarding agencies, it is remarkable that many consolidate carriers and forwarders do exist, fulfilling the need for the required functions. Efforts should be made for licensing of the business of all the categories stipulated by the law in the future.

2) Motor Car Act (1979)

The Police Department of the Ministry of Interior is empowered by the Act with the jurisdiction over controlling and regulating all vehicles which are not governed by the Land Transport Act and related transaction (such as registration, signage and the use of vehicles, and driving licenses). The law covers motor cars for public use (taxis), business service motor cars (passenger transport between airport, seaport, transport stations (buses), railway station and hotels, private residences and offices), motor cars for hiring, private motor cars with capacity of 7 people or less and small trucks of 4,000 kgs and under, which are not under the jurisdiction of the Land Transport Act.

However, the enactment of an Act to transfer vehicle registration from the jurisdiction of the Police Department to that of the Department of Land Transport in July 1987 will become effective as of July 1988. From thence, the registration and tax collection of all vehicles will come under the jurisdiction of the LTD.

3) Land Traffic Act (1979)

The Law governing traffic systems composed of motor vehicles, other vehicles, pedestrians and other means on the road is under the jurisdiction of the Police Department, the Ministry of Interior.

4) Announcement of the National Executive Council No. 295 (1972)

The Announcement was promulgated by the Executive Council established by the Revolutionary Administration in November, 1971, with the effect similar to an act of parliament. The announcement regulates highway construction and maintenance thereof under the jurisdiction of the Highway Department, the Ministry of Communications.

### 5.4.2 Comparison of Legal System for Truck Terminals between Thailand and Japan

The Land Transport Act that governs truck terminal consolidation today is outlined. Then legal systems are examined comparing Japanese legal system concerning public truck terminals.

1) Land Transport Act and Truck Terminals

Transport stations are referred inclusively in Chapter IX of the Land Transport Act as a station for passenger transport (the so-called Bus Terminal) as well as animals and/or things (the so-called Truck Terminal).

The Department of Land Transport has determined that truck terminal shall be set up in Bangkok Metropolis as well as in other provinces and shall be operated by state enterprise, governmental agencies, and LTD itself, or private operators under license.

The Director-General of LTD is empowered to supervise and control overall operation of truck terminals and is empowered to send officers and/or employees of LTD as station master and officers.

In setting up a truck terminal and in its operation, a license (maximum period of 20 years or less) is granted. The maximum charge for service should also be established. The person licensed is responsible for maintenance of safety and order as well as for management of terminal business. Within the terminal it will be obligatory to provide facilities such as garage for repair and maintenance where a mechanic is stationed all the time to examine the conditions of fixed route transport vehicles, parking space, provision of a bookkeeping record of vehicles coming in and going out.

The Ministerial Regulations (No. 18, 1982) related to the content of this Chapter are compiled for bus terminals as well as for truck terminals. However, the implementation of the latter is pending on grounds of incomplete enforcement of regulated traffic system conducive to activation of business potentials.

2) Legal System Relating Truck Terminals in Japan

Cases of Japanese legal system where public truck terminals are highly consolidated may serve as reference materials for promotion of regional truck terminals in the Kingdom of Thailand. The following are the laws related to truck terminals.

a) Laws Centering around Truck Terminals

The Thai law relating to truck terminal is found in Chapter IX "Transport Station" of Land Transport Act as mentioned previously.

The Japanese law directly corresponding to the above is the Motor Terminal Law as shown in Fig. 5.4.1. On the basis of the law, the Enforcement Regulations of the Motor Terminal Law and the Motor Terminal Structure and Facility Order are implemented. These regulations and order correspond to the Thailand Ministerial Regulation No. 18 issued in complement with the Land Transport Act. These Japanese law and regulations will be discussed later.

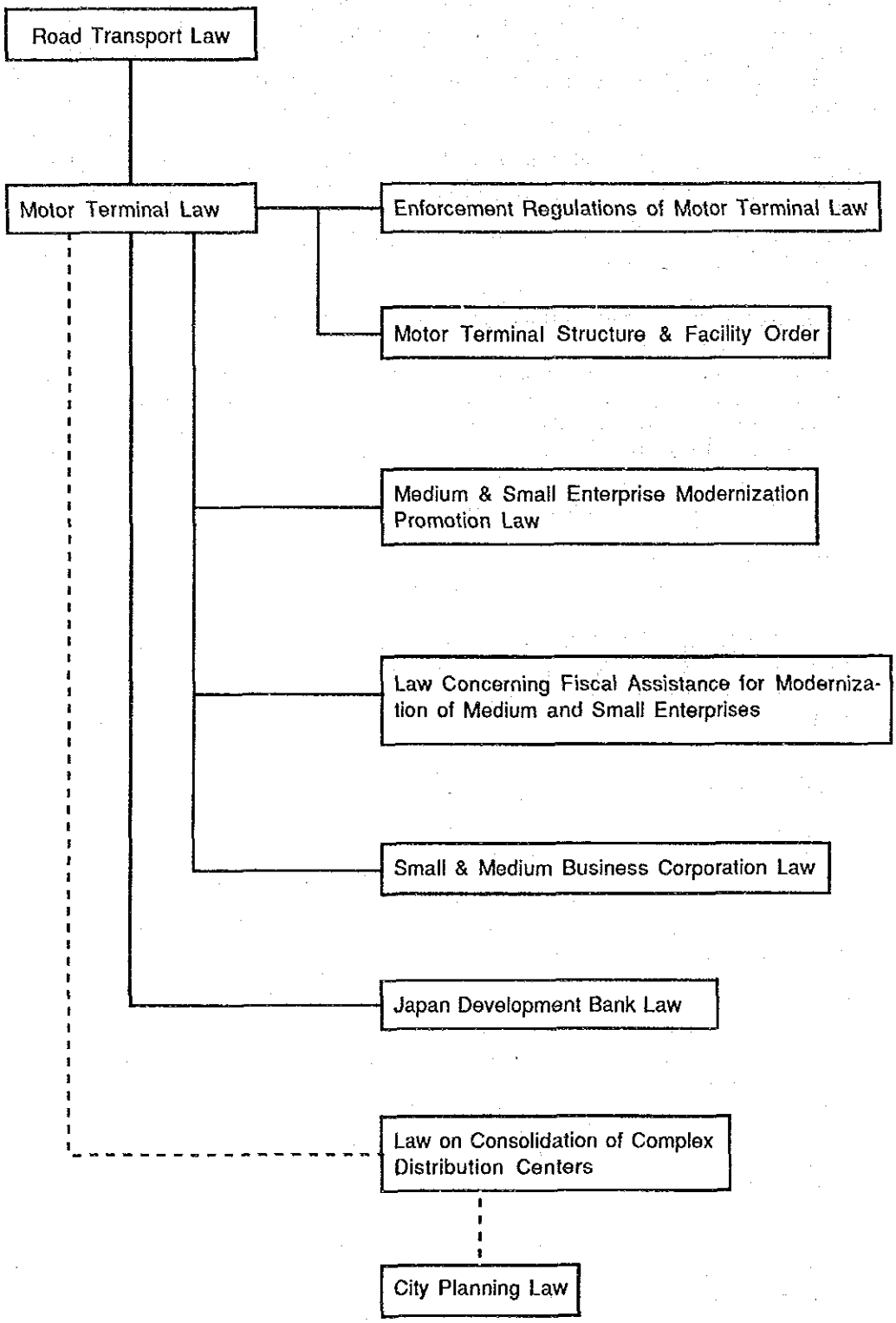
In addition, there are a few other laws enacted for the purpose of promoting truck operators to use public truck terminals. There are other related laws such as the Medium and Small Enterprise Modernization Promotion Law, the Law Concerning Fiscal Assistance for Modernization of Medium and Small Enterprises, and the Small and Medium Business Corporation Law.

Most of the prospective users of truck terminals are truck operators of small and medium enterprises. These laws, therefore, provide promotional measures for small and medium enterprises such as tax leniency, fund and subsidy provisions.

Truck Terminals, on the other hand, can borrow a long-term, low interest loan from the Japan Development Bank under the provisions of the Japan Development Bank Law.

Moreover, when a public truck terminal is to be set up on a plot of land in such a way that other distribution facilities, wholesale distribution facilities, warehouses, wholesale markets for fresh fruits, vegetables, and fish are organically combined, the Law for the Consolidation of Complex

**Fig. 5.4.1 System of Laws Related to Truck Terminals in Japan**



Distribution Centers can be applied to and land expropriation based on the City Planning Law becomes possible.

In this Section, detailed explanation will not be taken up in order to simplify the discussion.

b) Outlines of the Motor Terminal Law and Related Laws and Orders

The outlines of the Motor Terminal Law, the Enforcement Regulations of the Motor Terminal Law and the Motor Terminal Structure and Facility Order are given, followed by an account on the law that was the starting point of a private enterprise of Japan Motor Terminal Co.

i) The Motor Terminal Law

Purpose: The sound development of motor transport by securing just management of motor terminal business, and exact control of private truck terminals, and by promotion for consolidation of motor terminals.

Definition: Facilities (except roadside and so forth) with parking capacity of two vehicles engaging in motor transport business at a time for boarding and unboarding of passengers and loading and unloading of cargo.

Under this law, there are two types of motor terminals; one is the truck terminal and the other is the bus terminal.

In truck terminals, there are private truck terminals used by specific regular scheduled route truck operators and public truck terminals for truck terminal business.

- Truck Terminal Business

A person who wishes to operate terminal business is required to obtain a license from the Minister of Transport. He will have to decide on a work plan for facilities such as terminal structure, guiding lanes, car park, loading and unloading of cargo, of which construction permit should be obtained from the Minister of Transport. Prior to the opening of truck terminal applications for permits should be filed for charges, terms of lease, the way of leasing and they are required to pass the inspection of the authorities concerned.

Public truck terminals are subject to serve the public needs.

- Private Truck Terminal

On setting up a private truck terminal, a route scheduled truck operator is required to report to the Minister of Transport as to its name, location, business scale and outlines of structure and facilities. Its structure and facilities are required to pass inspection as well. When making alterations, a permit must be obtained. The regulations for the use of facilities need under-going an examination before permits are issued.

ii) The Enforcement Regulations for the Motor Terminal Law

The following items are subject to control and enforcement under the Enforcement Regulations of the Motor Terminal Law.

- Motor Terminal Business

Filing applications for various items such as business license, construction work permit, inspection on completion of construction, permit for proposed charges and prices, terms of lease and the scale of use and their alteration.

- Private Terminal

Reporting of set-up (name, location, scale, outlines of structure and facilities, scheduled opening day, number of vehicles planned per day), application for inspection, application for the proposed regulations for the use.

The items subject to control and enforcement common to the two types of terminals are management standards such as the maintenance of terminal function, operation control for business vehicles, control of parking method and others, prevention of accidents and prevention of dangers.

iii) Motor Terminal Structure and Facility Order

The Ministerial Order sets structural endurance, exit and entrance for vehicles, taxiing lanes, vehicle marshalling place, parking space, and structural standards against rain and storm, drainage, ventilation, and lighting.

iv) The Japan Motor Terminal Inc. Law (abolished)

Japan Motor Terminal Inc. was set up on the basis of the Law that proposed the operation of truck terminals in large cities and surrounding areas to rationalize truck transport and streamline road traffic.

At present, the law is abolished by the privatization policy of governmental corporations, and the corporation was privatized.

3) Comparison of Thai and Japanese Legal Systems Related to Truck Terminals

By comparison of legal system of both countries, the following differences can be pointed out:

i) In respect of the function controlling truck terminals, Thai legal system is found to be simply than that of Japan.

ii) In case of Japan, there are a number of legal enforcements in support of the consolidation of public truck terminals and promotion of usage demand of public truck terminals; while, in Thailand, there are no such laws directly in support of such undertakings.

iii) In Japan, in consolidation of truck terminals and other distribution facilities on the fringe of large urban areas, to serve as complex distribution centers, the Law on Consolidation of Complex Distribution Centers can be applied with attractive promotional privileges (low cost of land, tax leniency, etc.); while in Thailand no such laws exist. In other words, Japanese legal enforcement are more conducive to investment in public truck terminals.

4) Prospects for the Future

The following are problems to be tackled for promotion of consolidation and expansion of regional truck terminals.

i) Consolidation of the Ministerial Regulations for Truck Terminals based on Chapter IX, the Land Transport Act under the jurisdiction of the Land Transport Department.

Here the Motor Terminal Law and its Enforcement Regulations as well as the Order on Structure and Facility of Japan may serve as a good reference.

ii) Long term low interest rate loan for consolidation of regional terminals, and collectivization of smaller and medium operators to induce truck terminals in terms of tax measures and low interest rates.

In this case, the principles established by Japanese laws for promotion of small and medium enterprises may serve as a reference.

iii) It is clear that a truck terminal is a node that links a point with another point where a stock point for short term storing, sorting and distribution processing is necessary. For stock point operation of such activities that handle cargoes belonging to many unspecified shippers, service standards as well as charges should be controlled by introduction of new regulations which include a licensing system.

In examining the possible implementation in this regulation, Japanese Law on Warehouse Business, Orders relating to the Law, and the Enforcement Regulations may serve as a reference.

The warehouse in Thailand is within the jurisdiction of the Ministry of Commerce, of which right is specified by the Conditions for Control of Warehouse Operation. The items which are normally kept in the warehouse are tapioca, maize, rice and other agricultural products and public supplies from the government such as fertilizer. Both groups are bulk cargoes. There is another need for establishment of stock point, at a node of general cargo flow as in the case of truck terminals. In this case, the new regulations above-mentioned will be required.

iv) It is better for regional truck terminals to be set up as a nucleus of physical distribution in the region, where physical distribution sources and other physical distribution facilities are concentrated.

A regional truck terminal surrounded by truck center (non-fixed transport operators estate), warehouse estate, wholesale distribution estate, fresh produce market, and probably rail container depot in the future may be better in terms of efficiency in physical distribution

than a truck terminal by itself without such facilities. This will contribute to efficient suburban land use by usage, decreases in road traffic, and environmental pollution control.

This principle is shown in the Japanese Law on Consolidation of Complex Distribution Centers. On the basis of the above-mentioned and the City Planning Law, the authority can assure the right for land expropriation.

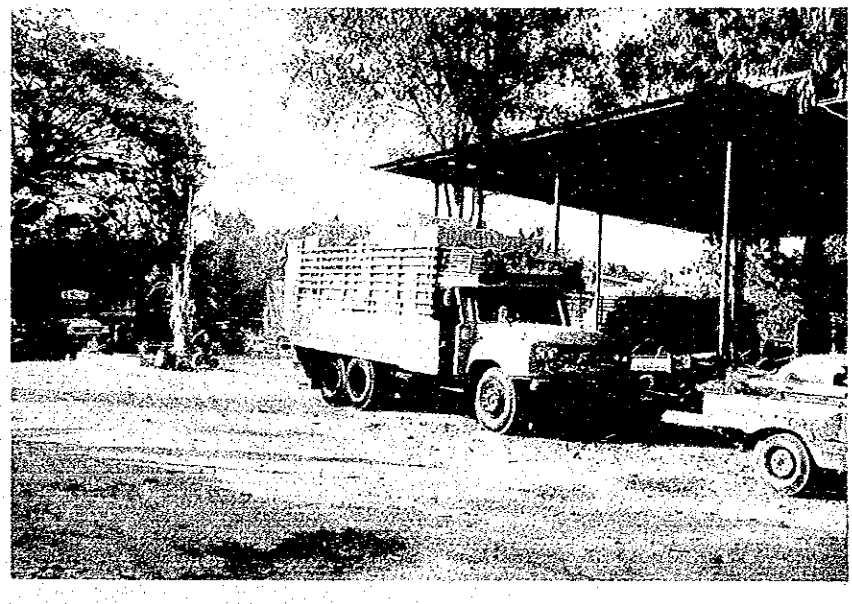
In addition to the above four problems, there are some points to supplement. There are the fostering of fixed route transport operation through consolidation of truck terminals and formation of a nationwide network.

At present, no license has been granted for fixed route operation. Moreover, the level of consolidated operation practised at present, though becoming sizable in these years, is yet limited in scale and quantity to form a feasible nationwide network. For these operators, truck terminals play an important role, giving impetus for them to grow into fixed route operators. This is a significant point in consolidation of truck terminal networks among regional core cities and surrounding hinterlands.

It may be desirable that a new regulation systems be developed for promotion of consolidation of public truck terminals, and for building up public truck terminal demand.

# CHAPTER 6

# DEMAND FOR REGIONAL TRUCK TERMINAL



# CHAPTER 6 DEMAND FOR REGIONAL TRUCK TERMINAL

## 6.1 General

In the preceding chapters, the general conditions and characteristics of commodity flow in Thailand were studied. The necessity, roles and functions of truck terminals, possible system of truck terminal network and utilization of each truck terminal are analysed in this Chapter based on the preceding studies and experiences in Japan for terminal planning.

## 6.2 Needs for Truck Terminals

This Section focuses to summarize the roles and functions of regional truck terminals considering the existing and future conditions in the road transport market.

The summary consists of three parts; first, from the line-haul network system point of view, the necessity of the Bangkok Truck Terminals is mentioned. Second, the desirable functions of regional truck terminals as the other side of node facility in line-haul transport system are examined. Finally, the roles and functions of respective regional truck terminals are characterized.

Incidentally, the roles and functions of Regional Truck Terminals are described in Chapter 4 of Progress Report II.

### 6.2.1 Truck Terminals in Bangkok

1) Distribution Characteristics in Bangkok

The present distribution characteristics of general cargoes in Bangkok are briefly summed up as follows:

General cargoes are mainly traded between Bangkok wholesalers usually clustered in the commercial zones of the city and their counterparts in regional core cities throughout the Kingdom.

Many trucking companies involved in general cargo transport are also located in the same areas as those wholesalers in central Bangkok. Almost as a rule, each trucking company is characterized by having its own routes and destinations to operate.

Consequently, the shippers of general cargo have to select a private truck terminal which is capable of handling transport of their cargoes both in volumes and destinations required.

The large volume of general cargoes generated in the central commercial zones of Bangkok has caused traffic congestion in the area.

In-bound and out-bound traffic, especially by 10-wheel trucks for loading and unloading cargoes seems to aggravate the already congested traffic in the city area.

Most of the private truck terminals located in this area are of small-scale with old fashioned facilities and manual handling methods; therefore, the capacity of cargo handling is relatively small. Numerous stacks of cargoes are loaded and unloaded in front of private terminals in shophouse style operation.

2) Restriction on Truck Operating Hours

There is another precondition that general cargo transport faces in Bangkok Metropolitan Area.

The restriction on truck operating hours has been imposed to relieve traffic congestion during rush hours in the Bangkok Metropolitan Area. Subject to this regulation are 6-wheel and 10-wheel trucks in the following patterns: (See Table 6.2.1)

During the restricted hours, trucks over 6-wheels are prohibited from operating in the BMA, and as a result they are forced to park either on the outskirts of the BMA boundary or somewhere inside the city.

**Table 6.2.1 Restricted Truck Operating Hours**

| | Morning | Evening | Total |
|---|---|---|---|
| 6 wheel trucks | 7-9 a.m. | 4-8 p.m. | 6 hrs |
| 10 wheel trucks | 6-10 a.m. | 3-9 p.m. | 10 hrs |

NOTE 1: Since 11th May, 1979, two regulations; "Prohibiting Four-wheel & Six-wheel Trucks to Operate in the Bangkok Metropolis", "Prohibiting Ten-or-more-wheeled Trucks and Certain Types of Vehicles to Operate in the Bangkok Metropolis" have been introduced. Details are shown in the Appendixes 6.1 through 6.3.

NOTE 2: The Commander of the Metropolitan Police announced that from 25 January, 1988 the 10-wheels trucks were prohibited to use Vibhawadee Road as follows:

Inbound: from intersection between Phahonyothin and Vibhawadee Road to Din-Daeng expressway between 06:00~10:00 a.m.

Outbound from Din-Daeng expressway Junction to Phahonyothin Road Junction (near the Airport) between 03:00~09:00 p.m.

However, the traffic condition in the BMA under the imposed truck operating hour regulation seems likely to have reached the saturation point of its capacity.

3) Dealing with Congestion

One of the most effective methods to deal successfully with such worsening urban traffic congestion is to move cargo handling facilities out of the inner BMA to the outskirts of the city as much as possible.

There must be some difficulties for such small scale wholesalers to move away from the crowded central area or set up their warehouses or depot separately elsewhere in the outskirts of Bangkok.

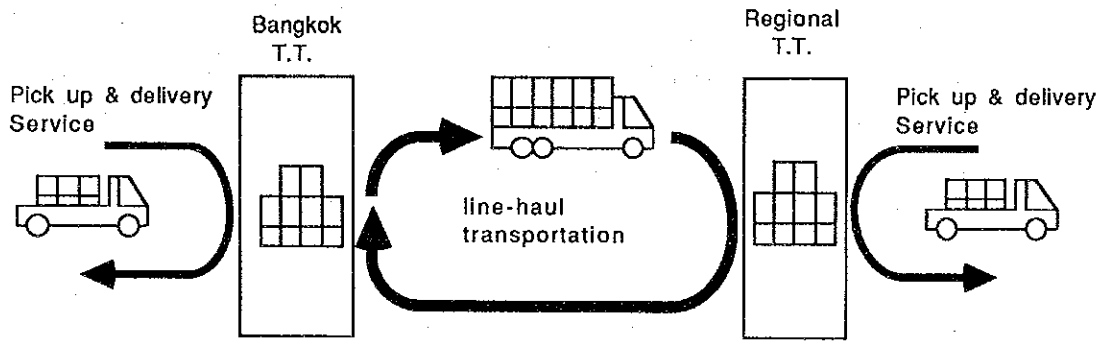
It seems that trucking companies do not seriously consider or are somewhat reluctant to move or relocate their truck terminals to the outskirts of BMA as do the wholesalers unless there is some degree of guaranty on the prospect of their business, i.e. maintaining business transactions with the cargo owners as usual or much better than before, and increasing the efficiency and convenience in their trucking operation to generate optimum amount of profit.

4) Establishment of Bangkok Truck Terminal

The way to relieve these trucking companies from such fetters of truck operating restricting hours is to establish truck terminals outside the BMA to serve as a connecting point between pickup/delivery services in the city by 4-wheel trucks and line-haul transport to and from provincial cities by 10-wheel trucks.

If 10-wheel trucks used for general cargo transport are banned from plying the BMA, the heavy traffic congestion in the inner city would be greatly lightened.

**Fig. 6.2.1 Separation of Line-haul Transport and Delivery Services**




5) Benefits to Trucking Companies

By using the Bangkok truck terminal, trucking companies will obtain some benefits. The adoption of the proper type of trucks, light and heavy, in each type of transport is essential for optimum operation. Newly built truck terminals will also provide vast handling space and will be equipped with efficient handling equipment, such as forklifts, conveyer belts, that enable an increase in handling efficiency.

Increased frequency of pickup/delivery services in the urban area will lead to a high loading ratio of the line-haul truck.

By locating a truck terminal outside the restricted zone of heavy truck operation, the hours can be made flexible and truck movement schedules can be adjusted when needed or as the situations call for. In this way, idle time will be greatly reduced and thus increase of profitability can be expected.

6) Benefits to Consignor

Not only the trucking companies but also consignors of general cargoes will be provided several benefits by using the Bangkok truck terminals.

Prospect of expanding line-haul network from Bangkok truck terminals to various destinations, consignors will be able to expand their marketing routes.

Guaranteed regularity and frequency of line-haul transport will enable the consignors to make a regular shipment schedule and proper manufacturing plan to save their manufacturing, storage and stocking costs accordingly.

7) Other Impacts of Bangkok Truck Terminal

Along with the other impacts by the establishment of Bangkok truck terminals, the following can be considered;

Some portion of land previously used as private truck terminals can be converted for other uses compatible to the master planning of the central urban area.

The establishment of Bangkok truck terminal will bring about new potentials for other aspects of development; related or allied industries and services may be developed in the surrounding area, thus creating additional local employment.

### 6.2.2 Truck Terminals in Project Cities

1) Distribution Characteristics in Project Cities

The present distribution characteristics of general cargoes in project cities are briefly summed up as follows;

General cargoes distributed in regional cities are mainly produced or originated in Bangkok and its vicinity, and imported goods landed at the port of Bangkok. Therefore, most of the general cargo may be transported from Bangkok to destinations in regional cities usually by 10-wheel trucks.

General cargo transported to regional cities are destined for private truck terminals located in the central commercial area. Most of such private truck terminals are of shophouse type.

Wayside cargo handling in front of the shophouse often causes some traffic congestion, however, it is not as serious as in Bangkok.

At present, only a small volume of textile goods, handicraft products and others are shipped from regional cities to Bangkok as general cargo compared to those transported from Bangkok to regional cities.

Some project cities have their own restricted truck operating hours within the central district. In such cities, private truck terminals are not only located in the central commercial area but also outside the restricted area for good access to Bangkok.

Cargo handling generally depends largely on manual labor, mechanization and semi-mechanization are not much used.

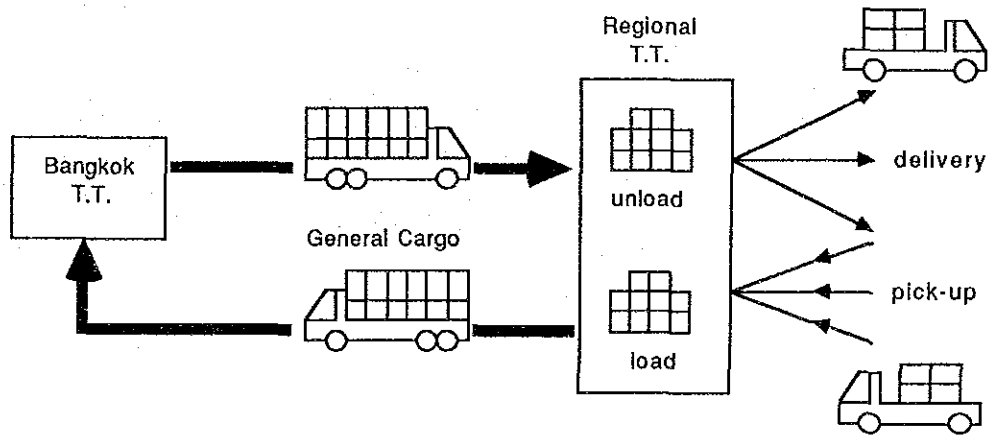
Some trucking companies in fact play not only the role of carriers but also that of forwarders.

2) Primary Roles and Functions of Regional Truck Terminals

Being the main stream of general cargoes originated from Bangkok, one of the primary roles and functions of the regional truck terminals is to receive, sort and deliver transported general cargoes to local customers according to their consignments.

To maintain regularity and frequency of trunk line, it is necessary that separate facilities be maintained to handle line-haul transport and pickup/delivery services.

**Fig. 6.2.2 Primary Roles and Functions of Regional Truck Terminal**




3) Benefits to Trucking Companies

Benefits to trucking companies by using a regional truck terminal are basically the same as those provided by the Bangkok truck terminal.

Firstly, separation of line-haul from pickup/delivery service will enable each of the facilities to concentrate on rendering single-phase performance likely to affect efficiency and reduction of operation costs.

Secondly, in the project cities where restricted truck operation hours are adopted, the establishment of a truck terminal outside the restricted area will enable trucking companies to operate with more flexible schedules.

Thirdly, returning 10-wheel line-haul trucks from the regional truck terminals will reduce the 10-wheel trucks traffic in the city area and thus enable more smoother and efficient operation of pickup/delivery by light trucks.

Concentrating local cargo information not only on general cargoes but also full truckload cargoes to a regional truck terminal will enable matching supply with demand for cargo transport. The utilization of the truck terminal as an information center will enable trucking companies to increase their marketing ability in the collection of cargo.

4) Influence on Local Development

Some influence of regional truck terminals on local development may be expected.

Guaranteed punctual delivery time, even for a small shipment lot, through regional truck terminals will enable local manufacturing producers to expand their marketing area and attract more customers.

Some local manufacturing products are export-oriented goods. The regional truck terminal, if set up, can be made to play the role of the Customs procedure to facilitate consignment of such cargoes through the terminal.

The construction of regional truck terminal itself and improvement of surrounding infrastructure will contribute to the promotion of local contractors and the opportunity for local employment to operate the regional truck terminal will be greatly enhanced.

Small private truck terminals established without due planning and coordination will be either gradually absorbed by or relocated to the regional truck terminals. Diversion or abolition of existing small private terminals and better utilization of vacant land as the result of relocation will no doubt be helpful to promote redevelopment of the urban center.

One of the expected roles of regional truck terminals may be to utilize its facilities as the shipper's local depots or distribution centers.

5) Utilization as Shippers' Local Depots

By maintaining a regional truck terminal, correct sorting of cargoes, efficient and well scheduled delivery and flexibility of emergent shipment can be made possible to replace the less efficient shippers' private distribution system. In such a case, the regional truck terminals can be made to play an important role in shippers' local distribution.

The efficient and systematic handling of cargo transport and distribution made possible by setting up the regional truck terminal will be of great benefit to nationwide producers and wholesalers.

6) Introduction of Freight Charge Clearing System

The typical flows of general cargoes and freight charges under the present practice may be drawn and summed up as follows: In Pattern I, a freight charge is paid to the forwarder by the consignor, as opposed to this a freight charge is paid by consignee in Pattern II (See Fig. 6.2.3). Especially in the case of Pattern II, clearing of freight charges, not only between local consignee and subcontractor but also Bangkok forwarder and sub-contractor, will be much more simplified if the regional truck terminal is installed with such a facility.

### 6.2.3 Roles and Functions of Regional Truck Terminals in the Five Project Cities

1) Common Roles and Functions and Fundamental Facilities

The roles and functions to be assigned or absorbed by the regional truck terminals may be summed up as follows:

- To serve as regional centers for receiving, sorting, and delivering to consignees general cargoes brought from Bangkok.

- To take charge of picking up, sorting and loading local manufactured products destined for Bangkok for shipment on line-haul heavy trucks as their other basic role and function.

To effectively carry out such roles and functions, each of the regional truck terminals need to be installed or equipped with fundamental facilities such as:

- adequate number of berths for loading and unloading general cargoes;
- adequate handling space/platform for sorting general cargoes according to their destinations or consignees;
- adequate reserved space necessary for temporary storage in case delivery of unloaded cargoes cannot be completed in the same day, or in case collected cargoes cannot be loaded on a line-haul truck in the same day.

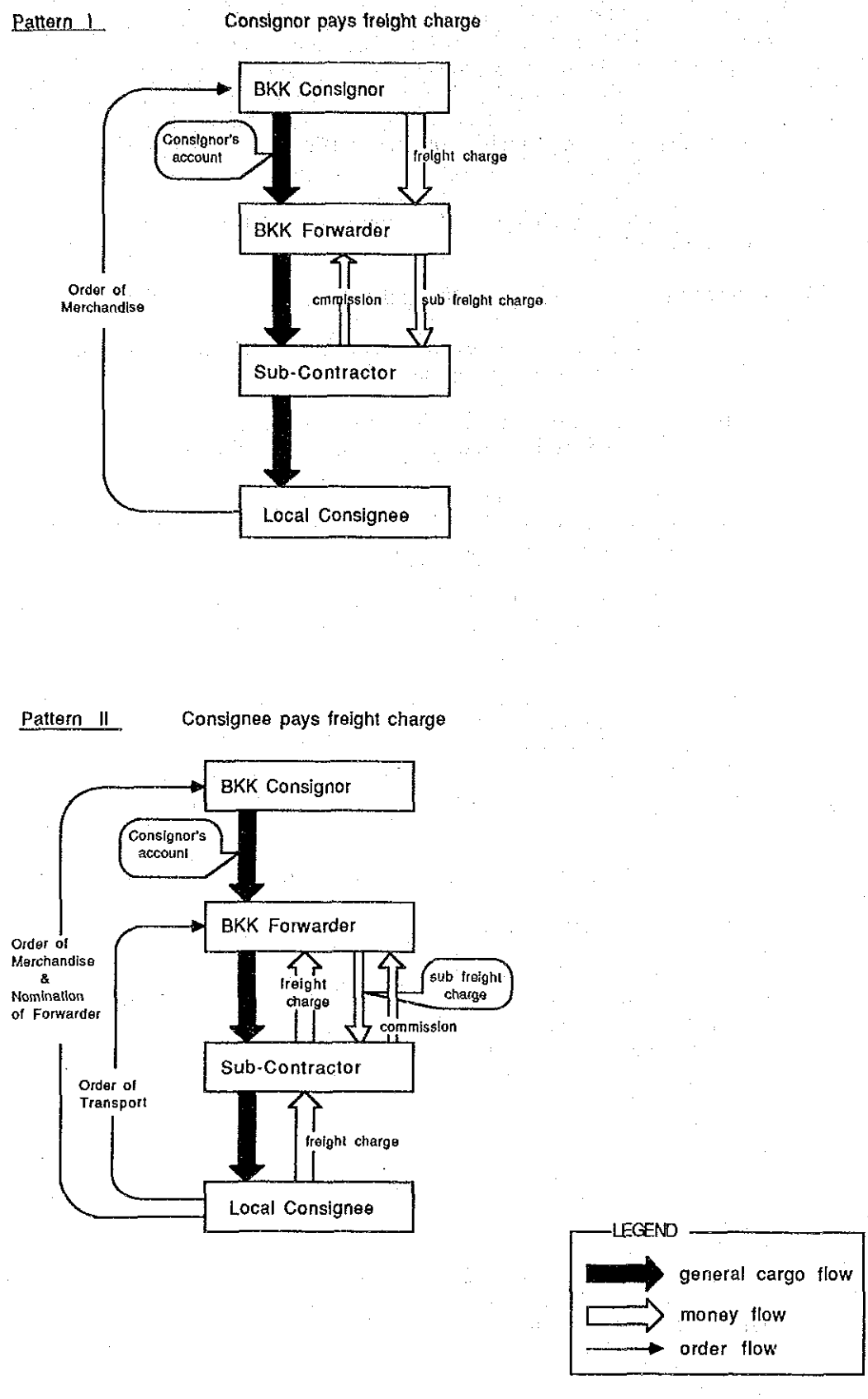
a) Local Depots of Consumer Goods as Desirable Facility

Changes in way of life or living pattern do have a certain impact on demand for consumer goods. Therefore, some producers and wholesalers of consumer goods of nationwide distribution will take into consideration the advantage of establishing or extending their depots upcountry for convenience and smooth operation in their product distribution. In such a case, the regional truck terminal will be made to play an important role of assigning part of its facilities to facilitate the producers and wholesalers of nationwide products. They will utilize the space in the regional truck terminal for their local distribution center and to stock their merchandise temporarily.

The facilities required for these producers and wholesalers may be some covered platform space attached to the berths.

The above-given roles and functions of the regional truck terminals with the necessary fundamental facilities are considered common among the five project cities (refer to Table 6.2.2).

## Fig. 6.2.3 General Cargo Flow and Freight Charge Flow



## Table 6.2.2 Common Facility among Five Project Truck Terminals

| | Basic Facility | Subsidiary Facility | Supporting Facility |
|---|---|---|---|
| Platform (handling space) | O | | |
| Berth (bay) | O | | |
| Trucking company office | O | | |
| Temporary storage space | Δ | | |
| BKK prod/whosa's stock point | Δ | | |
| Parking zone for trucks | | O | |
| Car parking area | | O | |
| Marshalling yard | | O | |
| Driveway | | O | |
| (Multi-purpose service center) | | | |
| Operating office | | | O |
| Maintenance office | | | O |
| Garage | | | O |
| Fuel station | | | O |
| Car wash | | | O |
| Canteen, stores | | | O |
| Restrooms | | | O |
| Shower room & toilets | | | O |

**Additional Specific Facility in the Future**

| | | |
|---|---|---|
| Bonded Area | International trade with LAOS (Khon Kaen) | ◊ |
| | International trade with Singapore and Malaysia (Hat Yai & Songkhla) | ◊ |
| Node Facility of Intermodal Transport | With inland waterway & rail (Nakhon Sawan) | ◊ |
| | With Songkhla deepsea port (Hat Yai & Songkhla) | ◊ |

LEGEND

Essential Facility O
Desirable Facility Δ
Possible Facility ◊

2) Respective Roles and Functions of Each Regional Truck Terminal

a) Chiang Mai

The major indigenous products in Chiang Mai consist of cash crops, such as fruits and vegetables and handicraft products, such as wood carving, celadonware and ready-made garments. Some portion of these local manufacturing products make up part of the return-haul general cargoes destined for Bangkok. On the average, the unit of shipment is usually small and sometimes transported as a consignment.

Therefore, to do away with uneconomical practice of less than a truckload return-haul among numerous small-scale trucking operators, the regional truck terminal for Chiang Mai when set up will serve as a center for assembly of small shipment units from various consignors to fill up a truckload for return-haul to Bangkok.

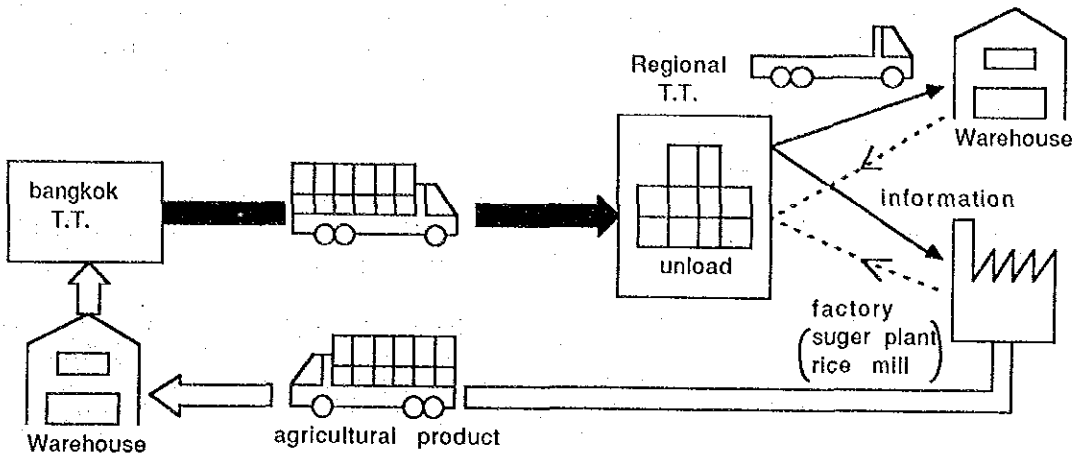
In such a way, Chiang Mai regional truck terminal will attract a number of potential return-haul cargo to be handled. In the case of export-oriented products of high value, in which Chiang Mai is now engaging, cargo handling by competent forwarders with a top-rate knowhow on international transport is vital. Hence, certain business areas concerned with international freight forwarding such as Customs formalities may be set up and handled by Chiang Mai truck terminal as one of its roles and functions.

b) Nakhon Sawan

Cargoes transported from Nakhon Sawan to Bangkok are mainly agricultural products such as rice, maize and tapioca. These bulk cargoes are carried not only by trucks but also by barges using water transport. A transport terminal for inland waterways with road and railway access is now under construction on the riverside in the eastern part of the city.

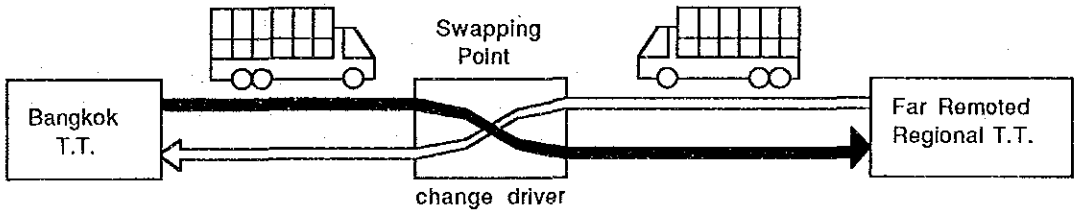
In comparison with the general cargo volume from Bangkok, the back-haul general cargo volume from Nakhon Sawan is relatively small. Therefore, some kind of sub-system of adjustment must be taken into consideration to maintain the optimum circulation of line-haul 10-wheel trucks. The concept of this sub-system is shown in Fig. 6.2.4. This sub-system consists of gathering of information on Bangkok-bound cargo shipment by Nakhon Sawan truck terminal and the terminal's assignment of cargoes, mainly consisting of bulky agricultural products, to the line-haulers as their return-haul to Bangkok.

Fig. 6.2.4 Return-haul Cargo Arrangement Sub-System




In addition, Nakhon Sawan truck terminal can be made to play another incidental role and function as the swapping point between Bangkok and far-off urban communities in the Northern Region. As Nakhon Sawan lies about 240 km to the north of Bangkok (See Fig. 6.2.5).

Fig. 6.2.5 Cargo Swapping System




c) Nakhon Ratchasima

Nakhon Ratchasima lies about 250 km to the northeast of Bangkok; the distance therefore provides some potential for Nakhon Ratchasima truck terminal to develop a swapping system among trucking operators similar to the Nakhon Sawan's case.

d) Khon Kaen

Khon Kaen's position as the geographical center and the hub of transport network for the entire Northeastern Region will continue to give it a development momentum. Khon Kaen truck terminal can become a primal distribution center for general cargoes from Bangkok. Khon Kaen is the central market for agricultural products, such as tapioca, rice, sugar, jute produced in the Northeastern Region; at the same time it serves as the distribution center of fertilizer, construction materials such as gravel and cement in this region.

Since the major cargo items are agricultural products, the volume of shipment varies widely depending on the season. Furthermore, the shipment for export requires delivery within 3 days after the sales are made. Khon Kaen truck terminal can be an ideal entity to play the role of forwarder to manage the sufficient number of trucks in order to carry such a large volume of commodities in time.

e) Hat Yai/Songkhla

The major industries in the Southern Region consist of farming, rubber plantation, fishery and tourism. Export of fish, vegetables and fruits seems to be typical business in the Southern Region.

The Songkhla deep-sea port with a berth capacity of 10,000 G.T. class is now under construction and expected to be completed in 1988. After completion of the Songkhla deep-sea port, the major cargo items of coastal shipping from Bangkok to Songkhla are likely to be fertilizer and from Songkhla to Bangkok, rubber, which are now transported mainly by trucks. Consequently, the subsidiary role and function of the Hat Yai/Songkhla truck terminal would possibly be that of gathering cargo information on the Songkhla's coastal shipping for release and assignment to the truck drivers who are looking for cargoes.

## 6.3 Containerized Transport and Truck Terminal

Containerized transport has become one of the major intermodal transport services, and plays a key role in providing "door to door" service. Containerized transport is mainly composed of general cargoes and appears as a representative aspect of the unit-load system.

There are two types of container transport, one engages in the international transport, and another of the domestic transport. In Thailand, maritime container transport and aero container transport have been developing as the international transport, however domestic container transport systems have not been adopted enough.

In this Section, the international maritime container transport will be described first, following the domestic container transport.

### 6.3.1 Inland Transport of Maritime Container

International maritime containers are handled at Bangkok Port to load and unload for container ships. In future, some deep sea ports which are now under-construction at Lean Chabang, Songkhla and others will be used as the container ports.

In the aspect of imported containers, the great portion of them consists of less-than-container-load (LCL) cargoes, conversely full-container-load (FCL) cargoes share in a small portion. LCL containers are mainly unpacked at Bangkok Port and the unpacked cargoes are destined for consignees respectively. FCL containers are taken to consignees' yards directly. Therefore regional truck terminals hardly have any connections with the inland transport of imported container transport at the present. Nevertheless, the Bangkok truck terminals seem to have some possibilities to play roles as the container freight stations (CFS) of imported cargoes.

On the other hand, the export container cargoes are composed mainly of the agricultural products. These commodities are carried by trucks to the Bangkok Metropolitan Area from the upcountry agricultural areas. A part of these commodities is packed into maritime containers at Bangkok port site. Therefore, under the present situations, regional truck terminals hardly seem to have any connection with the maritime containers for export.

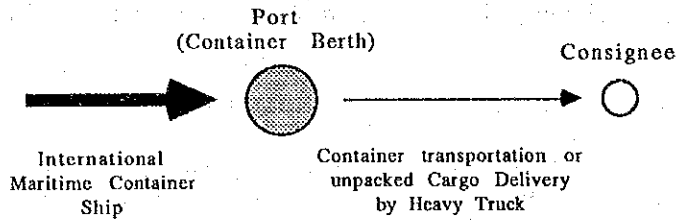
In the future, according to the development of regional economy, regional truck terminals may have a chance to play a role as the interior CFS for export-oriented cargoes.

### 6.3.2 Containerization on Domestic Transport

At present, Thailand has no domestic container transport systems adopted in the railway and coastal shipping transport. Consequently, truck terminals are considered not to have any possibility to function as the domestic container depots for packing/unpacking. But in the future, if domestic container transport systems are built, and infrastructures are well prepared, each regional truck terminals may have some opportunities to take part in the domestic container transport system.

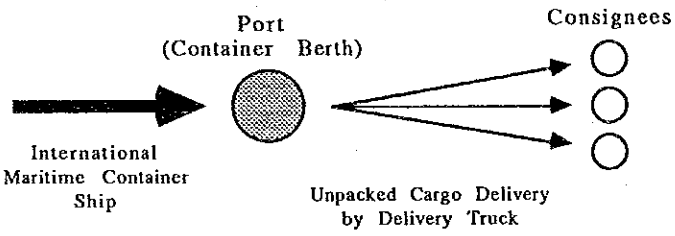
## Fig. 6.3.1 Inland Transport of Maritime Containers

### I. Import of Full-Container-Load

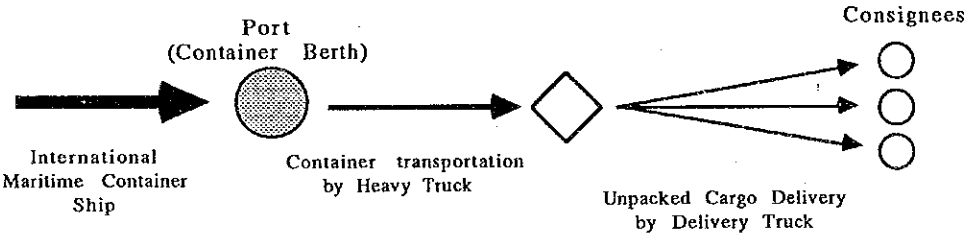



### II. Import of Less-Than-Container-Load

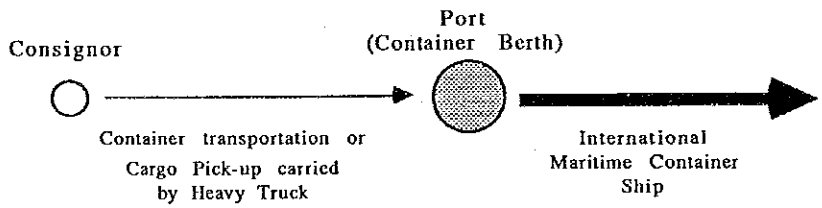
#### 1) Direct Delivery from Port




#### 2) Delivery through C.F.S.




### III. Export of Full-Container-Load



## 6.4 Truck Terminal System in Thailand

The fixed route transport system in Thailand, means that the cargo transport 'on scheduled time' and 'on fixed route' for the LTL (less-than-truckload) consolidated cargo, is at the starting point of its development. It is certain in near future that the transport development required by economic and social development will take place beyond the ratio of economic growth on a quantity base. In order to realize this development, it is essential to establish a network of the fixed route transport terminals through which the fixed route transport can be developed rapidly throughout the country.

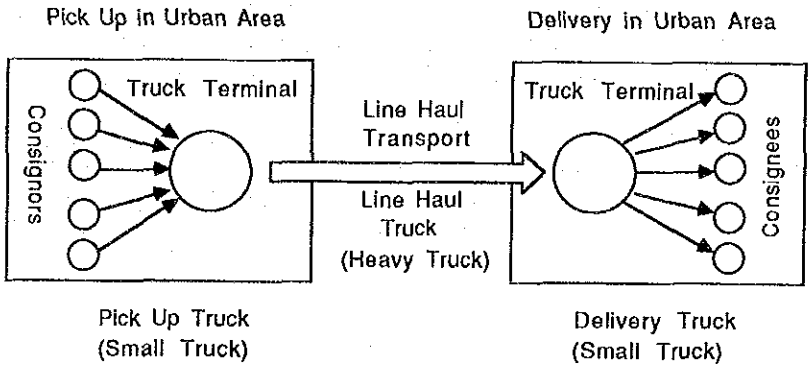
First of all, the functions and roles of the terminal between a certain pair of terminals including Bangkok Truck Terminals as a first priority of a minimum unit of the terminal system are discussed.

Secondly, arrangement of the five regional truck terminals assumed in this study, and expanded network are considered. Finally, the issue would be the concept of a nation-wide terminal network through which LTL cargo transport throughout the country would be required.

### 6.4.1 Minimum Unit of Truck Terminal System

Fig. 6.4.1 shows the basic functions and roles of the truck terminals. Pick-up services by pickup trucks for small-lot cargoes are from consignors to departure terminals, where cargoes are loaded into large vehicles to carry them to the destination terminals. Loading and unloading are performed there to deliver those cargoes to consignees by small delivery trucks.

**Fig. 6.4.1 Functions of Truck Terminals**




Through such transport processes, small-lot or LTL cargoes transport, which is inefficient now, would change for the better, and the efficient transport would supply high-quality services.

There used to be old-fashioned terminals only for freight handling in urban areas in the past experience of Japan. In those days the amount of physical distribution was quite small, and such terminals were just enough for the functions in the past. Japanese economy has accomplished a big growth, as a

result, the demand for expanded physical distribution has been raised, trucking at high speed by large trucks has been developed, urban areas have been expanded in their size, and inevitably traffic jam is a continuous problem. Under these situations, it has become a major issue to move terminals to the suburbs and reconstruct them as large-scale modern terminals. Today the functions and roles of these terminals are achieved fully.

This change was due to economic growth in the tertiary industries and increased demand for high-quality transport services caused by the value-added manufacturing industry.

### 6.4.2 The Primary Network of Truck Terminal

The development of trucking industry in Thailand will enhance the necessity of truck terminals. Some of the terminals in Bangkok will start construction as a top priority. It is assumed that regional terminals would be constructed in Chiang Mai, Khon Kaen, Nakhon Sawan, Nakhon Ratchasima and Hat Yai/Songkhla which are the biggest cities selected for this Study.

It is not realistic to assume that these terminals would be built and operate simultaneously. Two steps might be necessary, namely, Bangkok terminal construction as the first step, and some core cities which have economically higher priority as the second step.

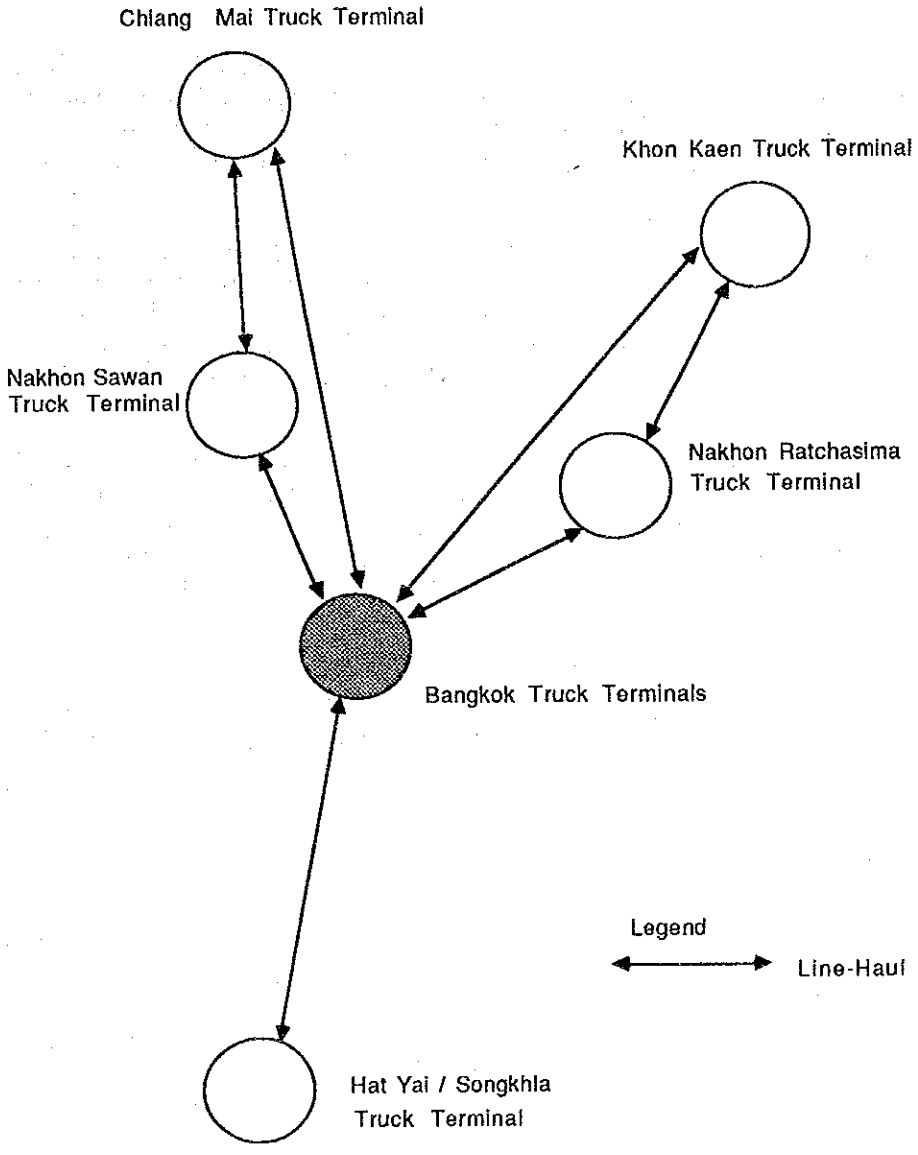
Fig. 6.4.2 shows the routes of the small-lot consolidated line-haul trucking under the above-mentioned network.

In efficiently developed existing cargo flows, products of manufacturing industry produced around Bangkok, especially daily necessities and durable consumer goods, would be transported from Bangkok terminal to each regional terminal with a low charge and high-quality services. Goods transported from each regional terminal to Bangkok would be local industry products and valuable agricultural products. Transportation with high-quality services and low charge would promote the development of regional economy.

Further, if cargo flows between regional cities become more active in the future, each region would promote the effective allotment of works relationship between regions by developing the trade of industrial products and agricultural products of their own. This would contribute to the development of characteristic of indigenous industries and agriculture.

Swapping points at Nakhon Sawan and Nakhon Ratchasima could be useful for long haul trucking to transport efficiently at high speeds. It would also be useful for preventing traffic accidents and improving the working conditions of truck drivers.

**Fig. 6.4.2 Primary Network of Regional Truck Terminal**



## 6.5 Utilization of Truck Terminal

### 6.5.1 Elimination of Demand in Short Distance

A consignor who wants to transport his general cargo for a short distance must determine whether he should use a chartered (or own) truck or a common carrier.

The chartered or own truck carries the consignment, which is often small, directly from the consignor to the addressed consignee. The type of truck used for this transport can be a medium or a light truck to reduce the total hauling cost and also to be free from the restricted hours of truck operation in the city area.

The common carrier truck operation generally involves, in addition to the line-haul operation, the collection service (cost) from the consignor to a terminal and the terminal service (cost) for sorting the collected general cargoes by destination and the delivery service (cost) from a terminal to the consignee. Therefore, a line-haul truck should have a large carrying capacity to off-set such additional costs.

The consignor may compare freight charges of the chartered truck with that of the common carrier truck. The freight charge depends on the volume and the transport distance of the consignment. Generally, if the consignment is small in volume the common carrier transport with the terminal system is not economical, unless the return-haul cargo is guaranteed. Terminal costs are added to the case of chartered truck transport.

The more the production of high valued commodities increases in regional cities, the more the transport demand by common carriers will increase. This will promote the development of sub-terminals in the regional cities to connect with the regional core cities.

The truck terminal system in the Kingdom is expected to undergo the development process described in Section 6.4.

However, it was assumed that the terminal system will not have been developed to the extent, before the year 2006, that sub-terminals within a radius of 100 to 150 kilometers from the project cities will be constructed in regional cities.

Accordingly, the future traffic demand of general cargoes estimated between the project city and the Changwats shown in Table 6.5.1 were eliminated from the use of proposed truck terminals in the respective project cities.

Table 6.5.1 Changwat within 150 Kilometers of Road Distance from Project Cities

| Project City | Road Distance (km) | Changwat |
|---|---|---|
| Chiang Mai | 27 | Lamphun |
| | 100 | Lampang |
| Nakhon Sawan | 44 | Uthai Thani |
| | 65 | Chainat |
| | 118 | Sing Buri |
| | 141 | Ang Thong |
| Nakhon Ratchasima | 120 | Chaiyaphum |
| | 148 | Saraburi |
| Khon Kaen | 68 | Maha Sarakham |
| | 75 | Kalasin |
| | 108 | Roi Et |
| | 117 | Udon Thani |
| Hat Yai/Songkhla | 102 | Satun |
| | 115 | Phatthalung |
| | 126 | Pattani |
| | 146 | Yala |

### 6.5.2 Utilization of Terminal by Commodity Type

The major classification of commodities comprises 23 groups, from which 10 were selected as the possible commodity groups to utilize the truck terminal. These O/D tables were estimated and described in Section 4.5.

Commodities which are most likely to use the truck terminal are scrutinized item by item shown in the further breakdown of the selected major commodity groups.

As a result, the major groups of "Animals", "Fish" and "Fertilizer and Feeds" were considered those least likely to use the truck terminal. At the same time, levels of terminal utilization were determined for each of the items included in each of the selected major commodity groups taking into consideration the experience in Japan and future prospects of transport demand in Thailand.

The utilization levels were only defined to be high, medium and low, in the absence of actual examples in Thailand. Utilization levels of 60%, 30% and 10% were employed for the "high", "medium" and "low" levels respectively; and they were applied as follows:

| | | |
|---|---|---|
| Other Construction Materials | : | 10% except for Asphalt (0%) |
| Vegetables and Fruits | : | 30% except for Sugar Cane (0%) |
| Beverages | : | 30% except for Ice & Ice Cream (0%) and Tea & Coffee (60%) |
| Processed Foods | : | 60% except for Meat (10%) |
| Household Appliances | : | 60% |
| Other Manufactured Items | : | 60% |
| All Others | : | 60% except for Rubber (30%), Cigarettes and Betel/Tobacco Leaf (0%) and Engine/Machines (30%) |

Based on the estimated future commodity flows to and from the project cities and the previously determined rates of terminal utilization by commodity, the future commodity throughput of the project terminals were estimated as summarized in Tables 6.5.2 through 6.5.4. The details by commodity are presented in Appendices 6.4 through 6.15.

**Table 6.5.2 Estimated Commodity Throughput at Truck Terminals in 1987**

(Tons/year)

| Terminals | Inflow from | | | Outflow to | | |
|---|---|---|---|---|---|---|
| | Bangkok | Others | Total | Bangkok | Others | Total |
| 1) Chiang Mai | 132,588 | 42,868 | 175,457 | 40,515 | 60,913 | 101,428 |
| 2) Nakhon Sawan | 138,943 | 117,615 | 256,558 | 25,571 | 205,745 | 231,316 |
| 3) Nakhon Ratchasima | 137,409 | 115,532 | 252,941 | 51,632 | 82,456 | 134,088 |
| 4) Khon Kaen | 186,461 | 456,152 | 642,613 | 180,459 | 288,613 | 469,071 |
| 5) Hat Yai/Songkhla | 129,055 | 143,544 | 272,599 | 40,536 | 80,094 | 120,630 |

**Table 6.5.3 Estimated Commodity Throughput at Truck Terminals in 1996**

(Tons/year)

| Terminals | Inflow from | | | Outflow to | | |
|---|---|---|---|---|---|---|
| | Bangkok | Others | Total | Bangkok | Others | Total |
| 1) Chiang Mai | 221,018 | 67,002 | 288,020 | 59,156 | 88,898 | 148,055 |
| 2) Nakhon Sawan | 225,757 | 190,490 | 416,246 | 42,132 | 333,497 | 376,630 |
| 3) Nakhon Ratchasima | 316,655 | 799,765 | 1,116,420 | 373,277 | 550,491 | 923,768 |
| 4) Khon Kaen | 224,422 | 190,046 | 414,468 | 98,984 | 147,538 | 246,522 |
| 5) Hat Yai/Songkhla | 271,386 | 306,005 | 577,391 | 91,843 | 170,531 | 262,374 |

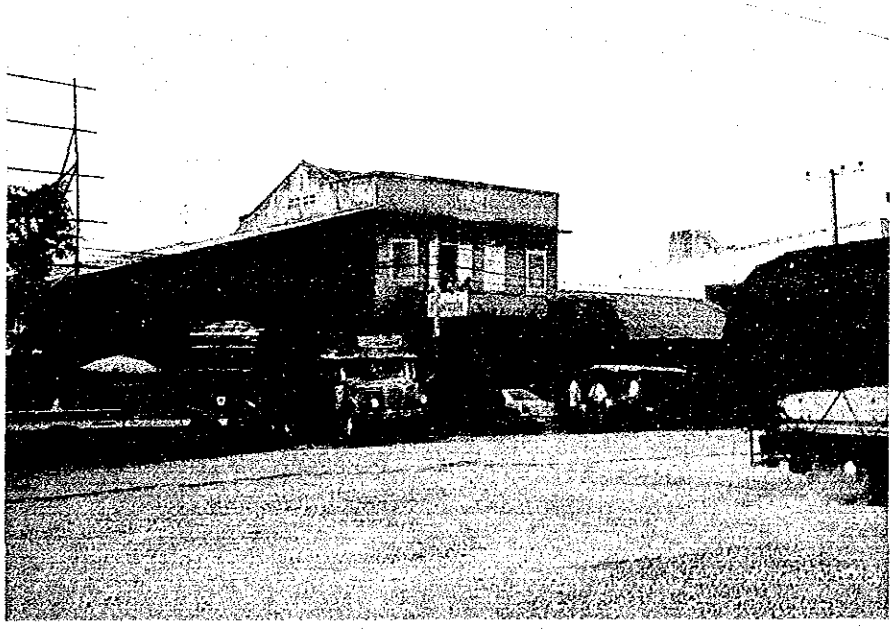
**Table 6.5.3 Estimated Commodity Throughput at Truck Terminals in 2006**

(Tons/year)

| Terminals | Inflow from | | | Outflow to | | |
|---|---|---|---|---|---|---|
| | Bangkok | Others | Total | Bangkok | Others | Total |
| 1) Chiang Mai | 355,830 | 100,889 | 456,719 | 84,356 | 126,191 | 210,547 |
| 2) Nakhon Sawan | 356,006 | 301,720 | 657,726 | 67,884 | 529,444 | 597,328 |
| 3) Nakhon Ratchasima | 537,746 | 1,385,128 | 1,919,874 | 719,913 | 1,018,673 | 1,738,586 |
| 4) Khon Kaen | 365,972 | 310,828 | 676,799 | 176,649 | 253,864 | 430,512 |
| 5) Hat Yai/Songkhla | 508,557 | 584,412 | 1,092,969 | 181,723 | 323,474 | 505,197 |

# CHAPTER 7

# PRE-FEASIBILITY STUDY FOR FIVE REGIONAL TRUCK TERMINALS



# CHAPTER 7 PRE-FEASIBILITY STUDY FOR FIVE REGIONAL TRUCK TERMINALS

## 7.1 General

Major work activities presented in this Chapter are terminal location study, preparatory facility planning, cost estimates, preliminary economic evaluation for five truck terminals and selection of three truck terminals for the next stage. On the basis of the pre-feasibility study, further feasibility studies are carried out for selected three truck terminals in the following chapters.

Section 7.2 contains the findings obtained by field reconnaissance and supplemental surveys, and the results of alternative location study to reach recommended terminal locations.

Section 7.3 discusses the preparatory facilities planning study, taking into consideration the topography and geology of the study areas and presents the findings and evaluation concerning the engineering aspects and selection of alternative locations.

Section 7.4 presents project preliminary economic evaluation including B/C ratio and internal rate of return of five truck terminals.

Section 7.5 discusses the selection of three truck terminals for feasibility study based on economic evaluation and other considerations.

The Study Team attempted to identify possible alternative terminal locations and select appropriate sites by conducting this pre-feasibility study. The selected and recommended sites are further studied in depth in various study items including analysis of existing situation of the project area, studies of engineering aspects, setting up of facilities layout, as well as cost estimates in Chapter 8 for selected three truck terminals.

## 7.2 Terminal Location Study

The truck terminal locations were selected through the study of project city planning and main flow of cargoes as well as preliminary engineering studies and economic considerations.

The finalization of the location of the truck terminals were completed in the earlier stage of Step 3 and the results were reflected in the consecutive work activities such as facilities planning, cost estimation, economic evaluation, operation of terminals, and so forth.

### 7.2.1 Alternative Location Study of Truck Terminal (Selection Method)

Following the general information obtained from previously collected data and the site investigation and the results of discussion with Governor's Offices in each Project Changwat, the Study Team studied the social, technical and economic conditions in the project area to select a suitable location of each truck terminal. A careful analysis was conducted to find possible alternative locations between the beginning of May 1987 and the end of July 1987, paying due attention to the following basic requirements:

1) High-Density Urbanized Area

Except for special cases, the terminal location should avoid high-density urbanized areas.

Location is away from CBD between 10 km and 20 km in consideration of distribution time. (3 or 4 times/day pick-up and delivery services from the experience in Japan)

2) Relationship with Town Planning

The location of terminals should be well coordinated with the town planning and it should avoid the planned future expansion of the urban area in the project cities.

3) Strategic Point in Transportation

A strategic location should be selected from the viewpoint of the physical distribution system and particularly from that of smooth pick-up and delivery services.

4) Land Acquisition and Construction Costs

Terminal locations should consider where the land can be acquired easily and cheaply, and how the terminal can be constructed at low costs.

5) Easy Access for Main Flow Trucks

In order to provide for the main flow of line-haul trucks with an easier access to the regional terminal, the terminal location should be selected on the left hand of the main line from Bangkok to the upcountry districts.

### 7.2.2 Selection of Optimal Locations of Terminals

The following were considered as the primary criteria for the comparison of alternative locations for each project city.

- Accessibility to CBD
- Strategic point in cargo transportation
- Condition of access roads
- Land acquisition and compensation costs
- Construction costs

1) Chiang Mai

All alternatives are located in the south of the city area because of ease of connection with Bangkok. (See Appendix 7.1)

Alternatives C-1 and C-2 face Route 11 (to Bangkok), and C-3 face Route 106 (old route to Bangkok). However, C-4 faces Route 108 (to Mae Hong Son).

Comparison of each alternative was made according to the criteria mentioned above by the rating system.

Alternative C-1 excels in all points. (See Appendix 7.7)

2) Khon Kaen

Alternatives K-1 and K-2 are located along Route 2 in the Bangkok side of the city because of smooth connection with Bangkok. K-3 faces Route 12 extending to Phitsanulok and it is near the intersection of Route 2062 which connects Route 12 and Route 2. (See Appendix 7.2)

Comparison of each alternative was made according to the criteria by the rating system.

Alternative K-1 excels in all points. (See Appendix 7.7)

3) Hat Yai/Songkhla

Alternatives H-1 is located at a strategic point near the intersection of Route 407 and the planned future bypass connecting Route 407 with Route 4. H-3 faces Route 4 on the south-side of Hat Yai near the intersection of the planned bypass.

H-2 and H-4 are located on Route 430 which is a new bypass on Route 4 on the north-west of Hat Yai. (See Appendices 7.3 and 7.4)

Comparison of each alternative was made according to the criteria by the rating system.

Alternative H-4 excels in all points. (See Appendix 7.8)

4) Nakhon Sawan

All alternatives (two) are located in the south of the city area facing Route 1 because of ease of connection with Bangkok. (See Appendix 7.5)

Comparison of each alternative was made according to the criteria by the rating system.

Alternative NS-1 excels in all points. (See Appendix 7.8)

5) Nakhon Ratchasima

Alternatives NR-1 is located at a strategic point near the intersection of Route 2 and Route 2068. The existing bypass (Route 2198) which connects Route 2 with Route 205 runs in parallel with Route 2068. NS-2 faces Route 304 to the south of the city.

NR-3 is located on Route 205 of the immediate north of the intersection among the Route 2198, Route 205 and the projected road connecting Route 205 and Route 24. (See Appendix 7.6)

Comparison of each alternative was made according to the criteria by the rating system.

Alternative NR-1 excels in all points except land acquisition cost. (See Appendix 7.9)

## 7.3 Preparatory Facilities Planning and Cost Estimates

### 7.3.1 Facilities Planning

This facilities planning of the five truck terminals was carried out at the pre-feasibility study level. More precise facilities planning will be discussed for selected three terminals in a later Chapter.

Only those essential as the minimum requirement in type and in size relative to the demand were adopted for each truck terminal planning of this pre-feasibility study.

The facilities in each truck terminal are planned to meet the needs of the trucking industry in project cities, that is, truck terminal facilities for the consolidation and transhipment of general cargo between intra-city pick-up/delivery and inter-city line-haul truckers.

In the following, the elements of each of the facilities are described along with the method for calculating the scale of facilities required to meet the size of demand previously determined.

1) Facility Elements

The elements of facility planning in the truck terminal cover the required trucking industry functions (namely, transhipment, and heavy truck parking) as well as two support functions for the truck terminals (namely, administration and maintenance). The three elements and their components are listed below. (See Appendices 7.10 through 7.14)

a) Truck Terminal Components

The main components of the truck terminal are as follows:

- Cargo handling platforms for consolidation of cargoes into near truckload lots and for transhipment between pickup/delivery and line-haul vehicles.
- Apron area adjoining the platform area.
- Branch or field office of the terminal operators.
- Parking area for pick-up/delivery and line-haul vehicles, and roadways surrounding the platform areas.

b) Truck Terminal Administration Building

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

- Administrative offices for the complex as well as an office for officials from the LTD
- Clerical offices for terminal operators
- Conference room
- Training room
- Cafeteria with vendors' stand
- Crew rest area
- Showers and toilets
- Public telephone facilities

c) Trucking Terminal Maintenance Area, etc.

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

2) Layout and Scale of Facilities

The following paragraphs explain the method used to calculate the scale of facilities in the truck terminal.

a) Scale of Truck Terminal Facilities

The determination of the scale of truck terminal facilities is primarily based on the projected volume of cargo to be handled. Cargo volumes handled at the regional terminals are composed of the attracted inbound, the generated outbound and the transhipment volumes.

The inbound volume to project cities from both Bangkok and other Changwats is considered as the subject volume for the calculation of terminal scale because this is the biggest among the three cargo flows mentioned above.

The general cargo volumes subject to each terminal are shown in Table 7.3.1 (refer to Section 6.4 for cargo volume calculation).

The procedure for calculating the scale of berths of truck terminal facilities is shown in the next formula. Basically, the procedure involves the following elements.

Number of berths ≈ Number of line-haul trucks
= Subject general cargo volume (t/day)
x Concentration ratio (%) ÷ Average payload (ton)
(See Table 7.3.2)

i) Total general cargo volume to be handled in project city (See Table 5.3.1)

ii) Average vehicle payload (tons) for inbound cargo: (Data from O/D survey) 10 tons/10-wheel truck

iii) Average vehicle payload (tons) for pick-up & delivery cargo: (Data from O/D survey) 1.50 tons/4-wheel truck

Turnaround time: About 3 times per day

iv) Concentration ratio per two hours (Data from O/D survey) (See Note 2/of Table 7.3.2)

19.84%/Chiang Mai
15.72%/Nakhon Sawan
10.43%/Nakhon Ratchasima
15.38%/Khon Kaen
18.75%/Hat Yai/Songkhla

v) Platform length: Number of berths x 3.5 m
Platform area: 1 $m^2$/3.5 tons

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

vii) Office Unit Area: 10 $m^2$/office staff
Crew Rest Room: 2 $m^2$/man

viii) Components determined from the layout chart:
- Apron distance between line-haul trucks and platform: 15 m
- Apron distance between pick-up/ delivery trucks and platform: 10 m
- Roadway widths ranging from 7 - 20 m

ix) Car parking area, vehicle washing facilities, green belt and guard box, etc.

The layout and total area of the truck terminal on each terminal and the elements mentioned above are shown in Table 7.3.3 and Appendices 7.10 through 7.14.

## Table 7.3.1 Cargo Capacity for Truck Terminals

(Unit: tons/year)

| Terminal | Type of Cargo | | |
|---|---|---|---|
| | Outbound Cargo Volume | Inbound Cargo Volume | Total Volume |
| Chiang Mai | 210,547 (702) | 456,719 (1,522) | 667,266 (2,224) |
| Nakhon Sawan | 597,328 (1,991) | 657,726 (2,192) | 1,255,054 (4,183) |
| Nakhon Ratchasima | 1,738,586 (5,795) | 1,919,874 (6,400) | 3,658,460 (12,195) |
| Khon Kaen | 430,512 (1,435) | 676,799 (2,256) | 1,107,311 (3,691) |
| Hat Yai/Songkhla | 505,197 (1,684) | 1,092,969 (3,643) | 1,598,166 (5,327) |

Note: Figures in parentheses show daily volume in tons.

## Table 7.3.2 The Forecast of Berths Requirements

| Terminal | Annual Inbound Cargo (tons) | Daily[1/] Inbound Cargo (tons) | Peak[2/] two-hour Inbound Cargo (tons) | Peak[3/] two-hour Trucks (vehicles) | Berths[4/] Required (berths) |
|---|---|---|---|---|---|
| Chiang Mai | 456,719 | 1,522 | 302 | 30 | 35 |
| Nakhon Sawan | 657,726 | 2,192 | 345 | 34 | 40 |
| Nakhon Ratchasima | 1,919,874 | 6,400 | 668 | 67 | 75 |
| Khon Kaen | 676,799 | 2,256 | 347 | 35 | 40 |
| Hat Yai/ Songkhla | 1,092,969 | 3,643 | 683 | 68 | 75 |

Note:
1/ Daily inbound cargo was calculated by dividing annual inbound cargo volume by yearly operating days, 300 days.
2/ A peak two-hour inbound cargo was computed as a daily volume multiplied by a concentration rate of 10-wheel trucks inbound during peak two hours per day. The respective concentration rates are as follows:

| | | | |
|---|---|---|---|
| Chiang Mai | 19.84% | Khon Kaen | 15.38% |
| Nakhon Sawan | 15.72% | Hat Yai/Songkhla | 18.75% |
| Nakhon Ratchasima | 10.43% | | |

3/ A loading capacity of a 10-wheel truck is estimated as ten tons.
4/ Number of berths required was set up as that of 1.1 times of peak two-hour trucks and approximately counted in every five berths.

**Table 7.3.3 Truck Terminal Facilities**

| Terminal | Design Elements | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Number of Berth | Trans-shipment Platform | Aprons | Admini-stration Building | Parking Area | Roadway | Other Area (Green Belt, Parking, Main-tenance Shop, Car Wash, etc.) | Total Area |
| | (berths) | ($m^2$) | ($m^2$) | ($m^2$) | ($m^2$) | ($m^2$) | ($m^2$) | ($m^2$) |
| Chang Mai | 35 | 2,450 | 3,062.5 | 400 | 1,440 | 6,110 | 3,014 | 16,476.5 |
| Nakhon Sawan | 40 | 2,800 | 3,500 | 400 | 1,680 | 6,670 | 3,228 | 18,278 |
| Nakhon Retchasima | 75 | 5,250 | 6,562.5 | 750 | 3,120 | 11,680 | 5,408.5 | 32,771 |
| Khon Kaen | 40 | 2,800 | 3,500 | 400 | 1,680 | 6,670 | 3,228 | 18,278 |
| Hat Yai/Songkhla | 75 | 5,250 | 6,562.5 | 750 | 3,120 | 11,680 | 5,408.5 | 32,771 |

### 7.3.2 Cost Estimates

1) General

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

a) The unit prices were computed under the economic conditions prevailing in 1987.

b) Land acquisition costs were based on the unit cost data obtained from each Project Changwat Office.

c) Contingency was assumed to be 10% of the total of construction cost, land acquisition and compensation costs, final engineering, supervision fees and administration cost.

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

- Final Engineering: 3%
- Supervision, administration and others: 7%

2) Unit Cost by Work Items

The unit cost by work item is calculated taking into consideration the local conditions. The results of the unit costs by items are as listed in Appendix 7.15.

3) Land Acquisition Costs

The land acquisition costs for each terminal proposed were calculated according to the data on district land prices obtained from each Changwat. Collected data of land acquisition costs per square meter are shown in Appendix 7.16.

4) Preliminary Construction Cost Estimates in 1987 Prices

The preliminary construction cost estimates were conducted for the project terminals as presented in Appendices 7.17 through 7.21 based on the quantities estimated in the facilities planning and on the unit prices by work items, and Table 7.3.4 shows the summary of cost estimates for each truck terminal.

## Table 7.3.4 Summary of Cost Estimate

(Unit: ฿ 1,000)

| Item | Terminal | | | | |
|---|---|---|---|---|---|
| | Chiang Mai (35 berths) | Nakhon Sawan (40 berths) | Nakhon Ratchasima (75 berths) | Khon Kaen (50 berths) | Hat Yai/ Songkhla (75 berths) |
| Construction Cost | 36,746.1 | 41,222.7 | 71,679.3 | 40,236.5 | 72,748.0 |
| Land Acquisition and Compensation | 3,566.0 | 575.8 | 2,153.0 | 8,454.2 | 649.9 |
| Final Engineering and Supervision | 3,674.6 | 4,122.3 | 7,167.9 | 4,023.7 | 7,274.8 |
| Contingencies | 4,398.7 | 4,592.1 | 8,100.0 | 5,271.4 | 8,067.3 |
| Total | 48,385.3 | 50,512.8 | 89,100.2 | 57,985.8 | 88,740.0 |

### 7.3.3 Construction Schedule

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

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

The detailed design will take about twelve months and loan negotiations and financial procurement will be succeeding. The land acquisition will start after completion of the detailed design.

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

## 7.4 Preliminary Economic Evaluation

### 7.4.1 Effects of Truck Terminal

A truck terminal is one of the facilities which constitute the transport system of general cargoes. The general cargo handled at the truck terminal is relatively small in size but contains a variety of goods.

The system consists of the origin and destination terminals, line-haul transport service between the two terminals, cargo collection services between consignors and the origin terminal, and cargo delivery services between the destination terminal and consignees.

The establishment of truck terminals in Bangkok has been planned and is expected to begin the implementation although the timing is uncertain. The necessity to move such traffic generators as forwarders and warehouses outside of the Bangkok city area has been stressed not only for the development of trucking industry but also for the development/renewal of the city.

The increase in urban traffic requires the control of heavy traffic (which reduces road traffic flow) and ultimately the establishment of restricted hours of heavy truck operation in the city area.

The terminal projects in the five upcountry cities intend to complete the transport system of general cargoes between Bangkok and these cities. Further, the restriction of heavy truck operation was put into practice in three cities out of five. Thus, the demand for establishing the truck terminal was enhanced due to the requirement of the city development, and such claim may arise in other cities in the near future.

The following Table 7.4.1 compares the conditions of transporting general cargoes "with" and "without" truck terminal, and summarizes the effect of the terminal.

To brief the effects of truck terminal, it will bring about:

i) Reduction of a turn-around time of the line-haul truck.

ii) Effective material handling for loading, unloading and sorting cargoes.

iii) Reduction of damage to cargoes mainly incurred at the material handling stage.

iv) Relief from traffic congestion in the urban area and the contribution to the promotion of urban renewals.

v) Consolidation of small-scale forwarders and truckers in order to enable them to effectively use line-haul and delivery trucks and other common facilities necessary to the general cargo transport.

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

vii) Centralization of transport demand and supply information for quick response to customer's orders.

viii) Increase not only in the productivity of cargo transport but also in the quality of transport services, and eventually increase in the value-added to the trucking industry.

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

x) Significant steps to proceed to the industrialized country

**Table 7.4.1 Effects of Truck Terminal**

| Particulars | "Without" Truck Terminal | "With" Truck Terminal | Effects of Truck Terminal |
|---|---|---|---|
| Collection (from consignor to Terminal) | - A general cargo less than truck load is brought to a private terminal by consignor's truck.<br>- A general cargo at full truck load is brought to a private terminal by forwarder's 10-wheel truck. | - Delivery districts and routes are fixed precedingly for collecting general cargos from scattered consignors with various volumes of consignors with various volumes of packages.<br>To make this operation more efficient, sub-depots located at a walking distance from expected consignors are preferable particularly for collecting small packages from various consignors.<br>Retail shops and supermarkets with small space for storing consignor's packages are often utilized as sub-depots.<br>- Scheduled operation of the cargo collection is possible from scattered consignors and regular customers such as wholesalers and manufacturers. | - Consolidation of small-scale forwarders to the terminal means to consolidate a small transport demand at each forwarder and form a large demand forwarder and form a large demand volume.<br>- This enables delivery trucks to operate efficiently and to save operating costs per cargo ton carried.<br>- Compared with the cargo delivery to the terminal by each consignor, the collection system provided by the truck terminal will reduce the total delivery distance between consignors and the terminal.<br>- Scheduled operation of the cargo collection will ensure the scheduled shipment from customers even with small size in volume.<br>- Consignors can avoid arranging delivery trucks by themselves. |
| Cargo Handling (Collection - Line-hauling) | - A light truck sent from a consignor stops at the roadside of a forwarder's shophouse for unloading, and a 10-wheel truck for the line-haul also parks at the roadside for loading. These are often the impediment to general traffic and pedestrians.<br>- Generally, the loading and unloading of cargoes to/from a truck accrue the vertical motion and this causes damage to cargoes by falling and the decline in handling efficiency. | - The premises of the truck terminals is isolated from general traffic.<br>- The loading and unloading of cargoes to/from a truck is mostly practiced on a flat level is between a truck and a platform of the terminal. | - The truck terminal will contribute to eliminating traffic congestion which may take place along the roadside of forwarder's shophouse when loading and unloading.<br>- The cargo movement on a flat level between a truck and the platform will reduce the damage to cargoes and increase the efficiency of cargo handling. |

**Table 7.4.1 Effects of Truck Terminal (Cont'd)**

| Particulars | "Without" Truck Terminal | "With" Truck Terminal | Effects of Truck Terminal |
|---|---|---|---|
| Line-hauling | - Line-haul trucks may not operate in a city area during the restricted hours. Therefore, 10-wheel trucks which arrived the city at a restricted hour have to wait at the city boundary until the restriction is lifted, and those which leave the city also cannot be operated during the restricted hours.<br>- The return-haul trucks are not necessarily carrying cargoes. Generally, a branch office or an agent of the forwarder in Bangkok does not take care of the return-haul cargoes. Therefore, trucks have to spend some time to look for return-haul cargoes, otherwise they have to return empty to Bangkok. | - A truck terminal is planned to be located outside of the city area. Therefore, it is free from restricted hours of heavy truck operation.<br>- The consideration of small-scale forwarders and truckers will enlarge the capacity of line-haul services with various destinations.<br>The information concerning the cargo transport supply and demand is integrated in the terminal. | - A scheduled operation of line-haul trucks becomes possible.<br>- Transport services will be improved in punctuality, speed and safety.<br>- A higher level of transport services will induce the development of industries.<br>- A large scale cargo transport service can absorb the fluctuation of transport demand and respond to customers need flexibility.<br>- A proper management of information and customers' orders will reduce the truck's empty operation and turn-around times. |
| Handling (Line-hauling, -Delivery) | - The cargo loading and unloading is carried out at the roadside in front of the forwarder's shophouse. This may cause a traffic congestion around there.<br>- General cargoes are unloaded from the 10-wheel truck and sorted for each destination districts on the roadside and loaded onto light trucks for delivery in the city area.<br>- Cargo handling requires vertical motion for loading and unloading. This may cause a damage to cargoes by the accidental mis-handling. | - The truck terminal has its own premises and the cargo handling is operated on a flat level between the truck and platform.<br>- All the general cargoes carried by the line-haul truck is unloaded and sorted for each destination district on the platform, and loaded onto delivery trucks.<br>- The movement of cargoes for loading and unloading is mostly horizontal, so that it is easier to handle the cargoes | - The truck terminal will reduce the operation of heavy trucks in the city area and contribute to the dispursement of traffic generating facilities to outside of the city.<br>- The efficiency of cargo handling will increase and damage to cargoes will reduce |
| Delivery (from terminal to consignees) | - A branch office or agent prepare delivery trucks to distribute the general cargoes transported by line-haul trucks, after they are sorted for respective districts of destinations.<br>- Line-haul trucks are used for delivering cargoes to final destinations, unless return-haul cargoes are ready for transport. | - Delivery trucks start operation in the morning and distribute the cargoes, which have been sorted by direction previously, to consignees.<br>- Line-haul trucks in principle are not used for cargo delivery in the city. | - Effective use of delivery trucks becomes possible, because of the increase in the cargo handling volume at the consolidated place (truck terminal) of small-scale forwarders.<br>- Cargoes can be delivered by light trucks. The use of heavy trucks for cargo delivery accrues a higher cost of operation. |

### 7.4.2 Quantification of Economic Benefits

1) General

Among the effects of the truck terminal enumerated in the preceding Section, the quantification of economic benefits were attempted only for: (a) the effective use of line-haul trucks, and (b) the effective cargo throughput at loading/unloading and sorting general cargoes by direction.

Each of the project terminals is connected with the Bangkok terminal and other Changwat centers. The line-haul operation from which the benefit is anticipated will be relevant to the connection between the Project Cities and Bangkok.

The efficiency in cargo handling, however, can be expected for all the general cargoes loaded and unloaded at the project terminals, no matter where they are going to or coming from.

The benefit quantified from the efficiency of the line-haul operation between Bangkok and the Project Cities comprises the following three elements:

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

ii) The second is the increase in the return-haul cargoes from the Project Cities to Bangkok by the centralization of transport demand and supply information at the terminal centers. The marginal return-haul capacity will be occupied by a bulk of agricultural products. Therefore, the running cost will increase in the return-haul operation.

iii) The third is the decrease in the total transport cost of agricultural products from the Project Cities to Bangkok, which accrued from the utilization of return-haul trucks for general cargo transport mentioned above.

2) Fixed Costs of 10-wheel Truck Operation

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

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

In the existing situation, the round trip for a distance of up to 600 km takes, on the average, 4 days or 6-7 trips per working month of 26 days. This means the annual trip distance of 90,000 km, which is quite close to the truck utilization rate of 85,000 km per year for a 10-wheel truck which was adopted in the "Study of Trucking Industry: Phase II, 1987".

A reduction of the round-trip days for the above case by at least one day will extend the truck's operation distance to 120,000 km per year assuming the operation days to be 300 days per year.

Taking the above two models as the typical and average cases for the line-haul operation of a 10-wheel truck of "with" and "without" truck terminal situations, the fixed capital costs were calculated with several assumptions as shown in Table 7.4.2.

3) Running Costs of Main-haul and Return-haul Operation of 10-Wheel Trucks

The main-haul operation will be made by full-load trucks, generally from Bangkok to the upcountry, and the return-haul operation will be made with relatively little chance of Bangkok-bound cargoes. Most of the forwarding offices in the upcountry at present are only involved in delivery operation and not undertake the return-haul cargoes.

The truck terminals in the Project Cities, however, will positively seek for the return-haul cargoes, whether they are general or bulk cargoes, by using the terminal's function of the centralized information about the transport demand.

Concerning the return-haul transport the following assumptions were made:

i) General cargoes in the main-haul operation is transported by a 10-wheel truck with a full-load of 10 tons.

ii) As far as there exists a return-haul demand for general cargoes, they are transported by the 10-wheel return-truck whether "with" or "without" a truck terminal.

iii) The return-haul operation of general cargoes will be filled out by 50% of the remaining transport capacity with such bulk cargoes as agricultural products, if the return-haul direction is from the upcountry to Bangkok. The application of the 50% to the remaining capacity is based on the consideration of seasonal fluctuation of the transport demand for agricultural products. If the return-haul direction is from Bangkok to the upcountry, the remaining capacity will not be filled out anymore.

iv) Based on the result of reviewing the "Study of Trucking Industry: Phase II, 1987 - Survey Report IX" running costs of a 10-wheel truck are estimated as follows:

- Travel speed: 55 km/hr
- Economic running costs at gross vehicle weights of:
  8 tons B1.414/km
  21 tons B2.928/km

Based on the above assumptions and the estimated future traffic demand of each truck terminal, the running costs of 10-wheel trucks were estimated for the main-haul and return-haul operations as shown in Appendices 7.11 through 7.16.

**Table 7.4.2 Comparison of Fixed Costs of 10-Wheel Truck between "With" and "Without" Situations**

| Particulars | | "Without" Truck | "Without" Terminal | "With" Truck | "With" Terminal |
|---|---|---|---|---|---|
| (1) Annual Capital Cost: | | | | | |
| a) Vehicle Cost (Economic) including Tyres (B) | : | 690,345 | | 690,345 | |
| b) Annual Kilometrage (km) | : | 85,000 | | 120,000 | |
| c) Truck Service Life (year) | : | 12 | | 8 | |
| d) Interest Rate (% p.a.) | : | 12 | | 12 | |
| e) Salvage Value (10% of a)) | : | 69,035 | | 69,035 | |
| Annual Capital Cost (B/year) | : | 108,588 | | 133,353 | |
| (2) Other Fixed Costs (B/year): | | | | | |
| f) Basic Salaries: Driver | | 37,200 | | 37,200 | |
| Assistant | | 22,800 | | 22,800 | |
| Sub-total | | 60,000 | | 60,000 | |
| g) Allowance | | 19,200 | | 27,100 | |
| h) Overheads | | 31,100 | | 43,900 | |
| Other Fixed Costs (B/year) | : | 110,310 | | 131,000 | |
| (3) Fixed Costs: (1) + (2) (B/year) | | 218,898 | | 264,353 | |
| (B/km) | | 2.575 | | 2.203 | |
| (4) Saving in Fixed Costs (B/km) | : | | 0.372 | | |

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

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

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

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

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

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

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

4) Transport Costs of Agricultural Products

It was assumed in the previous section of para. 3) that the marginal transport capacity of the return-haul trucks to Bangkok will be utilized to transport agricultural products from the upcountry.

This will bring about the economization of transport costs for agricultural products as a whole and fewer trucks will be required for transporting agricultural products under the "with" project situation.

Therefore, both fixed and running costs of truck operation can be saved in this situation. However, only the saving in running costs should be taken for benefit calculation because the transport demand for agricultural products is fluctuating by season and the demand is scattered throughout the country.

The additional running costs accruing from the comparison between "with" and "without" project situations for transporting agricultural products were calculated in Appendices 7.23 through 7.28.

5) Handling Costs

According to the result of interviews with forwarders in Bangkok, it was found that a handling cost for loading or unloading of a 10-wheel truck's full-load cargo was 100 Baht or about 10 Baht per ton.

The use of a platform in the terminal is expected to increase the efficiency of cargo handling and sorting works, if compared with those without platform as they are at most of forwarders' shophouses.

The number of laborers required for a 10-wheel truck-load averages about 8 persons at present and it was assumed to decline to 6 persons, which means the improvement of handling efficiency by 25%.

6) Summary of Quantified Economic Benefits

Savings in the fixed cost and the running cost of the 10-wheel line-haul truck, and the saving in the cargo handling cost were analysed by comparing "Without" and "With" truck terminal situations.

The economic benefits, therefore, were based on the above results and the estimated future tonnages of main-haul and return-haul operations, and their distances between Bangkok and the project cities. The total handling volumes were also applied to estimate the benefit obtained from the saving in cargo handling costs. The summary of these benefits is presented in Table 7.4.3 and the details are incorporated into Appendices 7.23 through 7.28.

### 7.4.3 Cost-Benefit Analysis

1) Economic Cost and Benefit Flows

An implementation schedule was assumed to begin with the detailed engineering in 1989 and the operation in 1993 for each of the project terminals. Based on this implementation schedule, the disbursement program was assumed as presented in Appendices 7.29 through 7.31.
The economic costs of the projects were estimated assuming that they were 81% of the financial costs excluding land acquisition and compensation costs. This percentage was derived from the "Study of Trucking Industry: Phase II, 1987", and the resulting economic cost flows are also summarized in Appendices 7.29 through 7.31.

The administration and maintenance costs were estimated in Table 9.3.5 in Section 9.3.

The economic benefits were estimated previously for the target years of 1996 and 2006. The intermediate year benefits were, therefore, interpolated exponentially between the two target years.

After the year 2006, the rate of benefit growth was assumed to decline to half the rate used before 2006 and to continue up to the terminating year of the project life of 20 years. This was done with an intention to maintain the conservative estimate for the benefit in a distant future.

**Table 7.4.3 Summary of Economic Benefits in 1996 and 2006**

(Unit: 1000 Baht/year)

| Terminals | | Year 1996 | Year 2006 |
|---|---|---|---|
| 1) | Chiang Mai: | | |
| | - Main-haul | 5,731 | 9,226 |
| | - Return-haul | 17,234 | 28,694 |
| | - Handling Cost Saved | 1,090 | 1,668 |
| | Total Savings | 24,055 | 39,588 |
| 2) | Nakhon Sawan: | | |
| | - Main-haul | 2,024 | 3,192 |
| | - Return-haul | 6,540 | 10,257 |
| | - Handling Cost Saved | 1,980 | 3,138 |
| | Total Savings | 10,544 | 16,587 |
| 3) | Nakhon Ratchasima: | | |
| | - Main-haul* | 3,555 | 6,856 |
| | - Return-haul | 3,555 | 6,856 |
| | - Handling Cost Saved | 5,100 | 9,146 |
| | Total Savings | 12,210 | 22,858 |
| 4) | Khon Kaen: | | |
| | - Main-haul | 3,715 | 6,058 |
| | - Return-haul | 9,426 | 14,673 |
| | - Handling Cost Saved | 1,652 | 2,768 |
| | Total Savings | 14,793 | 23,499 |
| 5) | Hat Yai/Songkhla: | | |
| | - Main-haul | 9,692 | 18,162 |
| | - Return-haul | 27,406 | 50,409 |
| | - Handling Cost Saved | 2,099 | 3,995 |
| | Total Savings | 39,197 | 72,566 |

Note: * The main-haul direction is estimated to flow from Nakhon Ratchasima to Bangkok

2) Comparison of Cost and Benefit Flows

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

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

The results of the above cost and benefit analysis were summarized in Table 7.4.4.

**Table 7.4.4 Comparison of Economic Cost and Benefit Flows of Candidate Truck Terminals**

| Candidate Terminals | Discounted at 12% p.a. NPV (฿1000) | B/C | IRR (%) |
|---|---|---|---|
| 1) Chiang Mai | 108,700 | 3.53 | 43.12 |
| 2) Nakhon Sawan | 18,490 | 1.40 | 18.42 |
| 3) Nakhon Ratchasima | 5,873 | 1.08 | 13.24 |
| 4) Khon Kaen | 40,558 | 1.79 | 23.10 |
| 5) Hat Yai/Songkhla | 184,808 | 3.45 | 42.24 |

## 7.5 Selection of Three Terminals for the Feasibility Study

### 7.5.1 Method of Selection

The Scope of Work of this Study calls for the feasibility study of three terminals. It was necessary to select three out of the five terminals for the study up to this stage. The comparison of economic benefits and costs as presented in the preceding Section 7.4 cannot be the only criterion for evaluating the five candidate terminals. Social and political considerations will come into play in the actual policy making since such considerations, no matter how non-economic in the short run, may be one of the main factors in determining the country's long run economic efficiency. In this Study five criteria were considered for the purpose of selecting the three out of the five. Each terminal was evaluated by means of indicators which were converted into scores in a scale from 1 to 5. Table 7.5.1 summarizes data associated with such indicators, and Table 7.5.2 shows the evaluation indicators. A weight was assigned to each criterion and the weighted total of scores by each criterion was calculated for each terminal for the comparison with other terminals.

The five terminals were ranked in terms of the weighted total score. The following describes each criterion and the assigned weights.

1) Economic Internal Rate of Return

The economic internal rate of return of each of the five terminals was estimated as shown in the preceding Section 7.4. The estimation of economic benefits was made in a simplified manner with many associated benefits being ignored for simplicity, and suitable for the pre-feasibility study. The method should be given conservative estimates. Estimated IRRs are 43.1% for Chiang Mai, 42.2% for Hat Yai/Songkhla, 23.1% for Khon Kaen, 18.4% for Nakhon Sawan, and 13.2% for Nakhon Ratchasima.

A weight of 0.6 was assigned to this criteria considering its importance and explicitness.

2) Promotion of Regional Development

The promotion of development of projects away from the Bangkok Area has been one of the major policies advocated by the Royal Government of Thailand. Successive Five Year Plans' with stated objectives have always included the development of regional cities as a means of regional development promotion. The establishment of a truck terminal in the Project City of a region would certainly contribute to the development of the region. An indicator of such impact was devised in the form of the ratio of truck terminal annual throughput and influence area gross product. If the ratio is high, the terminal's impact on the regional economy would be high as well. The ratios in terms of one thousandth were 29.8 for Nakhon Ratchasima, 11.1 for Nakhon Sawan, 10.5 for Hat Yai/Songkhla, 9.5 for Khon Kaen, and 8.1 for Chiang Mai. The high ratio for Nakhon Ratchasima may indicate the role of the city as the distribution center of the whole Northeast.

A weight of 0.1 was assigned to this criterion.

## Table 7.5.1 Evaluation Base Data

| | Base Data | Chiang Mai | Khon Kaen | Nakhon Sawan | Nakhon Ratchasima | Hat Yai/ Songkhla |
|---|---|---|---|---|---|---|
| (A) | Influence Area's Gross Product (in 1986, million ฿) | 34,296 | 40,706 | 44,110 | 37,6354 | 37,621 |
| (B) | Industrial & Commercial Land Uses ($Km^2$) | 4.00 (1982) | 2.87 (1981) | 0.86 (1982) | 1.95 (1982) | 1.08 (Hat Yai 1982) |
| (C) | Municipal Population (1983, thousand) | 150 | 116 | 95 | 191 | 194 |
| (D) | Truck Terminal Area (thousand, $m^2$) | 23.6 | 25.8 | 25.8 | 43.0 | 43.0 |
| (E) | Truck Terminal Cargo (1987, thousand tons/yr.) | 277 | 387 | 488 | 1,112 | 393 |

## Table 7.5.2 Evaluation Indicators

| | Base Data | Chiang Mai | Khon Kaen | Nakhon Sawan | Nakhon Ratchasima | Hat Yai/ Songkhla |
|---|---|---|---|---|---|---|
| 1. | Internal Rate of Return (%) | 43.12 | 23.10 | 18.42 | 13.24 | 42.24 |
| 2. | Regional Development: (E)/(A) (tons/yr/million ฿) | 8.08 | 9.51 | 11.06 | 29.77 | 10.45 |
| 3. | Urban Environment (E)/(C) (%) | 1.85 | 3.34 | 5.14 | 5.82 | 2.03 |
| 4. | Promotion of Desirable Land Use: (D)/(B) (%) | 0.59 | 0.90 | 3.00 | 2.21 | 3.98 |
| 5. | Stragetic Growth Centers | 5 | 5 | 1 | 3 | 5 |

Note: Capital letters indicate items shown in Table 7.5.1.

3) Improvement of Urban Environment

The introduction of a regional truck terminal expedites the distribution of commodities and eventually contributes to the socio-economic development of the region.

At the same time, such commodities to be handled at the truck terminal will influence the traffic flows particularly inside the city area. Without the truck terminal, heavy trucks cannot avoid travelling in and out of the city for the distribution of regional cargoes. This increases the traffic congestion and urban environment deteriorates accordingly.

In order to compare the candidate terminals in terms of the extent of their impact on the respective urban societies, the ratio of the amount of cargoes handled by the truck terminal and the municipal population of the project changwat was employed. The higher the rate the larger the terminal's impact on the society.

The ratio in terms of annual tons per person for the Chiang Mai terminal was low at 1.85 compared with others due to the high volume exchange with the nearby Lampang, which could not be handled by the Chiang Mai terminal.

The ratio for Nakhon Ratchasima was estimated at 5.82, the highest figure, followed by Nakhon Sawan terminal of 5.14, among the candidate terminals.

A weight of 0.1 was assigned for this criterion.

4) Promotion of Desirable Land Use

Many of the existing trucking operations involve streetside loading, unloading and stockpiling at the shop front in many locations within the crowded urban centers. If such operations and facilities could be concentrated in a terminal outside of crowded urban centers, beneficial effects on the surroundings and the conversion of facilities would no longer be needed to promote desirable urban land use. The ratio of commercial, high density residential, and industrial land use and the truck terminal in terms of land area for each project area was taken as the indicator for this criterion.

Chiang Mai and Khon Kaen have relatively wide areas of commercial, high-density residential and industrial land use. Consequently, the ratio of the proposed terminal to the total area of such land used turned out to be low at less than 1%. Other project areas indicated 2.2% to 3% of such land use for truck terminals.

A weight of 0.1 was assigned to this criterion.

5) Promotion of Strategic Growth Center

The NESDB designated 5 cities as the strategic growth centers of high potentials for regional development; they are Chiang Mai in the North, Nakhon Ratchasima and Khon Kaen in the Northeast, Chonburi in the East, and Songkhla in the South. All the candidate terminals except Nakhon Sawan are included in these growth centers.

Chiang Mai, Khon Kaen and Songkhla are commonly designated as the political, social and cultural centers of the respective regions. Taking the above into consideration, Chiang Mai, Khon Kaen and Hat Yai/Songkhla were given a ratio of 5 points, and Nakhon Ratchasima 3 points, and Nakhon Sawan 1 point.

A weight of 0.1 was assigned to this criterion.

### 7.5.2 Conclusions for the Justification of the Project

The above indicators were converted to rankings in a scale from 1 to 5 in order to facilitate an overall comparison. Table 7.5.3 summarizes the resulting scores together with evaluation weights associated with each criterion. Weighted totals are, shown in descending order; 3.9 for Hat Yai/Songkhla, 3.8 for Chiang Mai, 3.0 for Khon Kaen, 2.5 for Nakhon Sawan, and 2.2 for Nakhon Ratchasima.

All five project terminals are economically justifiable assuming an opportunity cost of capital of 12%. The degree of desirability, however, varies among the five terminals as described in the preceding sub-section.

In conclusion, it is recommended that regional truck terminals for Hat Yai/ Songkhla, Chiang Mai and Khon Kaen be subject to the ensuing feasibility study of this Study.

**Table 7.5.3 Overall Score and Evaluation Summary**

| Evaluation Item | Weight | Chiang Mai | Khon Kaen | Nakhon Sawan | Nakhon Ratchasima | Hat Yai/ Songkhla |
|---|---|---|---|---|---|---|
| 1. Economic Return | 0.60 | 5 (3.0) | 3 (1.8) | 2 (1.2) | 1 (0.6) | 4 (2.4) |
| 2. Regional Development | 0.10 | 1 (0.1) | 2 (0.2) | 4 (0.4) | 5 (0.5) | 3 (0.3) |
| 3. Favorable Urban Environment | 0.10 | 1 (0.1) | 3 (0.3) | 4 (0.4) | 5 (0.5) | 2 (0.2) |
| 4. Better Land Use | 0.10 | 1 (0.1) | 2 (0.2) | 4 (0.4) | 3 (0.3) | 5 (0.5) |
| 5. Strategic Development | 0.10 | 5 (0.5) | 5 (0.5) | 1 (0.1) | 3 (0.3) | 5 (0.5) |
| Weighted Total | | 3.8 | 3.0 | 2.5 | 2.2 | 3.9 |

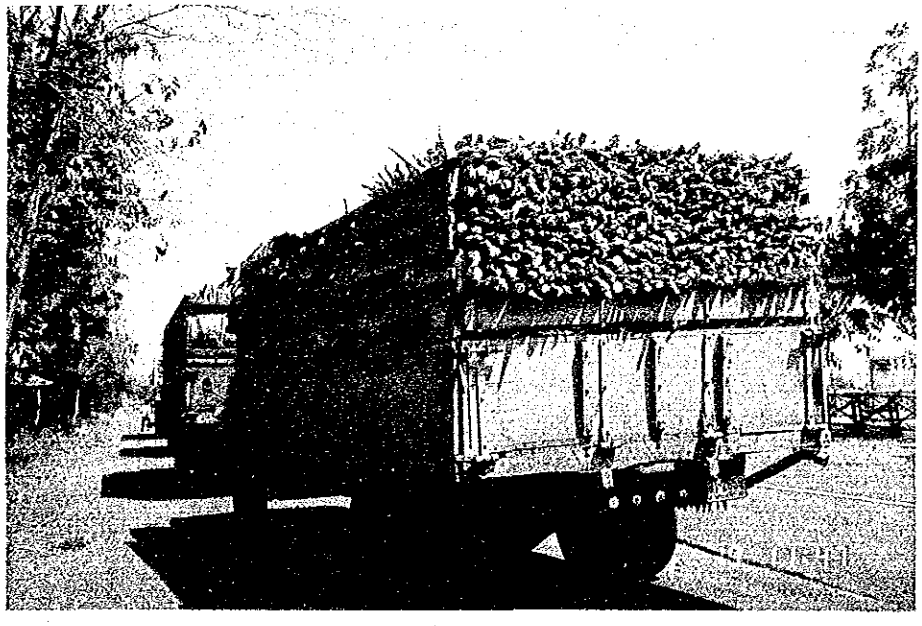
Note: Figures in parentheses show the weighted scores.

# PART III

# FEASIBILITY STUDY FOR SELECTED THREE REGIONAL TRUCK TERMINALS

# CHAPTER 8

# PRELIMINARY DESIGN OF THREE TRUCK TERMINALS



# CHAPTER 8 PRELIMINARY DESIGN OF THREE TRUCK TERMINALS

## 8.1 General

The preliminary facilities planning for three truck terminals was made according to basic considerations as follows:

- The preliminary design of the selected three truck terminals conforms to the study results of the pre-feasibility study regarding terminal locations.

- Terminal complex such as truck terminals, warehouses, truck centers, wholesaler's stock point, etc., is planned as a combined distribution center. However, this complex planning is only confined to a layout designing. Engineering design work in this feasibility study is limited to the project truck terminals.

- The temporary storage space is defined as one of the facilities involved in the truck terminal.

Based on the above-mentioned concepts, studies of basic design concepts, preliminary design and cost estimates for the three project truck terminals were conducted as follows:

## 8.2 Basic Concepts for Terminal Planning

In this section, basic requirements for preliminary design and terminal layout of the three proposed sites which were selected in Section 7.5, are discussed.

It should be noted, however, that design conditions and terminal layouts were considered collectively for the three selected sites since they do not have marked differences in topography, land use pattern in the surrounding areas, and road conditions.

### 8.2.1 Basic Design Conditions

1) Considerations for Site Planning

   a) Since these terminals will mainly serve line-haul trucks from Bangkok, the sites are better to be located on the left side of the main roads radiating from Bangkok.

   b) Also, the sites should be 40m or more away from the main roads to minimize land acquisition costs.

   c) The sites should have sufficient space for a future expansion of the terminal and related facilities.

2) Considerations for Facility Layout

   a) For the arrangement of platform and its apron, primary consideration should be given to the separation of different types of traffic, particularly traffic flows of line-haul trucks and pick-up/delivery trucks.

b) Among the related facilities recommended in Chapter 10, a temporary storage area should be provided by giving extra length to terminal platforms.

c) Since other related facilities will be provided around the terminals in the future, the proposed facilities layouts should take into consideration efficient connections with truck terminals.

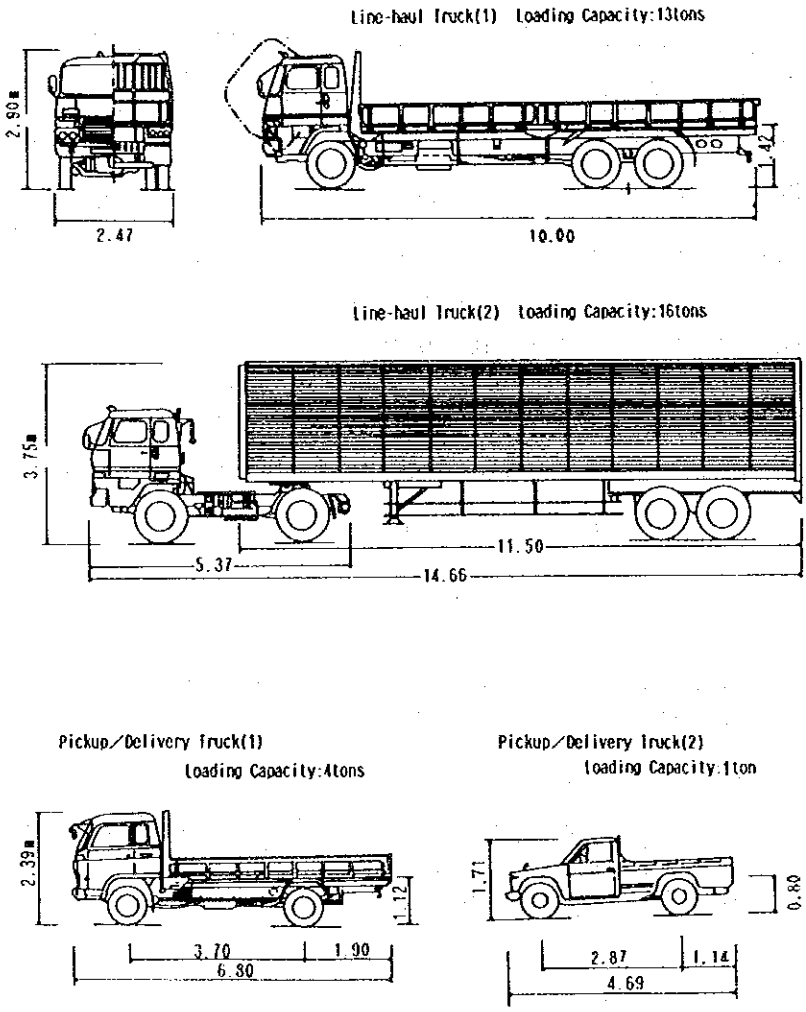
d) The administration building should be provided near the main entrance to ensure effective facilities management and security. In addition, the truck terminals should be enclosed by gates and fences.

e) Green areas should be provided around the truck terminals to minimize environmental impacts to surrounding areas.

3) Main Features of Trucks

The following are the main features of trucks which are considered for planning of truck terminals. (See Fig. 8.2.1)

**Fig. 8.2.1 Main Features of Trucks**



### 8.2.2 Basic Layout

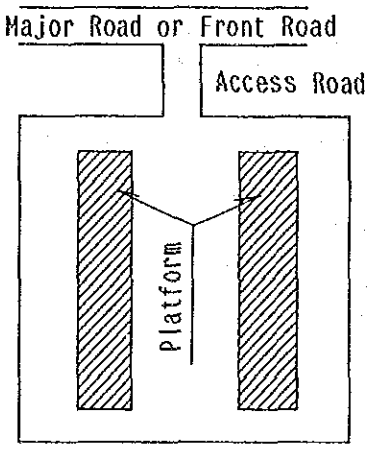
The following three types of layouts were compared in order to select the most suitable one.

1) Basic Layout Plans

a) Type A

An access road is connected to the center of the terminal site, and platforms are arranged perpendicular to the front road.

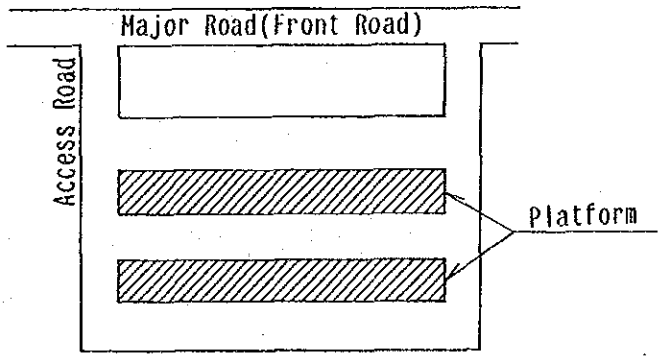
**Fig. 8.2.2 Basic Layout Plan (Type A)**




b) Type B

Two access roads are provided on both sides of the terminal site to separate outbound and inbound traffic, and platforms are arranged parallel to the front road.

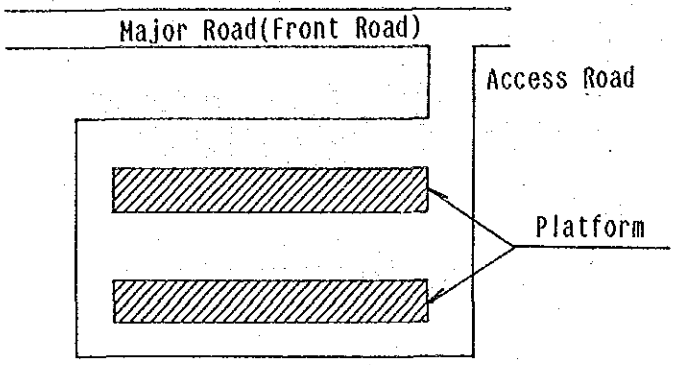
**Fig. 8.2.3 Basic Layout Plan (Type B)**



c) Type C

Modified Type B. One access road into the terminal is provided.

**Fig. 8.2.4 Basic Layout Plan (Type C)**




2) Evaluation of Layout Plans

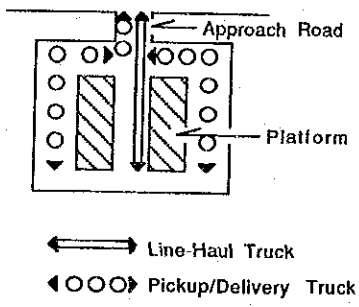
The above layout plans were evaluated for the following factors:

- Traffic flow
- Construction cost
- Relationship with related facilities

a) Traffic Flow

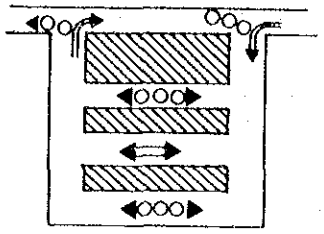
i) Type A: As shown in the sketch, different types of traffic will cross at one point, so that it is assumed that a traffic congestion will take place there.

**Fig. 8.2.5 Traffic Flow (Type A)**



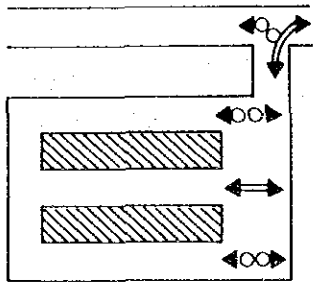

ii) Type B: Since an entrance and an exit are separately provided, inbound and outbound traffic flows are completely separated. However, this results in two intersections on the front road within a relatively short distance.

Fig. 8.2.6 Traffic Flow (Type B)



iii) Type C: Traffic flow within the site can be separated, while only one access point is provided.

Fig. 8.2.7 Traffic Flow (Type C)



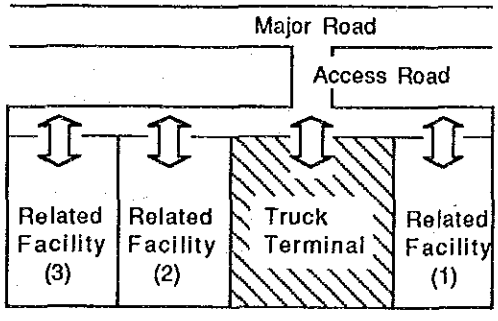
b) Construction Costs

Construction costs for Types A and C are less, while those for Type B as well as land acquisition costs will be relatively high because of the two access roads.

c) Relationship with Related Facilities

i) Type A: Since the access road is connected only to the truck terminal, arrangement of related facilities adjoining the truck terminal is difficult. As a result, related facilities will have to be constructed in a linear pattern, but which will cause less efficient connections between the terminal and the related facilities. This layout will entail relatively high land acquisition costs.

Fig. 8.2.8 Layout of Terminal Complex (Type A)



ii) Type B and C: Related facilities can be arranged relatively freely around the truck terminal. Also, efficient connections among the facilities can be maintained with relatively low land acquisition costs.

**Fig. 8.2.9 Layout of Terminal Complex (Type B)**

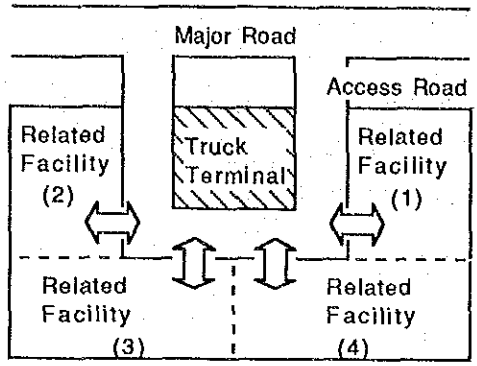
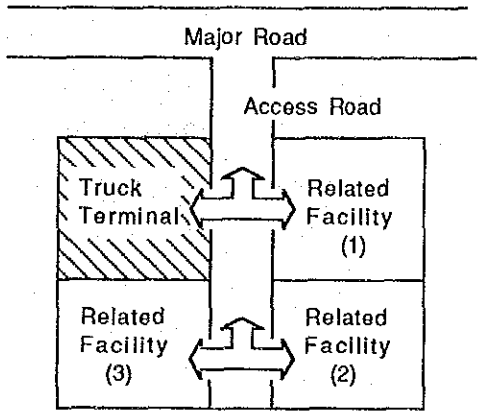



**Fig. 8.2.10 Layout of Terminal Complex (Type C)**




d) Overall Evaluation

Overall evaluation considering the above three factors is summarized in Table 8.2.1. This indicates that Type C is most suitable.

**Table 8.2.1 Overall Evaluation of Alternative Layout Plans**

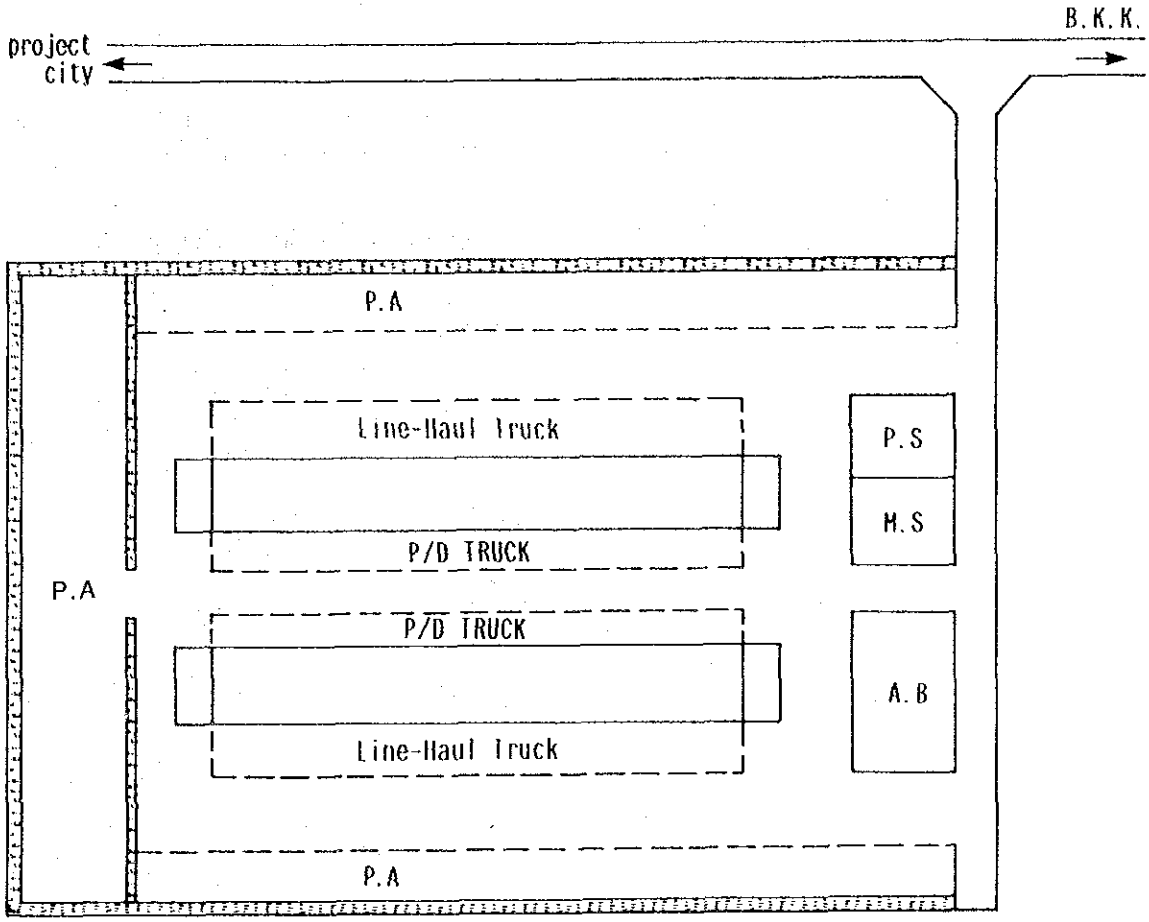
| Criteria | Type A | Type B | Type C |
|---|---|---|---|
| Traffic flow | x | Δ | ◊ |
| Construction cost | ◊ | x | ◊ |
| Relationship with auxiliary facilities | x | ◊ | ◊ |
| Overall evaluation | Δ | ◊ | o |

Note: o: Most Excellent
◊: Excellent
Δ: Good
x: Fair

e) Standard Facilities Layout

On the basis of Type C layout, a type of standard facilities layout are proposed according to berths numbers as follows: (See Fig. 8.2.11)

**Fig. 8.2.11 Standard Facilities Layout**




Note:
P.S : Petrol Station
M.S : Maintenance Shop
A.B : Administration Building
P/D : Pickup/Delivery
P.A : Parking Area

## 8.3 Preliminary Design

### 8.3.1 Design Conditions

1) Cargo Handling Volumes

Cargo volumes to be handled by the truck terminals are estimated in Chapter 7 and are summarized as follows: (See Table 8.3.1)

**Table 8.3.1 Cargo Capacity for Truck Terminals**

(Unit: tons/year)

| Terminal | Type of Cargo | | |
|---|---|---|---|
| | Outbound Cargo Volume | Inbound Cargo Volume | Total Volume |
| Chiang Mai | 210,547 (702) | 456,719 (1,522) | 667,266 (2,224) |
| Khon Kaen | 430,512 (1,435) | 676,799 (2,256) | 1,107,311 (2,691) |
| Hat Yai/Songkhla | 505,197 (1,684) | 1,092,969 (3,643) | 1,598,166 (5,327) |

Note: Figures in parentheses show daily volumes in tons. Annual operating rate was assumed to be 300 days.

2) Berth Dimensions

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

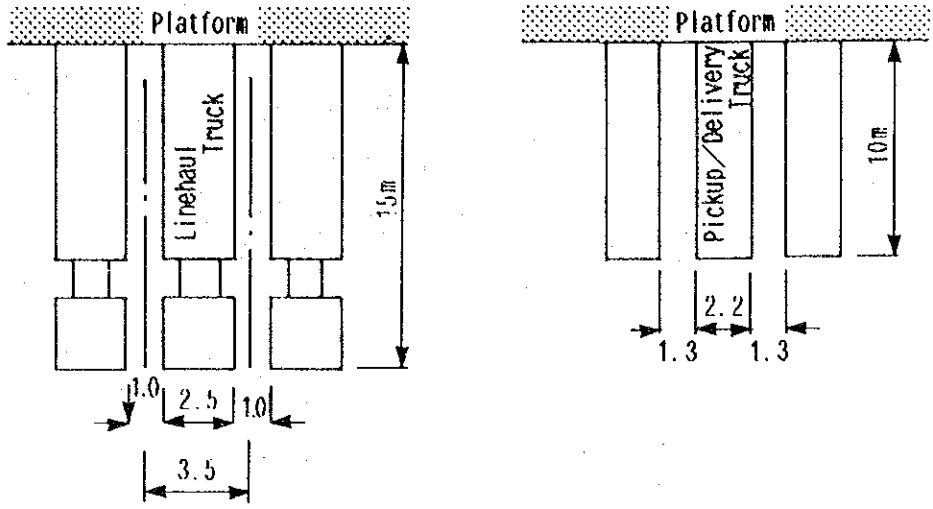
a) Berths for Line-haul Trucks

General dimensions of berths for line-haul trucks were determined for semi-trailer trucks in consideration of scale allowance to meet various kinds of trucks in future.

b) Berths for Pick-up/Delivery Trucks

General dimensions of berths for pick-up/delivery trucks were determined for 4-ton trucks.

Fig. 8.3.1 General Dimensions of Berths for Trucks




3) Spacing between Platforms

a) Line-haul Trucks

Spacing between the two platforms along which line-haul trucks face each other was determined at 50m as shown in Fig. 8.3.2.

b) Pick-up/Delivery Trucks

Spacing between the two platforms along which pick-up/delivery trucks face each other was determined at 32 m as shown in Fig. 8.3.2.

It should be noted that the platforms were arranged in such a manner to avoid berthing face to face a line-haul truck and a pick-up/delivery truck, which would result in the crossing of traffic flows.

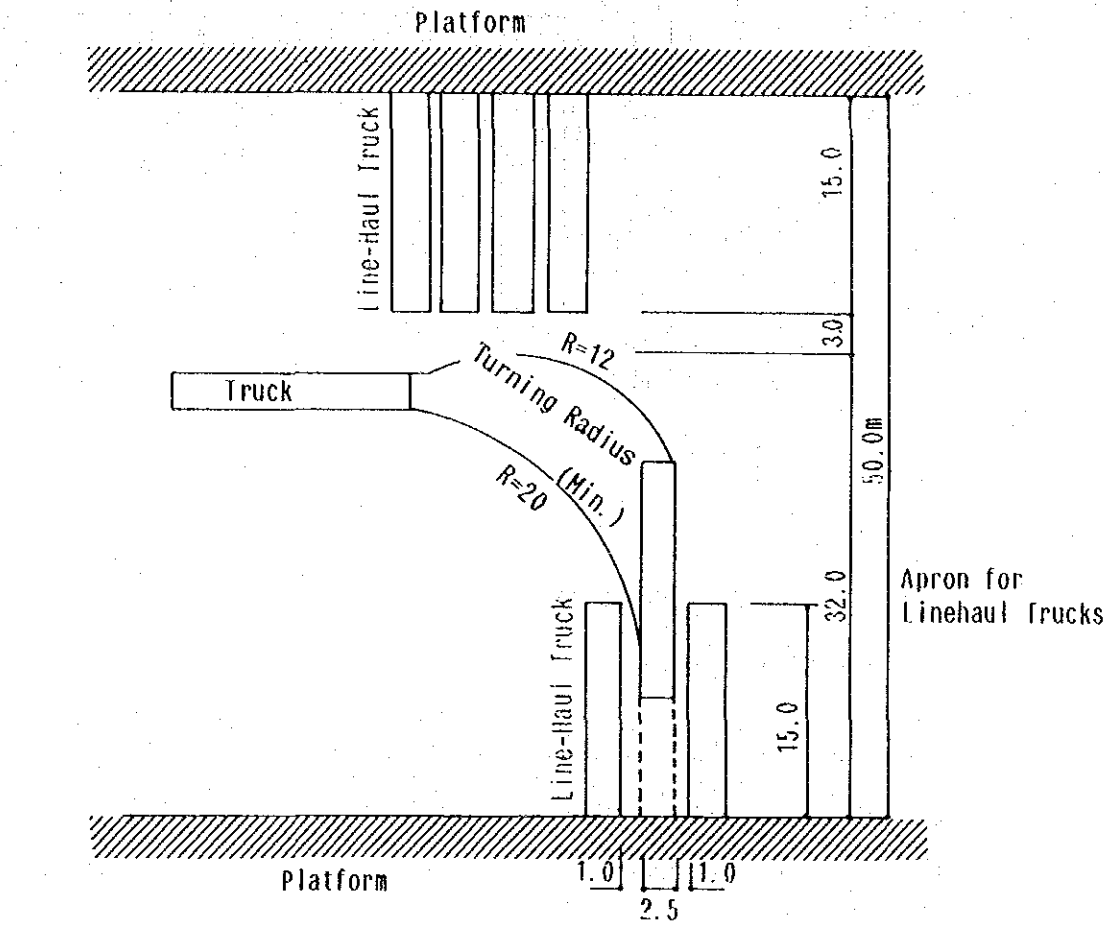
4) Platform Width and Shape

Since platforms provide the space for storing and sorting out cargoes and for service path, their shape should preferably be linear (rectangular) type to ensure efficient operation. Since the site has no spatial restriction from the site shape and size, the rectangular shape is employed for the platforms.

Similarly, a desirable width of the platform is 20 to 25m to satisfy the above functions. Although 25m is desirable if cargo handling machines are to be introduced, it was decided that 20m would be sufficient for the time being judging from the cargo volumes estimated to be handled.

Platform level was determined at the same level as truck beds so as to minimize manpower requirements for loading and unloading operations and to minimize the risk of damage to cargoes during loading and unloading operations. Above dimensions are illustrated below.

**Fig. 8.3.2 Spacing between Platforms**



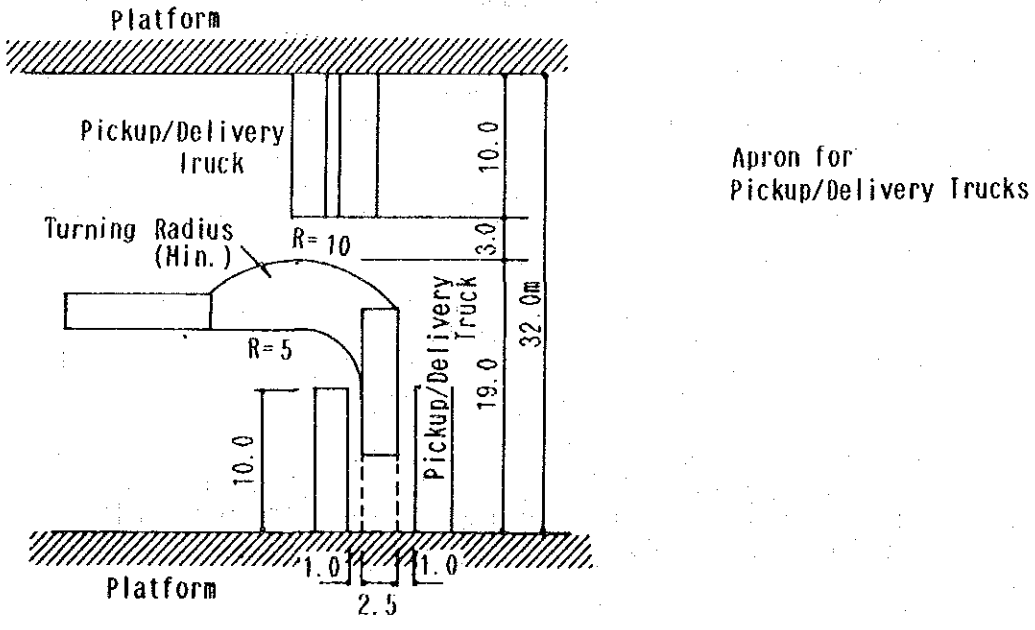
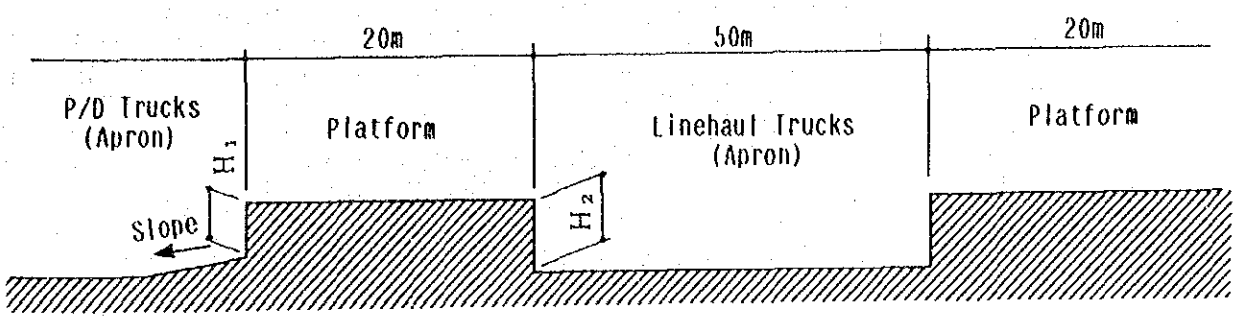



**Fig. 8.3.3 Cross-Sectional Dimensions of Platform**




Note
P/D : Pickup/Delivery

It should be noted that $H_1$ and $H_2$ are based on Japanese vehicle specifications since accurate data was not available during the field study.

H1 = 1.1 m (4-ton truck)
H2 = 1.4 (10-ton truck)

a) Checking on Platform Area

Platform width was determined at 20m from data of truck terminals in Japan. On the other hand, required platform area was checked from space requirements for cargo handling. The platform area can be calculated by the following formula:

Floor space for cargo stacking ($m^2$)
= Cargo volume to be stacked (t)/Specific gravity of cargo ($t/m^3$)
x stacking height (m)

Platform area ($m^2$)
= Floor space for cargo stacking ($m^2$)/1 - Ratio of passageway area

where,
Specific gravity of cargo: 0.26 $t/m^3$
Stacking height: 1.5 m
Ratio of passageway area: 0.35 (manual cargo handling)

Based on the above relationships, required platform area for Chiang Mai terminal was calculated as follows:

Stacked cargo volume is based on inbound cargo during peak two hours.

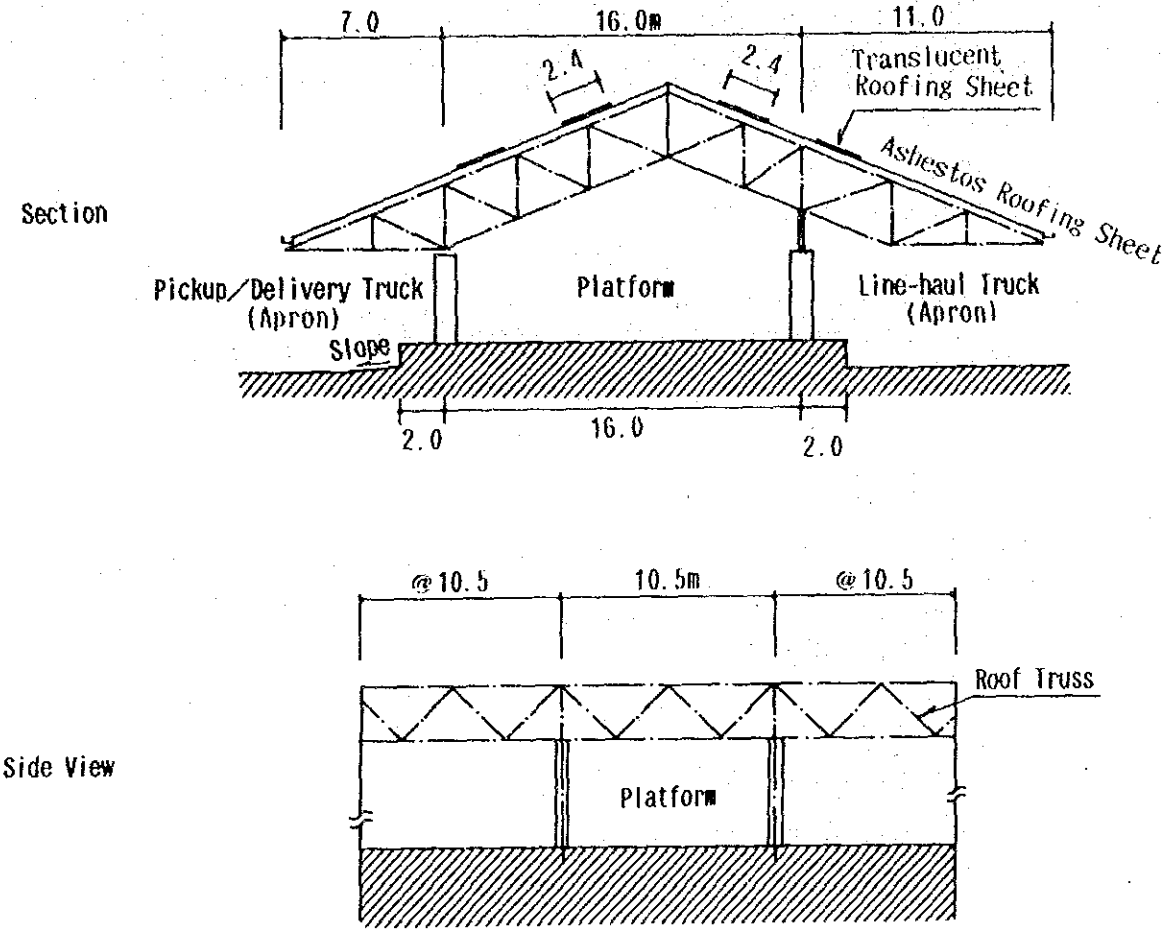
Floor space for cargo stacking $= \frac{302}{0.26 \times 1.5} = 774\ m^2$

Platform area $= \frac{774}{1 - 0.35} = 1{,}191$ m2 < 30 berths x 3.5 x 20 = 2,100 $m^2$

5) Platform Roof Structure

A roof structure over the cargo handling yards were designed with the most economical span of 10.5 m, within which 3 berths are provided. (each berth will be 3.5 m wide) The roof will be made of asbestos roof tiles with skylights provided in between.

**Fig. 8.3.4 Platform Roof Structure**




6) Finished Grade Level for Terminal Sites

A finished grade level of the terminal sites will be at least the same as that of roads near the site. This was determined from the consideration to minimize the risk of flooding which occurs in and around the proposed sites, and to facilitate vehicle's approach from the roads to the terminals.

Actual finished grade levels should be determined on the basis of flood level and soil investigations of the existing ground and fills.

7) Estimation of Manpower Requirements at the Terminals

The following personnel are required as manpower for truck terminals:

- Administration office workers
- Platform workers
- Truck drivers and assistants

Manpower requirements were estimated by using the following basic data:

- Office workers: 12 persons (as shown in Table 9.3.5, Section 9.3)
- Cargo volumes handled by platform worker: 15 tons/worker/day*
- Truck driver/assistant: 1.8 persons/vehicle for a line-haul truck* (average)
- 2.0 persons/vehicle for a pick-up/delivery truck*

* Obtained from the field survey and hearings in the field.

Estimated manpower requirements at the terminals are summarized in the table below (See Table 8.3.2)

**Table 8.3.2 ManPower Requirements for Truck Terminals**

| Terminal | Daily Inbound Cargo (tons) | Manpower Requirements (persons) | | | |
|---|---|---|---|---|---|
| | | Office Worker | Platform Worker | Driver Assistant | Total |
| Chiang Mai | 1,522 | 12 | 100<br>50<br>150 | 270<br>240<br>510 | 672 |
| Khon Kaen | 2,256 | 12 | 150<br>100<br>250 | 400<br>480<br>880 | 1,142 |
| Hat Yai/ Songkhla | 3,643 | 12 | 240<br>120<br>360 | 655<br>560<br>1,215 | 1,587 |

Notes: 1. The number of trucks was estimated under the assumption of average cargo load for line-haul trucks as 10 tons, and for pick-up/delivery trucks as 3 tons (average between 2 - 4 tons).

2. Figures in the upper columns denote manpower requirements for line-haul trucks, and those in the lower columns for pick-up/delivery trucks.

3. Drivers and assistants for pick-up/delivery trucks are assumed to operate at a turnover of 2 times.

8) Estimation of Number of Berths

The number of berths required at the terminals were estimated as a sum of those required for transhipment (Table 7.3.2, Chapter 7) and required for temporary storage.

The number of berths required for transhipment is summarized as follows: (See Table 8.3.3)

**Table 8.3.3 Number of Berths Requirements**

| Terminal | Annual Inbound Cargo (tons) | Daily Inbound Cargo (tons) | Peak two-hour Inbound Cargo (tons) | Peak Two-hour Trucks (vehicles) |
|---|---|---|---|---|
| Chiang Mai | 456,719 | 1,522 | 302 | 30 |
| Khon Kaen | 676,799 | 2,256 | 347 | 35 |
| Hat Yai/ Songkhla | 1,092,969 | 3,643 | 683 | 68 |

The number of berths required for temporary storage was calculated on the basis of relationship between the number of berths (X) and storage space (Y $m^2$) which was determined by experiences in Japan as follows:

$$Y = 0.1688X^2 + 728.8$$

From the above relationship, temporary storage spaces required at the truck terminals were estimated as follows: (See Table 8.3.4)

**Table 8.3.4 Temporary Storage Spaces Requirements**

| Terminal | Berths Requirement (X) (berths) | Storage Space (Y) ($m^2$) | Berths Required for Storage Space a [1] (berths) | Berths Required for Storage Space b [2] (berths) |
|---|---|---|---|---|
| Chiang Mai | 30 | 880 | 12.5 | 15 |
| Khon Kaen | 35 | 940 | 13.4 | 15 |
| Hat Yai/ Songkhla | 68 | 1,500 | 21.4 | 25 |

Notes: 1) Column a shows the number of berths required.
2) Column b shows rounded figures in Column a to a multiple of five.

Total number of berths required at each truck terminal was determined as shown in Table 8.3.5.

**Table 8.3.5 Number of Berths**

| Terminal | No. of Berths Permanently Required | No. of Berths Required for Temporary storage | Total |
|---|---|---|---|
| Chiang Mai | 30 | 15 | 45 |
| Khon Kaen | 35 | 15 | 50 |
| Hat Yai/Songkhla | 70 | 25 | 95 |

9) Basic Units for Water Supply/Sewage Treatment Facilities

Basic units required for determining the size of water supply and sewage treatment facilities were estimated as follows:

- Water requirement for daily consumption: 100 *l*/person/day[Note 1]
- Waste water production: 90 *l*/person/day[Note 2]
- Water requirement for car wash: 1 ton/vehicle[Note 3]

Note 1: Based on water requirements in Laem Chabang Industrial Estate
Note 2: 100 *l*/person/day x 0.8 x 1.1
Note 3: Based on average water consumption for car wash in Japan, adjusted in accordance with data available in Thailand

10) Intensity of Rainfall

Intensity of rainfall in the proposed sites was estimated as follows:

Chiang Mai, Khon Kaen } 170 mm/day (daily max.)
Hat Yai/Songkhla 330 mm/day (daily max.)

Source: Climatological Data of Thailand 30 Year Period (1951-1980) (Meteorological Department, Ministry of Communications)

### 8.3.2 Estimation of Facility Sizes

The facility sizes were estimated by formulas based on the examples of truck terminal in Japan. These sizes indicate required minimum values. Therefore, designed facility sizes adopted were bigger than calculated sizes in consideration of balance and harmony of total arrangement in truck terminal area.

1) Platform Area

**Table 8.3.6 Platform Area**

| Terminal | No. of Berths | Platform Length | Platform Width | Platform Area |
|---|---|---|---|---|
| Chiang Mai | 45 | 157.5 m | 20 m | 3,150 $m^2$ |
| Khon Kaen | 50 | 175.0 | 20 | 3,500 |
| Hat Yai/Songkhla | 95 | 332.5 | 20 | 6,650 |

2) Administration Building

Facilities required in the administration building and their sizes are as follows.

a) Administration Office

The administration office will accommodate office workers including LTD staff (one person). Based on the office space required per person of 10 $m^2$ (determined from data in Japan), the floor area required for each administration office is estimated as follows:

$$12 \text{ persons} \times 10 \text{ m}^2 = 120 \text{ m}^2$$

b) Meeting Room

A meeting room of 80 $m^2$ will be provided for each terminal (determined from data on public truck terminal facilities in Japan).

c) Training Room

A training room of 80 $m^2$ will be provided for each terminal.

d) Cafeteria and Concession

Each cafeteria and concession is assumed to be used by 60% of the persons who are estimated to use each terminal, with the turnover of 6 times (from data by Japanese Truck Terminal Construction Promotion Committee). A space required for each person is estimated at 1.25 $m^2$.

Chiang Mai 672 persons x 0.6 x 1/6 x 1.25 $m^2$/person ≒ 100 $m^2$
Khon Kaen 1,142 persons x 0.6 x 1/6 x 1.25 $m^2$/person ≒ 150 $m^2$
Hat Yai/Songkhla 1,587 persons x 0.6 x 1/6 x 1.25 $m^2$/person ≒ 200 $m^2$

e) Resting Room

Each resting room is assumed to be used by a half of line-haul truck drivers at the same time, with 3.3 $m^2$ to be allocated for each person.

| | | |
|---|---|---|
| Chiang Mai | 270 persons x 1/2 x 3.3 $m^2$/person ≒ | 450 $m^2$ |
| Khon Kaen | 400 persons x 1/2 x 3.3 $m^2$/person ≒ | 700 $m^2$ |
| Hat Yai/Songkhla | 655 persons x 1/2 x 3.3 $m^2$/person ≒ | 1,100 $m^2$ |

f) Shower Room

Each shower room is assumed to be used by 60% of the terminal users, with a turnover of 10 and a space required per person of 1 $m^2$ (based on a report by Japanese Truck Terminal Construction Promotion Committee).

| | |
|---|---|
| Chiang Mai | 672 persons x 0.6 x 1/10 x 1 $m^2$/person ≒ 50 $m^2$ |
| Khon Kaen | 1,142 persons x 0.6 x 1/10 x 1 $m^2$/person ≒ 70 $m^2$ |
| Hat Yai/Songkhla | 1,587 persons x 0.6 x 1/10 x 1 $m^2$/person ≒ 100 $m^2$ |

In summary, the space required for each administration building is estimated as follows: (See Table 8.3.7)

**Table 8.3.7 Floor Area of Administration Building**

(Unit: $m^2$)

| Terminal | Administration Office | Meeting Room | Training Room | Cafeteria /Concession | Resting Room | Shower Room | Medical Treatment Room | Total x 1.3 |
|---|---|---|---|---|---|---|---|---|
| Chiang Mai | 120 | 80 | 80 | 100 | 450 | 50 | 50 | 1,200 |
| Khon Kaen | 120 | 80 | 80 | 150 | 700 | 70 | 50 | 1,600 |
| Hat Yai/ Songkhla | 120 | 80 | 80 | 200 | 1,100 | 100 | 50 | 2,300 |

3) Parking Area

a) Chiang Mai

i) Line-haul trucks

1,522 tons/day x 1/10 ton/vehicle ≒150 vehicles
(number of vehicles entering the terminal per day)

302 tons/2 hr x 1/10 ton/vehicle ≒ 30 vehicles
(number of vehicles entering the terminal during the 2 peak hours)

Number of vehicles to be parked is estimated as follows:
Assuming 60% of number of vehicles entering during the 2 peak hours: 30 x 0.6 = 18 vehicles

Assuming 30% of number of vehicles entering during the off-peak hours: (150 - 30) x 0.3 = 36 vehicles

Total = 54 → 55 vehicles

Parking space per vehicle:
3.0 m x 15 m = 45 $m^2$/vehicle

Total parking space required for line-haul trucks:
55 vehicles x 45 $m^2$ = 2,475 $m^2$

ii) Pick-up/delivery trucks

Number of berths, same as those for line-haul trucks, are provided for pick-up/delivery trucks: 45 berths

Parking space per vehicle:
3.0 m x 10 m = 30 $m^2$

Total parking space required for pick-up/delivery trucks:
45 berths x 30 $m^2$ = 1,350 $m^2$

b) Khon Kaen

i) Line-haul trucks

| | | |
|---|---|---|
| 2,256 tons/day x 1/10 | ≒ 226 | vehicles |
| 347 tons/2 hr x 1/10 | ≒ 35 | vehicles |
| 35 vehicles x 0.6 | ≒ 21 | vehicles |
| (226 - 35) x 0.3 | ≒ 58 | vehicles |
| Total | ≒ 79 | vehicles |

Total parking space required for line-haul trucks:
79 vehicles x 45 $m^2$ ≒ 3,555 $m^2$

ii) Pick-up/delivery trucks

50 berths x 30 $m^2$ ≒ 1,500 $m^2$

c) Hat Yai/Songkhla

i) Line-haul truck

| | | |
|---|---|---|
| 3,643 tons/day x 1/10 | ≒ 365 | vehicles |
| 68 tons/2 hr x 1/10 | ≒ 69 | vehicles |
| 69 vehicles x 0.6 | ≒ 41 | vehicles |
| (365 - 69) x 0.3 | ≒ 89 | vehicles |
| Total | ≒ 130 | vehicles |

Total parking space required for line-haul trucks:
130 vehicles x 45 $m^2$ ≒ 5,850 $m^2$

ii) Pick-up/delivery trucks

95 berths x 30 $m^2$ ≒ 2,850 $m^2$

4) Petrol Station

a) Chiang Mai

Line-haul trucks
150 vehicles x 1/60 vehicles/station/day = 3 stations

Pick-up/delivery trucks
234 vehicles x 1/180 = 2 stations

Total = 5 stations

Area required for petrol station
5 x 50 $m^2$ = 250 $m^2$

b) Khon Kaen

Line-haul trucks
226 x 1/60 = 4 stations

Pick-up/delivery trucks
478 x 1/180 = 3 stations

Total = 7 stations
7 x 50 $m^2$ = 350 $m^2$

c) Hat Yai/Songkhla

Line-haul trucks
364 x 1/60 = 6 stations

Pick-up/delivery trucks
560 x 1/180 = 3 stations

Total = 9 stations
9 x 50 $m^2$ = 450 $m^2$

5) Repair Shop

Shop space
Line-haul trucks: 4 m x 15 m = 60 $m^2$
Pick-up/delivery trucks: 3 x 10 = 30 $m^2$

| | |
|---|---|
| Chiang Mai | 400 $m^2$ |
| Khon Kaen | 540 $m^2$ |
| Hat Yai/Songkhla | 440 $m^2$ |

6) Car Wash Facility

Car wash area

| | | | |
|---|---|---|---|
| Line-haul trucks: | 4 m x 15 m | = | 60 $m^2$ |
| Pick-up/delivery trucks: | 3 x 10 | = | 30 $m^2$ |

| | |
|---|---|
| Chiang Mai | 300 $m^2$ |
| Khon Kaen | 540 $m^2$ |
| Hat Yai/Songkhla | 300 $m^2$ |

7) Weighbridge

A weighbridge with control office should be provided for each truck terminal in order to keep truck payload of within legal requirement.

| | | |
|---|---|---|
| Area of weighbridge | : | 3.5 m x 12 m |
| Area of control office | : | 3.5 m x 6 m |

8) Facilities Layout Plan for Each Truck Terminal

On the basis of basic concepts of facility planning and required spaces and sizes for various facilities, layout plans for the truck terminals are prepared as shown in Figs. 8.3.5 through 8.3.7, and details of each facility are shown in Appendices 8.1 through 8.6. Also, floor spaces of the facilities are summarized as follows: (See Table 8.3.8)

### 8.3.3 Design of Major Facilities

Outline of platforms and administration buildings was designed, and design capacities of water supply and sewage treatment facilities were determined as follows.

1) Platform

Platforms are structures to withstand roof and wind loads by 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 3.5 m, with main members being ø60.5 mm x 3.2 mm. RC columns are ø900 with spacing of 10.5 m lengthwise. RC piles are 22 cm square and 10 m long.

Details of the roof truss and platform are illustrated in Appendix 8.1.

2) Administration Building

Administration building consists of the following three sections:

a) Administration section: Administration office, meeting rooms and training rooms
b) Medical care section: Doctor's offices, medical supply storage room, and consulting rooms
c) Service section: Cafeteria, kitchen, lodgings, and bath rooms

**Fig. 8.3.5 Truck Terminal Layout (Chiang Mai)**

SCALE 1:1,000

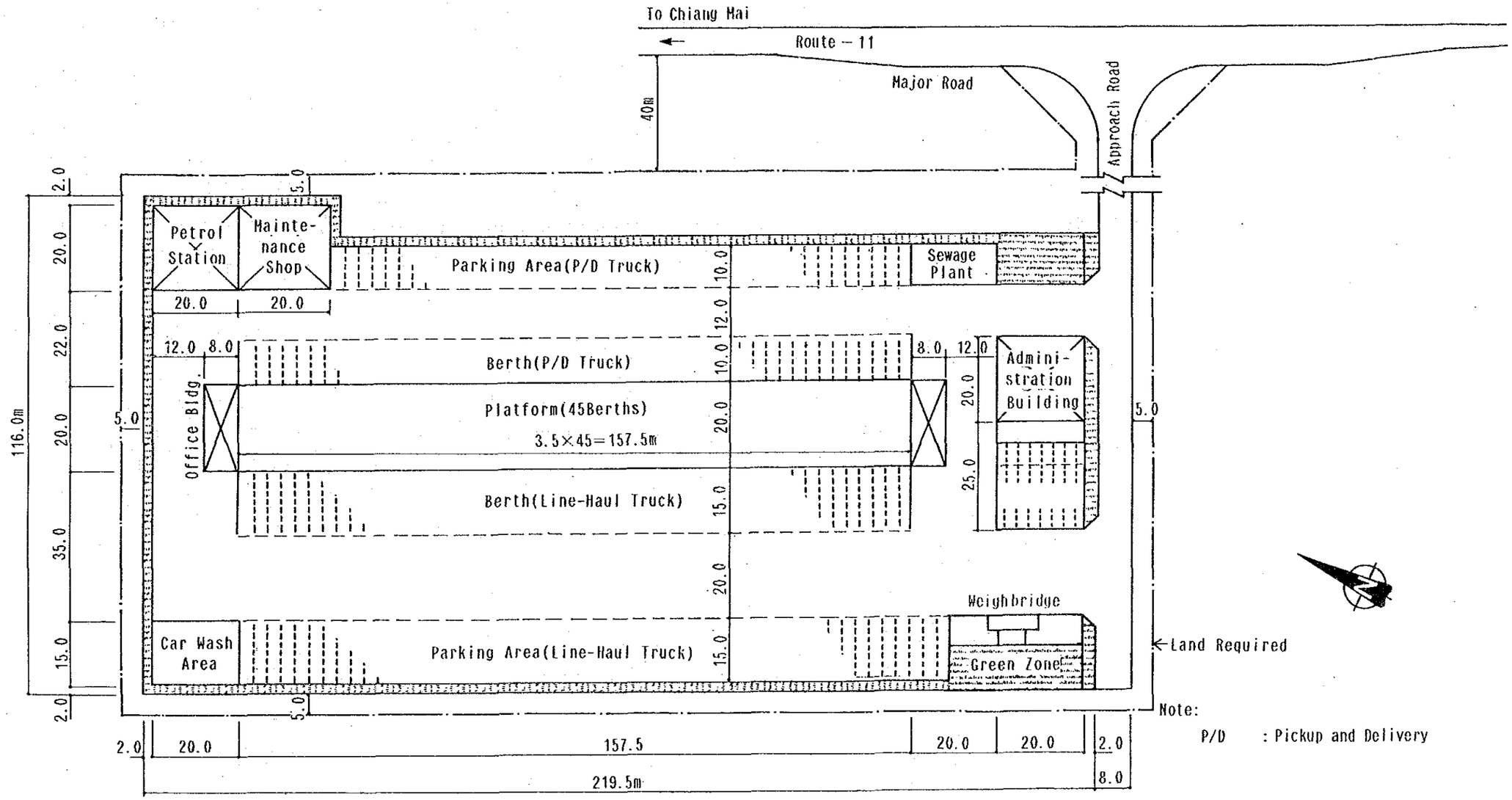
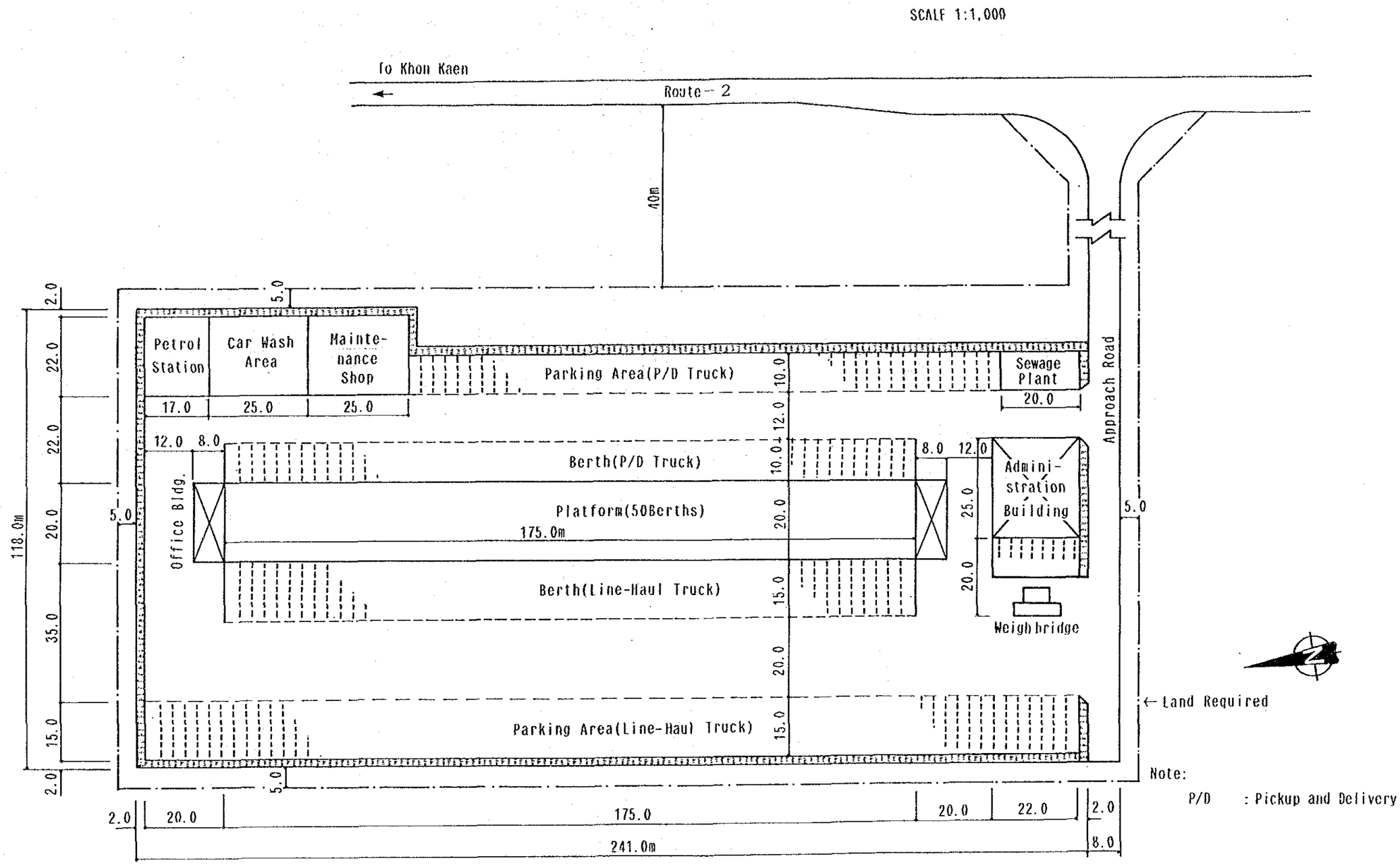


**Fig. 8.3.6 Truck Terminal Layout (Khon Kaen)**




Note:
P/D : Pickup and Delivery

**Fig. 8.3.7 Truck Terminal Layout (Hat Yai/Songkhla)**

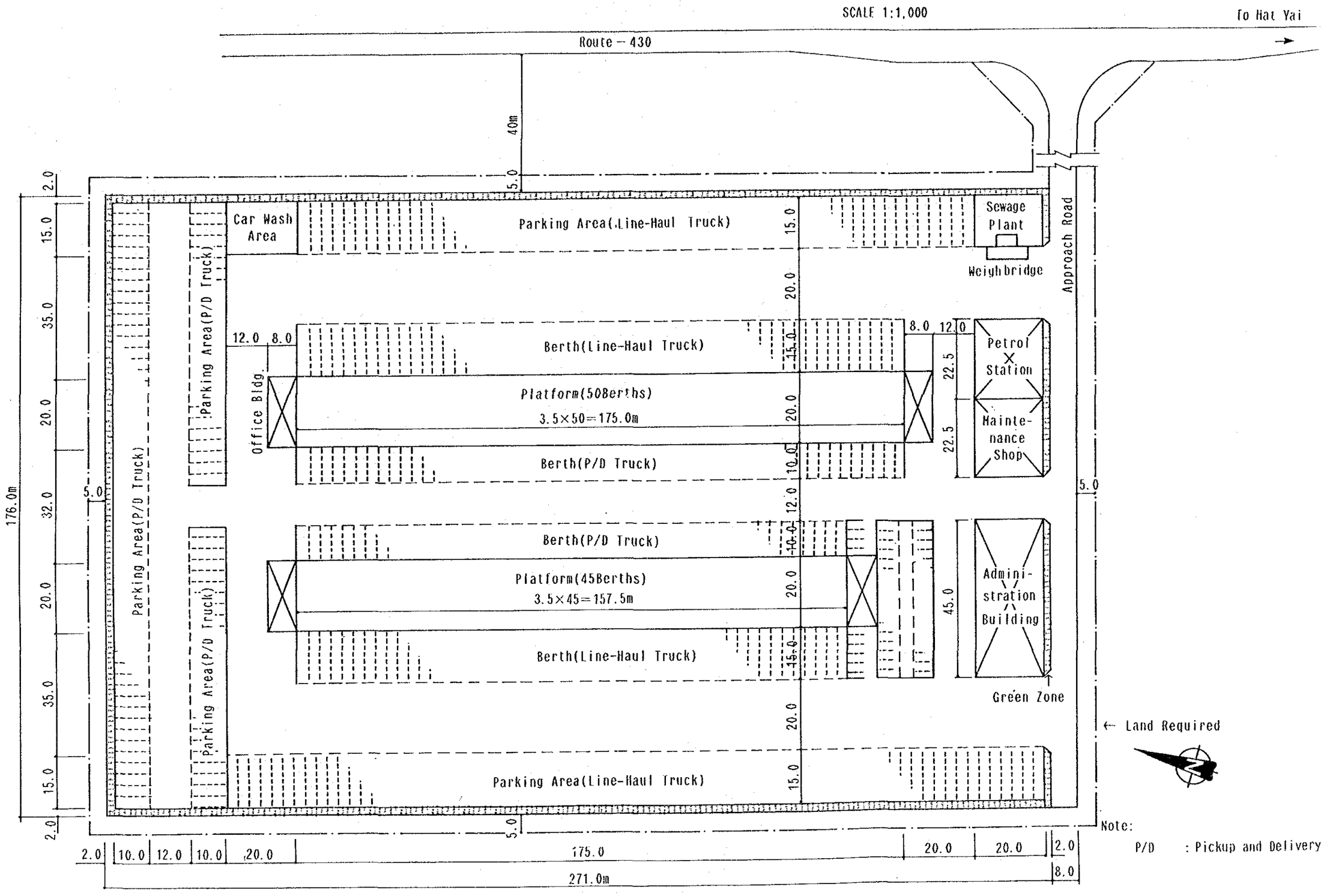


**Table 8.3.8 Estimated Spaces for Terminal Facilities**

(Unit: $m^2$)

| Facility/Terminal | Chiang Mai | Khon Kaen | Hat Yai/ Songkhla |
|---|---|---|---|
| Platform | 3,150 | 3,500 | 6,650 |
| Administration building | 400 | 550 | 900 |
| Office | 320 | 320 | 640 |
| Petrol station | 400 | 374 | 450 |
| Repair shop | 400 | 550 | 450 |
| Car wash area | 300 | 550 | 300 |
| Sewage treatment plant | 200 | 200 | 300 |
| Berth (line-haul trucks) | 2,362.5 | 2,625 | 4,987.5 |
| Berth (pick-up/delivery trucks) | 1,575 | 1,750 | 3,325 |
| Parking area (line-haul trucks) | 2,475 | 3,555 | 5,850 |
| Parking area (pick-up/delivery trucks) | 1,350 | 1,500 | 2,850 |
| Parking area (ordinary vehicles) | 500 | 440 | 965 |
| Road and service path | 8,440 | 9,064 | 15,084 |
| Green zone | 1,834.5 | 1,420 | 2,290.5 |
| Approach | 848 | 848 | 1,408 |
| Total | 24,555 | 27,246 | 49,104 |

Note: Access road from the front road to each terminal is not included.

On the basis of floor spaces estimated for each terminal, interior layout of administration building was developed in accordance with the following criteria:

a) Each section should be arranged separately from others where possible.
b) The administration office and cafeteria are provided on the first floor, with public toilet.
c) Lodgings are provided at the highest floor level.
d) The building are of RC rigid frame structure.

Plans for administration buildings are illustrated in Appendices 8.2 through 8.4.

3) Design Capacities of Water Supply and Sewage Treatment Facilities

a) Water Supply Requirements

Water supply requirements were estimated as the total water consumption by workers at the terminals and car washing.

Number of workers and per unit consumption for each terminal are summarized in Table 8.3.9.

Number of trucks requiring car wash daily was assumed to be 5% of all trucks entering each terminal daily.

**Table 8.3.9 Estimated Water Consumption by Terminals**

(Unit: $m^3$/day)

| Terminal | General Water Consumption | | | Car Wash | | | Total |
|---|---|---|---|---|---|---|---|
| | Persons | Unit Consumption | Requirements | No. of Cars | Unit Consumption | Requirements | |
| Chiang Mai | 670 | 100 *l* | 67 | 44 | 1,000 *l* | 44 | 111 |
| Khon Kaen | 1,140 | 100 *l* | 114 | 74 | 1,000 *l* | 74 | 188 |
| Hat Yai/ Songkhla | 1,587 | 100 *l* | 159 | 107 | 1,000 *l* | 107 | 266 |

Note: No. of trucks requiring car wash

| | | | | |
|---|---|---|---|---|
| Chiang Mai | Line-haul trucks : 2,224 t/day ÷ 10t | = | 222 | Vehicles |
| | P/D trucks : No. of line-haul trucks x 3 | = | 666 | " |
| | No. of trucks requiring car wash: (222 + 666) x 0.05 | = | 44 | " |
| Khon Kaen | 3.691 ÷ 10 | = | 369 | Vehicles |
| | 369 x 3 | = | 1,107 | " |
| | (369 + 1,107) x 0.05 | = | 74 | " |
| Hat Yai/Songkhla | 5,327 ÷ 10 | = | 533 | " |
| | 533 x 3 | = | 1,599 | " |
| | (533 + 1,599) x 0.05 | = | 107 | " |

b) Sewage Treatment Requirements

Only waste water discharged from facilities other than car wash is subject to sewage treatment. Sewage treatment requirements per person are 90 *l*/day. (100 *l*/day x discharge rate 0.8 x ground water 1.1 = 90 *l*/day)

**Table 8.3.10 Sewage Treatment Requirements by Terminals**

(Unit: $m^3$/day)

| Terminal | Persons | Unit Production | Total |
|---|---|---|---|
| Chiang Mai | 672 | 90 *l* | 60.5 |
| Khon Kaen | 1,142 | 90 *l* | 102.8 |
| Hat Yai/Songkhla | 1,587 | 90 *l* | 142.8 |

c) Power Consumption

Power receiving capacities for the proposed terminals are calculated under the following assumptions:

Load capacities

| | |
|---|---|
| Office, Workshop | 100 W/$m^2$ (including airconditioning) |
| platform | 20 W/$m^2$ |
| Site boundary | 1 W/$m^2$ (exterior lighting, other) |

Chiang Mai

| | | |
|---|---|---|
| Site boundary | 24.555 $m^2$ x 1 W/$m^2$ | = 25 kW |
| Platform | 3.150 $m^2$ x 20 W/$m^2$ | = 63 kW |
| Office/workshop | 2.420 $m^2$ x 100 W/$m^2$ | = 242 kW |
| | | 330 kW |

Khon Kaen

| | | |
|---|---|---|
| Site boundary | 27.246 $m^2$ x 1 W/$m^2$ | = 27 kW |
| Platform | 3.500 $m^2$ x 20 W/$m^2$ | = 70 kW |
| Office/workshop | 2.944 $m^2$ x 100 W/$m^2$ | = 294 kW |
| | | 391 kW |

Hat Yai/Songkhla

| | | |
|---|---|---|
| Site boundary | 49.000 $m^2$ x 1 W/$m^2$ | = 49 kW |
| Platform | 6.650 $m^2$ x 20 W/$m^2$ | = 133 kW |
| Office/workshop | 4.516 $m^2$ x 100 W/$m^2$ | = 452 kW |
| | | 634 kW |

d) Storm Water Drainage

Amounts of storm water to be discharged were estimated by using the Rational Formula.

$$Q=\frac{1}{360} \times C \times R \times A$$

where,

Q: Discharge ($m^3/s$)
C: Coefficient of Discharge
R: Intensity of Rainfall (mm/hr)
A: Drainage area (ha)

i) Ratio of runoff (Coefficient of Discharge)

Since each terminal site will be mostly covered by buildings and pavement, ratio of runoff was assumed to be 0.9.

ii) Intensity of rainfall

Since hourly precipitation data is not available in regional cities, it was estimated on the basis of daily maximum precipitation by using the following formula which is generally used in Japan.
Estimation formula:

$$R=\frac{R24}{24}\left(\frac{24}{t}\right)^{2/3}$$

where,

R: Intensity of Rainfall (mm/hr)
R24: Daily rainfall (mm)
t: Unit time (hr)

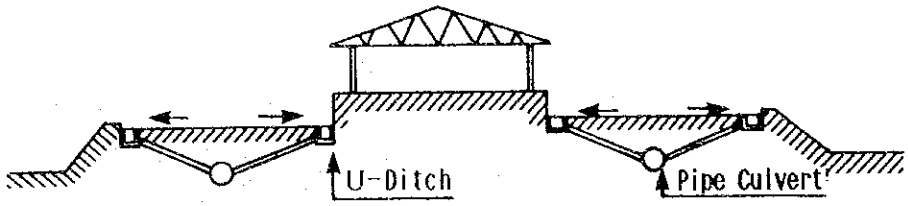
Chiang Mai
Khon Kaen $\quad R=\frac{170}{24}\left(\frac{24}{1}\right)^{2/3} = 59$ mm/hr

Hat Yai/Songkhla $\quad R=\frac{330}{24}\left(\frac{24}{1}\right)^{2/3} = 115$ mm/hr

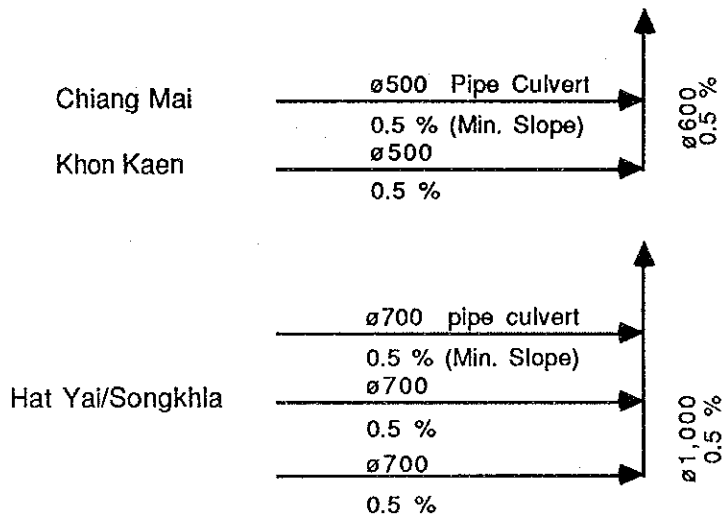
iii) Layout of drainage facilities

As shown below, storm water is collected into U-ditches and then to drainage pipes.

**Fig. 8.3.8 layout of Drainage Facilities**




Pipe culvert diameters for each terminal are estimated as follows:



4) Intersections and Access Roads

Intersections and access roads were designed as shown in Figs. 8.3.9 through 8.3.11.

**Fig. 8.3.9 Cross Section of Access Road**

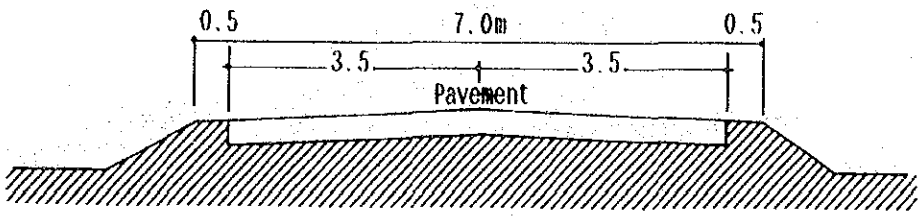



**Fig. 8.3.10 Pavement**

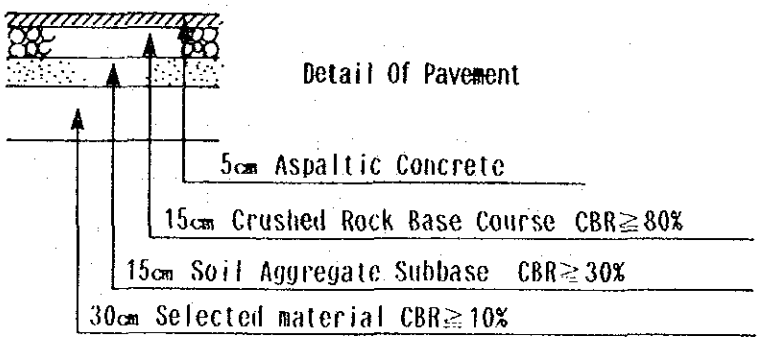


**Figure 8.3.11 Intersection Layout**