4.1.4 Inland Waterways

Viet Nam has 2,360 rivers and canals with a total length of 41,900km, of which 11,000km has been exploited including 2,500km in the north and 4,500km in the south.

Two big river systems in the Red River Delta and Mekong River Delta are formed by these exploited rivers and canals.

The rivers and canals are mainly in the natural form with many silted places and curve streams. The difference of water level between flood and dry seasons is big. So annual dredging is required to maintain navigable drafts.

In the north of Viet Nam, the river system is formed form two rivers: Red River and Thai Binh River. Almost all rivers flow in the northwest-southeast direction connected by the Duong and Luoc Rivers. The rivers are limited in the depth and curvature radius.

The lane for ships has a depth of 2.5-3.0m. The bridges on the rivers in the north are short in length and low in height. Most of the bridges have a height less than 5-7m. In the south of Viet Nam, there is a river and canal network that creates the inter-provincial water lines. Natural rivers are wide and deep. The Tien Giang and Hau Giang Rivers are following to 9 estuaries, with a depth of 5m for the ships of 3000-5000 tons coming in and going out.

The canal and stream network develops creating a water line network connecting the rivers. The water line density is 3 times compared with the road network.

In the north, 5 ports are under the central management:

Hanoi, Ninh Binh (and Ninh Phuc), Ha Bac, Viet Tri, Hoa Binh and 2 ports being constructed in Hoa Binh lake: Van Yen, Ta Hoc.

Besides, 5 other ports are under the provincial management.

In the south, there are 8 ports: Binh Dong, Thu Duc, Tan Thuan, Long Xuyen, Vinh Long, Cao Lanh, Ca Mau, My Tho. They are under localities or professional agencies.

The main task concerning inland waterways is to regulate and control river systems in the Red River Delta and Mekong River Delta in order to ensure the transport of large amount of cargo from Quang Ninh and Hai Phone to deep inland and between eastern and western regions of the southern part of Viet Nam and also to enable sea river ships of 1000-2000 tons to go into deep inland.

4.1.5 Roles of Each Mode

The utilisation and combination of such positive features of various transport modes as safety, punctuality, high speed, low cost, energy consumption efficiency and/or low pollution to meet the transport demand are essential in view of achieving effective and efficient transport activities from the viewpoint of the national economy.

With regard to medium and long distance passenger transportation, there is competition between air, railway and long distance bus services. The share of air transportation is expected to increase in the future when the economic growth of the country makes it possible for the country at large to bear a higher transportation cost.

In the immediate future, however, long distance bus and railway services are the most practical means of mass transportation. The railway service has an advantage in terms of intercity transportation. While the railway, roads and inland water/coastal shipping are strongly associated with short distance transportation, road transportation is the most convenient due to the freedom of access to any destination.

In order for the railway to play a more important role in short distance transportation, the introduction of train types which meet the user requirements and a fare level which is competitive vis-a-vis other modes of transportation is essential. At the same time, development of the public transport network is necessary to ensure harmonious intercity traffic. In addition to the installation of new traffic signals and the enforcement of regulations designed to restrict access by cars for personal use to specified roads at certain hours, such long-term measures as the development of the road network through the replanning of streets and the construction of railway flyovers should be promoted to solve road congestion and other urban problems in an integrated manner.

With regard to cargo transportation, an increased share of road haulage vis-a-vis railway transportation, inland water/coastal shipping and maritime transportation may create serious problems in terms of traffic congestion, noise, air pollution due to exhaust gas and traffic accidents, etc. The encouragement of railway and maritime transportation through consolidation of the preconditions for their use in areas suitable for these modes of transportation, such as medium distance and long distance mass transportation and container transportation, is preferred. The dominance of road and inland water/coastal transportation is likely to continue in the field of short distance transportation while the share of air cargo transportation is likely to remain small in the foreseeable future.

4.2 Overview of Base Year Conditions

The overview on traffic demands in the base year 1994 is presented in this section.

4.2.1 Traffic Modes

Passengers have a choice of traveling by rail, by road, or by air transportation. Inland waterway is also available, but it is not considered in this study because the network is not competitive with other modes. Total volume of trips made by travelers and commuters in Vietnam is estimated 191 million trips (excluding intra province trips) in the year 1994. This represents 2.7 trips per person in a year, reflecting small activities among provinces.

The most popular traffic modes among the travelers and commuters are bus and automobiles. The share of railway is about 5%. Share of air traffic is very small as shown in Fig. 4.2.1.

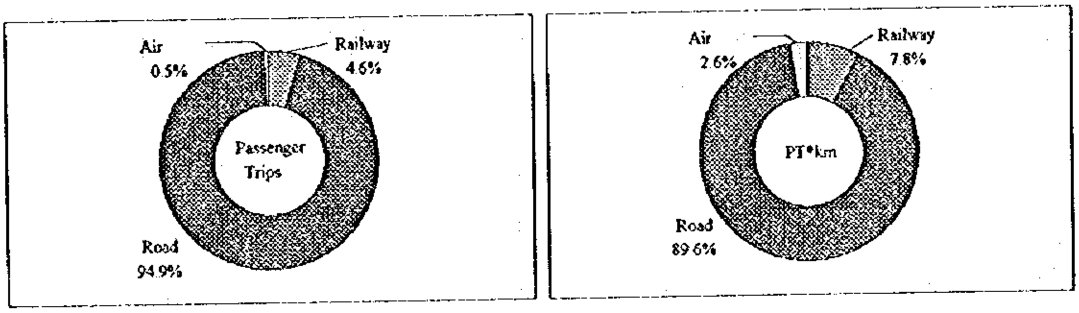
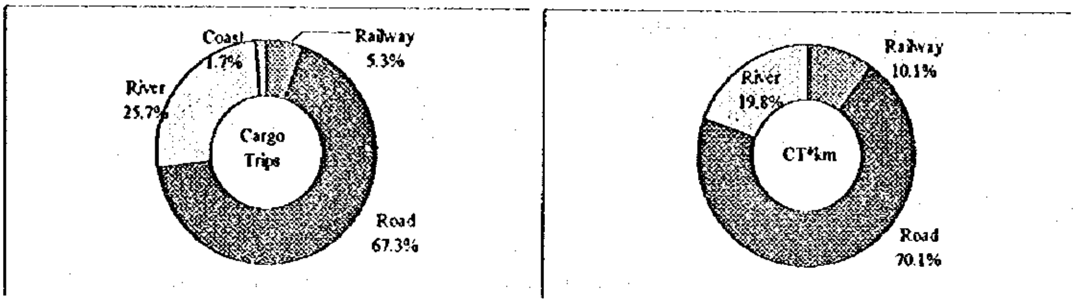


Fig. 4.2.1 Passengers Analysis by Transportation (1994)

Cargo is transported mostly by trucks. The share of truck freight is about 67% in the year 1994, which is relatively low compared to the percentage of passengers, because railway, inland waterway and coastal shipping are also available for cargo freights. The share of each mode are shows in Fig. 4.2.2. Total volume of cargo trips is 60.5 million tons.



*) The volume of CT*km by coastal shipping is unknown.

Fig. 4.2.2 Cargo Analysis by Transportation (1994)

4.2.2 Railway Demand

The number of passengers using railway stations in the Hanoi zone marks the largest figure. It is approximately 1.6 million trips in the year 1994. The second largest is generated in the Ho Chi Minh zone. Total number of passengers were 8.8 million trips. This number has been consistent for a few years. The Hanoi - Ho Chi Minh line transported 5 million, which is 57% of the whole railway passengers in Vietnam. Along the Lao Cai line, the number of passenger was 2.2 million trips including connecting trips to/from other lines. The passengers at stations in Quang Ninh and Ha Bac zones was 0.6 million trips.

Total volume of cargo handled by railway was 3.2 million tons in the year 1994. The volume is almost the same as that in the year 1993 but it has been grown up since the year 1990. The share of the Hanoi - Ho Chi Minh line accounts for 60%, including cargoes that go to/from other lines.

Main cargo items by railway are cement along The Hanoi - Ho Chi Minh line, apatite along Lao Cai line and coal along Cai Lan line. Along The Hanoi - Ho Chi Minh line, cement is loaded at Thanh Hoa and goes to Hanoi and southern direction as far as Quang Ngai. Coal is transported from the northern area to Thanh Hoa or from Ninh Binh to Thanh Hoa. The trip distance of coal is not so long.

Table 4.2.1 Cargo Items by Railway (1994)

unit: ton/year

	All Vietnam		Hanoi-HCM Line		Lao Cai Line		Cai Lan Line	
	1994	Ratio	1994	Ratio	1994	Ratio	1994	Ratio
Coal	756,974	20.7%	305,468	13.9%	37,856	3.7%	493,948	82.1%
Gasoline, kerosene	72,306	2.0%	22,853	1.0%	24,243	2.4%	121	0.0%
Minerals	82,551	2.3%	9,177	0.4%	21,284	2.1%	52,115	8.7%
Machinery, Equipment	78,711	2.2%	26,281	1.2%	4,578	0.4%	769	0.1%
Apatite	504,902	13.8%	30,558	1.4%	504,446	48.9%	1,044	0.2%
Fertilizer	270,448	7.4%	233,997	10.6%	176,319	17.1%	2,946	0.5%
Chemical	64,482	1.8%	27,112	1.2%	34,617	3.4%	476	0.1%
Cement	775,355	21.2%	607,020	27.5%	99,466	9.6%	24,725	4.1%
Stone, Sand, Soil, Gravel	594,431	16.3%	532,690	24.2%	54,292	5.3%	14,987	2.5%
Lime, Brick, Tile	25,281	0.7%	17,760	0.8%	149	0.0%	113	0.0%
Wood, Wood furniture	134,388	3.7%	126,027	5.7%	5,364	0.5%	6,024	1.0%
Forest product	11,778	0.3%	11,552	0.5%	3,987	0.4%	769	0.1%
Other agricultural product	6,262	0.2%	3,399	0.2%	2,575	0.2%	441	0.1%
Rice, Corn	43,661	1.2%	41,245	1.9%	3,439	0.3%	642	0.1%
Salt	20,806	0.6%	5,178	0.2%	19,470	1.9%	0	0.0%
Foodstuff	80,304	2.2%	80,043	3.6%	353	0.0%	0	0.0%
Cotton, Silk fabric	1,587	0.0%	1,587	0.1%	0	0.0%	0	0.0%
Cotton yarn	13,270	0.4%	12,943	0.6%	171	0.0%	0	0.0%
Other commodity	45,479	1.2%	44,500	2.0%	11,513	1.1%	0	0.0%
Animals	74,326	2.0%	65,078	3.0%	27,434	2.7%	2,443	0.4%
Total	3,657,302	100.0%	2,204,468	100.0%	1,031,556	100.0%	601,563	100.0%

*) excluding intra province trips
*) generated/attracted trips to/from zones along each railway line
*) trips are double counted in the other lines
Source: VNR

4.2.3 Road Transportation

Average daily traffic excluding motor cycle on the National Road 1 shows that rather heavy vehicular volumes are observed at the section between Hanoi - Thanh Hoa, around cities of Vinh, Da Nang, Qui Nhon and Ho Chi Minh. This traffic count data will be used for modifying the roadway passenger OD matrix developed in the Master Plan.

In order to confirm the volume and distribution pattern of dominant traffic generation zones, traffic count and roadside interview survey was conducted at the end of June, 1995 on the Hanoi cordon line.

Total volume of traffic generation and attraction of Hanoi accounts for 74,000 in non-motorized-vehicle (NMV), 90,000 in motor cycle (MC), and 24,000 in motorized vehicles of more than four wheels (MV). More than 80 % of traffic is made by NMV and MC, while only 13 % of traffic is made by MV.

4.2.4 Coastal Shipping

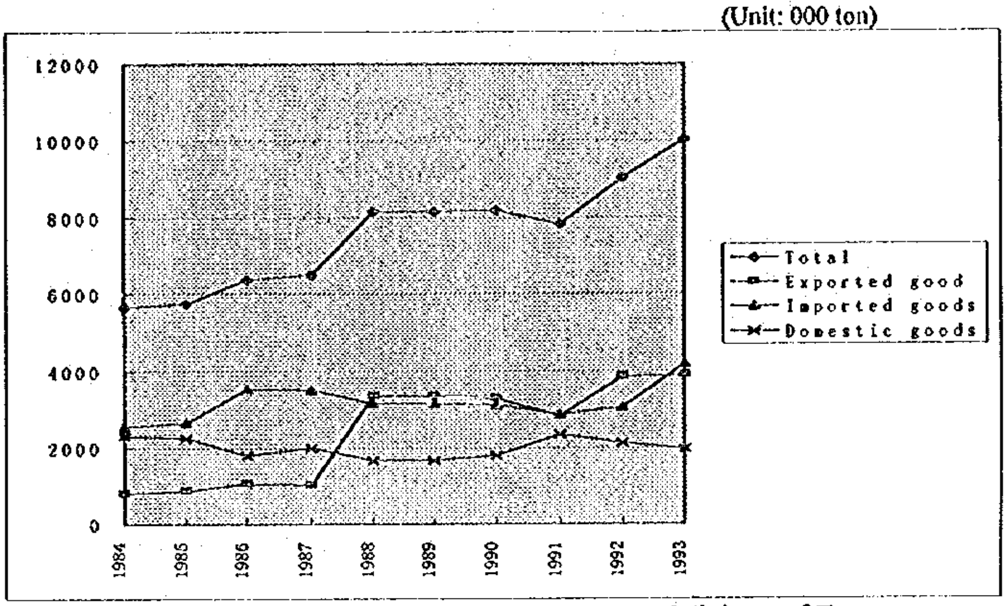
MOT statistics indicates that the total cargo volume of major coastal ports shows increase in recent years. Increases amount 10 million tons in the year 1993, and consists of export/import cargo. The volume of domestic cargo is consistently about 2 million tons.

On domestic cargo the analysis of the transport between railway and coastal shipping needs two kinds of data, the demand matrix from/to ports to/from inland and the cargo flows among ports. But these data are not available at present, so any traffic models with the demand of coastal shipping can not be prepared until those research will be completed in the future.

Nevertheless, export/import cargoes that build up the most of the cargo at major ports have to be transported from the port toward inland or vice versa by road, railway or inland waterway. So it will co-exist and not compete with other traffic modes.

The demand of traffic between the port and inland towns depends on the cargo volume which each port can handle. In this study the share of railway cargo was estimated based on the plan of Cai Lan port.

(Unit: 000 ton)



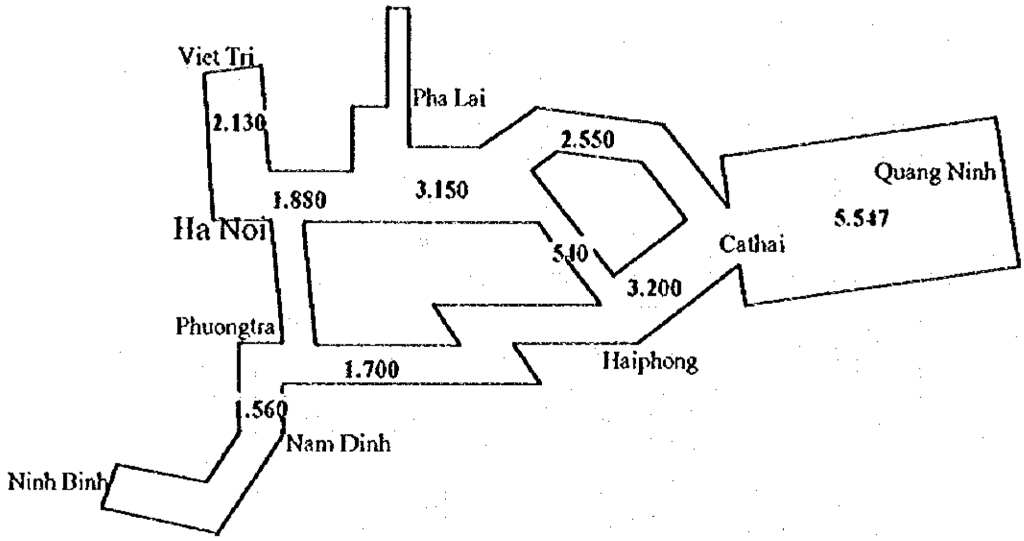
Source: Ministry of Transport

Fig. 4.2.3 Cargo Volume

4.2.5 Inland Waterway

The Red river delta and the Mekong river delta form important network for cargo transportation. In the Red river delta, total volume of cargo is about 8.8 million tons and in the Mekong river delta it is 7.8 million tons in the year 1995 according to the estimation by Vietnam Inland Waterway Bureau. Major items of cargo are construction materials (4.2 million tons) and coal (4 million tons) in the Red river delta. In the Mekong river delta, they are agricultural products (3.5 million tons) and construction materials (2.5 million tons).

The transport system by inland waterways is competitive with railways only in the northern districts. The route between Hanoi and Hai Phong connects with Quang Ninh through the sea and the other direction reaches to Viet Tri. The details of cargo volume in each section are shown in Fig. 4.2.4.



Source: Vietnam Inland Waterway Bureau

Fig. 4.2.4 Cargo Flow in the Year 1995 (unit: 000 tons)

4.2.6 Air Transportation

Airlines carried 0.25 million passengers in 1993 according to the government statistics. Major airport to airport passenger OD matrix in the year 1993 was obtained. According to the matrix, the air transportation demand between Hanoi and Ho Chi Minh city was 180 thousand passengers in one way trip counts. The third large airport was Da Nang. The air fare is relatively cheap considering the time needed for traveling, but absolutely expensive as compared with average income level of the average Vietnamese people. Thus the majority of the passengers are people with high-income, and with official purpose. But in the future this mode will be more popular as GDP per capita increases, and become competitive traffic mode to land transport.

Air cargo was 1.4 thousand tons from Hanoi and 2 thousand tons from Ho Chi Minh city in the year 1993. The volume at these years is very small. The target demand by the government in the year 2010 is 3 thousand tons from Hanoi and 7.6 thousand tons from Ho Chi Minh city including international cargo. The small volume is not expected to increase so drastically by the year 2010, so it is decided to exclude air cargo from the modal split model in this study.

4.2.7 Major Result of the Traffic Survey

Questionnaire surveys were conducted in order to find the traffic characteristics of long distance passengers in Viet Nam as well as to collect the necessary data for developing discrete choice model for railway passengers. The survey forms are translated into Vietnamese and the trained survey staffs from the TEDI and the VRDI asked domestic passengers to answer the questions at various points; the Noi Bai airport, the three bus terminals in Hanoi, the three railway sections of the Hanoi - Ho Chi Minh line, the Hanoi - Lao Cai line and the Hanoi - Ha Long line. The survey was carried out from June 1995 to July 1995.

About half of the air passengers and 13.9 % of the Hanoi - Ho Chi Minh railway passengers have "official" purpose for their trips. Other transport modes except the air are mainly used by the passenger whose trip purpose is "self-business", which accounts for about 30 to 40 % of the total. Almost all the air passengers selected "time" for their dominant decision making factor. The significant share of railway passengers prefers the transport modes that guarantee the "Safety" and "Comfort," whilst the majority of bus passengers selected its mode because of its "Frequency" and "Time". The most frequent answer for the fare evaluation is voted for "Reasonable", which well exceed 50 % of total passengers by each mode except the Hanoi - Ho Chi Minh line passenger. There are variations in the railway passengers' responses for the travel time evaluation. Majority of the railway passengers on the Hanoi - Ho Chi Minh line and the Hanoi - Ha Long line voted for "Rather long." On the contrary the passengers on the Lao Cai line responded "Rather short".

CHAPTER 5 CURRENT RAILWAYS PROFILE

5.1 Introduction

The existing routes, commercial distances and gauge of the Vietnam National Railways are shown in Fig. 5.1-1. The aggregate length of the meter gauge sections is 2,265.3 km while the standard gauge sections total 161.6 km. With the combined use of meter gauge and standard gauge covering 222.0 km, the total commercial distance is 2,648.9 km. The commercial distances of the major routes are listed below.

Hanoi	- Ho Chi Minh City	: 1,726.2 km
Hanoi	- Haiphong	: 101.5 km
Hanoi	- Lao Cai	: 296.0 km
Hanoi	- Lan Son - Dong Dang	: 163.0 km
Kep	- Ha Long	: 106.0 km
Dong Anh	- Quan Trieu	: 53.9 km

In addition to the above routes, the trunk routes include that between Luu Xa and Kep and the detour route between Hanoi and Don Anh.

Table 5.1-1 compares the details of the Hanoi - Ho Chi Minh Railway and railway lines in northern Vietnam. The former accounts for 72% and 78% of the combined population along the routes and the combined GNP production along the routes respectively for the year 2010. In 1993, the former accounted for 81% of the combined passenger transportation volume (unit: million passenger-kms) and 62% of the combined freight transportation volume (unit: million ton-kms), indicating the former's dominant role in passenger transportation with a longer average transportation distance. While the former is important in medium-distance passenger transportation between cities, the latter are characterized by a relatively high share of freight transportation and a shorter average passenger transportation distance, suggesting the predominance of short-distance transportation services.

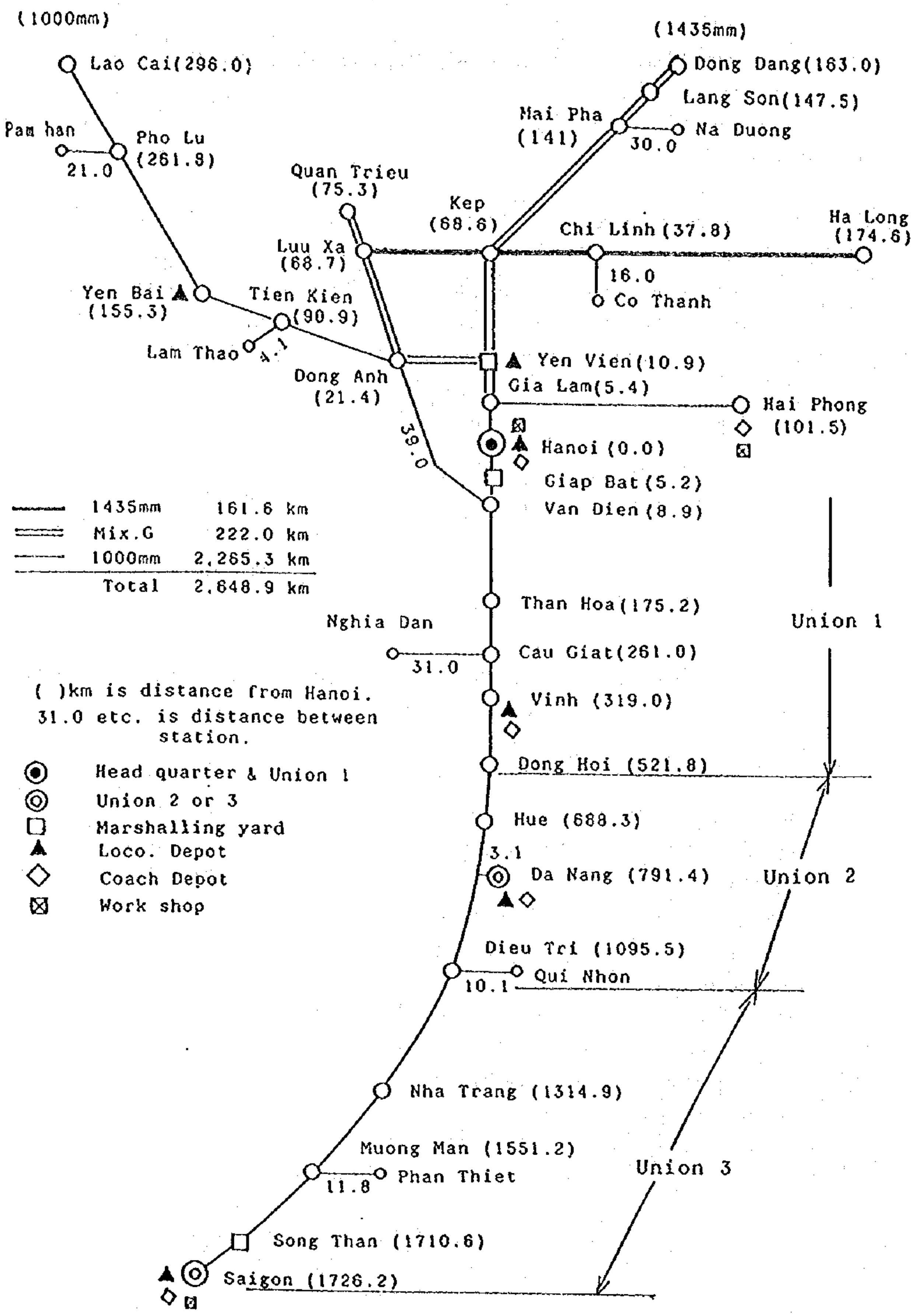


Fig.5.1-1 Railway Routes and Commercial Distances (VNR)

Table 5.1-1 Comparison Between Hanoi - Ho Chi Minh Railway and Northern Railway Lines

Item	Unit	Hanoi - Ho Chi Minh	Northern Railway Lines	Combined Total
Population Along Routes (2010)	1,000 persons	68,709 (72%)	26,291 (28%)	95,000
GDP Along Routes (2010)	million US$	56,632 (78%)	16,079 (22%)	72,711
Commercial Distance	km	1,726.2 (65%)	922.7 (35%)	2,648.9
Passenger Transportation Volume (1993)	1,000 persons	3,675 (47%)	4,118 (53%)	7,793
	million passenger-kms	1,401 (81%)	320 (19%)	1,721
Average Travel Distance	km	381	78	221
Freight Transportation Volume (1993)	1,000 tons	1,581 (50%)	1,606 (50%)	3,187
	million ton-kms	602 (62%)	376 (38%)	978
Average Haul Distance	km	381	234	307

5.2 Review of Role of Each Line of Railway Network

5.2.1 Hanoi - Ho Chi Minh Line

This is an old line which was originally constructed between 1899 and 1936. Its total length is as long as 1,726.2 km with single track of meter gauge. Such major cities and industrial zones as Hanoi, Nam Dinh, Thanh Hoa, Vinh, Hue, Da Nang, Quy Nhon, Bien Hoa and Ho Chi Minh City lie along this route and the route travels from north to south. There are 5 bottleneck sections, such as Hai Van Pass and Kep Pass, with poor alignment characterized by steep slopes and sharp curves. There are 686 bridges with a total length of 24,563 m and most of these are designated slow speed sections due to noticeable deterioration caused by war damage and ageing. There are 27 tunnels with a total length of 8,405 m in the hillside and mountainous areas in the Central Region. Leakage through cracks is observed in many places and there is a risk of the falling of the lining concrete. The train speed is limited in appropriate places. Some 98% of the total length are composed of such earth work as cutting and banking.

In terms of the rails, many old, light weight rails (27-30 kg/m) are used, particularly in the Union 3 area, causing concern in regard to safe train operation. A slow speed limit has also been introduced in many places where the turnouts are deteriorated. Table 5.2-1 lists the slow speed sections classified by slow speed level and causes. In short, the slow speed sections of the Hanoi - Ho Chi Minh Line are predominantly associated with hazardous bridges.

Every year, part of the track is submerged under water for a few days or even several weeks due to torrential rain. The length of those sections which are particularly vulnerable to flooding is approximately 160 km. Sites are dotted along the entire route where there is a danger of falling rocks. The transportation volume analysis by section shows that the Hanoi - Ho Chi Minh Line has the highest passenger transportation level of Vietnam's railway network. In the case of freight transportation, the volume is the network's highest in the Union 1 area while the volume in the Union 2 and Union 3 area is similar to that of the Hanoi - Lao Cai Line. The main freight transportation items are gravel, cement and chemical fertilizer although the list reveals a large variety of items transported along this route.

As mentioned earlier, the average transportation distance of the Hanoi - Ho Chi Minh Line is longer than the national average for both passenger and freight operations. This trend is particularly conspicuous in the case of passenger transportation where the average travelling distance of 300 - 380 km is much longer than the national average of 180 - 220 km, indicating the dominance of medium-distance passenger transportation between cities on this line. The dominant status of the line is also underlined by the fact that it accounts for some 60% of the national total ton-kms figure for freight transportation and some 80% of the national total passenger-kms figure for passenger transportation.

The Hanoi - Ho Chi Minh Line plays a crucial role in Vietnam's economic development through its vital link and role sharing with State Route 1 which runs parallel to the railway route with such key international ports in Vietnam along the route as Haiphong, Da Nang and Ho Chi Minh City. The Hanoi - Ho Chi Minh Line can also be expected to assist the creation of a unified national identity in Vietnam, a country which was socially, culturally and economically divided into the North and South for some 30 years in its recent past.

5.2.2 Hanoi - Haiphong Line

The Hanoi - Haiphong Line branches off at Gia Lam Station, located 5.4 km north of Hanoi, reaching Haiphong through Hai Hung Province. The line consists of single track of meter gauge. As it runs across a plain, its alignment is good and is almost flat except for a short section with a relatively steep gradient of 6‰. The track conditions are also good.

The sectional transportation volumes in 1992 were 752,000 passengers and 400,000 tons of cargo. The statistics for April, 1993 showed that 4,300 tons of oil and 3,800 tons of cement originated from this section to Luu Xa in the case of the former and Vinh Phu Yen Bai and Lao Cai in the case of the latter. An additional 3,200 tons of cargo were also dispatched from this section. In contrast, 4,500 tons of construction materials, 5,000 tons of apatite and 4,000 tons of other items arrived at this section from outside. The transportation of goods over the some 100 km long distance between Port Haiphong and Hanoi is mainly conducted by road haulage due to the inadequate loading and unloading facilities of the existing railway line. The route, which links the capital city of Hanoi with the international port city of Haiphong, runs through relatively developed areas in northern Vietnam and it appears reasonable to expect that this line will play an important role in the transportation of cargo to and from Port Haiphong and passenger transportation between the two cities.

With the expected economic development in the River Hong delta area, which includes areas along this route, the national income per capita will increase and a faster travelling time will become an important factor in deciding the mode of passenger travel. The number of railway passengers should increase if the service level is sufficiently improved to prove competitive vis-a-vis the bus service. Any planned improvement of the line should, therefore, be geared to fulfilling the promising potential of the route.

5.2.3 Hanoi - Lao Cai Line

This is another old line which was originally constructed between 1901 and 1906. It branches off at Yen Vien Station, located 10.9 km north of Hanoi, reaching Lao Cai through Vinh Phu, Yen Vai and Lao Cai Provinces. It runs along the River Hong and the population along the route totals some 6 million. The gauge in use is 1,000 mm gauge with single track. In the section between Yen Bai and Lao Cai, curved sections (R = 100 - 200 m) continue as the route runs between the foot of the mountain range and the River Hong. In contrast, the gradient is gentle along the entire route with an average gradient as small as 0.3‰. There are 142 bridges between Thack Loi and Lao Cai, most of which are much deteriorated due to ageing. A speed limit of 15 - 25 km/hr has been introduced at 5 bridges while a speed limit of 30 - 40 km/hr has been introduced for most other bridges in view of train safety. Due to the topographical conditions, submersion of the roadbed or loss of track ballast occurs fairly frequently along the route during the rainy season between May and October. The complicated geological features of areas along the route makes the roadbed quality rather poor.

The sectional transportation volumes for 1992 were 752,000 passengers and 334,000 tons of cargo. The statistics for April, 1993 showed that 36,500 tons of apatite and 2,400 tons of miscellaneous cargo originated from this section while 9,100 tons of coal and construction materials arrived at this section from outside. An apatite rock mine is located near Pom Han Station, the terminal for a branch line from Pho Lu Station. Areas along the route have iron ore and copper development potential. The line is a lifeline for areas along the route due to the lack of a well connected road network. The fact that most areas along the route are mountainous indicates relatively slow industrial development in the future. Even though such mineral resources as apatite, iron ore and copper are deposited along the route, any plan to develop the transportation capacity of the line must take the actual development prospect of such resources into proper consideration. While the international transportation of several million tons of cargo from Kunming in China to Port Haiphong and Port Cai Lan has been planned, the current prospect of this is uncertain. Unless the possibility of this international transportation is taken into consideration, the present transportation capacity of the line is still higher than the actual demand and its service can be further improved with relatively small investment.

5.2.4 Hanoi - Lan Son - Dong Dang Line

This line stretches from Hanoi to Lan Son through Ha Bac Province and Lan Son Province and further to Dong Dang, a town on the border with China. Dual gauge of meter gauge and standard gauge are used. The route beyond Dong Mo Station, located two-thirds of the way from Hanoi, runs through a mountainous region with a gradient increasing to as steep as 17‰ and with a series of sharp curves in some sections. The minimum curve radius is 150 m upto Kep and 100 m beyond Kep.

The sectional transportation volumes in 1992 were 548,000 passengers and 152,000 tons of cargo. The statistics for April, 1993 showed that 11,300 tons of coal and 5,300 tons of miscellaneous cargo originated from this section while 4,200 tons of coal, 2,900 tons of cement, 2,400 tons of timber and 6,300 tons of miscellaneous cargo arrived at this section from outside. Neither the population nor the scale of industrial activities along the route are large and future industrial development in areas along the route is expected to be slow. The transportation demand in terms of passenger and freight transportation on this route does not meet the minimum level required for healthy railway management. This trend will not change for some time unless international transportation to and from China is developed. In short, this line is likely to be subject to small investment with a view to maintaining the minimum transportation service.

5.2.5 Kep - Ha Long Line

This line branches off at Kep Station, located 68.6 km north of Hanoi, reaching Ha Long. It was constructed in 1970 to transport coal produced in Quang Ninh Province. The current standard gauge (1,435 mm) should be replaced by meter gauge in the future in accordance with the government policy. Although there are two sections with a series of small curves (R = 100 - 200 m), the alignment is generally good. The back conditions are also reasonably good. Construction of the roadbed has so far been completed for the proposed 5 km extension from Ha Long to Port Cai Lan.

The sectional transportation volumes in 1992 were 88,000 passengers and 488,000 tons of cargo. The main cargo items are coal, cement, machinery and construction materials. The population along the route is small. The line was originally constructed to mainly serve as a freight transportation line and coal transportation is still a dominant feature. With the construction of a new international port at Cai Lan and the growing importance of the triangular area formed by Hanoi, Haiphong and Quang Ninh (Ha Long) as a centre for regional development in the coming years, the volume of cargo moving through Port Cai Lan will definitely increase. In addition, the number of tourists visiting Ha Long will increase, following an increase of the national income per capita and the improved availability of hotel accommodation. Any improvement efforts for this line should, therefore, be based on a careful forecast of the likely demand increases described above.

5.2.6 Dong Anh - Quan Trieu

This line branches off at Dong Anh Station, located 21.4 km northwest of Hanoi, reaching Quan Trieu Station and used dual gauge of meter gauge and standard gauge.

The sectional transportation volumes in 1992 of 409,000 passengers and 114,000 tons of cargo were rather small. The statistics for April, 1993 showed that 5,500 tons of coal, 2,400 tons of iron products, 4,500 tons of fertiliser and 1,800 tons of miscellaneous cargo originated from this section while 4,800 tons of coal, 2,300 tons of mineral ore, 3,100 tons of apatite and 4,600 tons of miscellaneous cargo arrived at this section from outside. Neither the passenger transportation volume nor the freight transportation volume on this route are large. The improvement emphasis should be placed on maintaining the transportation service to the minimum requirement, taking the future demand forecast into consideration.

5.2.7 Other Lines

The Luu X - Kep Line has standard gauge but is not currently used. The minimum maintenance should be conducted for this line based on the future demand forecast. The detour route from Hanoi to Don Anh uses meter gauge and was constructed in the west of Hanoi to bypass central Hanoi. Its importance is likely to increase with the development of Hanoi and its role should be determined as part of an urban development master plan for Hanoi.

Table 5.2-2 shows the details and expected roles, etc. of each line described so far.

Table 5.2-1 Hanoi ~ Saigon : Numbers of Slow Speed Sections

Restricted Speed(km/h)		5	15	25	30	35	40	45	50	55	60	65	70	Summary	Remarks
Bridges	L ≧ 20 m	1	14	11	90		17	1	69	45	31	8		287	5km/h : No.301 Bridge (1,670km, L = 200 m)
	L < 20 m	1	3		48		19		92	2	200	6	9	380	No. 83 (L < 20 m)
	Sub-Summary	2	17	11	138		36	1	161	47	231	14	9	667	
Tunnels			9		12	1	5							27	
Turnouts (Numbers of Stations)					1		16							17	
Others			6		4					1	2			13	
Summary		2	32	11	155	1	57	1	161	48	233	14	9	724	

Notes 1. Slow speed sections associated with curves are excluded.

2. Speed restriction associated with turnouts in 17 stations is as follows ; Passenger Trains : 40 km/h
Freight Trains : 30 km/h

3. Others are associated with sections under construction.

Table 5.2-2 Characteristics of Major Railway Lines in Vietnam

Item		Hanoi - Ho Chi Minh	Hanoi - Haiphong	Hanoi - Lao Cai	Hanoi - Lan Son - Dong Dang	Kep - Ha Long	Dong Anh - Quan Trieu
Commercial Distance (km)		1,726.2	101.5	296.0	163.0	106.0	53.9
Maximum Sectional Transportation Volume	Passengers (1,000 persons/year)	1,482	752	752	548	88	408
Hanoi - Ho chi Minh (1994) Northern Railway Lines (1992)	Freight (1,000 tons/year)	808	400	334	152	488	194
Major Freight Items		Gravel, Cement, Chemical Fertiliser	Oil, Cement, Construction Materials, Apatite	Apatite, Coal, Construction Materials	Coal, Cement, Timber	Coal, Cement, Machinery, Construction Materials	Coal, Iron Products, Fertiliser, Mineral Ore, Apatite
Gauge (mm)		1,000	1,000	Hanoi - Gia Lan: 1,000, Gia Lam-Dong Anh: 1,000+1,435, Dong Anh-Lao Cai:1,000	Hanoi-Gia Lam: 1,000, Gia Lam-Dong Anh: 1,000+1,435	1,435	1,000+1,435
Alignment	Masimum Gradient (‰)	17	6	0.3 (average)	17	4	
	Minimum Radius of Curve (m)	97	300	100	upto Kep 150 after Kep 100	100	
	Characteristics	Five poor alignment sections with continuous steep slopes and sharp curves, including Hai Van Pass and Kep Pass	Good alignment with little gradient as it runs through a plain	Continuous curves (R=100-200m) beyond Yen Bai due to mountainous surroundings; gentle gradient throughout as is runs along River Hong	Some sections with continuous curves beyond Don Mo due to mountainous surroundings	Two sections with continuous small curves (R=100-200m) but alignment is generally good	
Facilities	Block System	Tokenless block system (1995)	Hanoi-Gia Lam: automatic block system, Gia Lam-Haiphong: tokenless block system	Hanoi-Gia Lam: automatic block system, Gia Lam-Lao Cai: tablet block system	Hanoi-Gia Lam: automatic block system, Gia Lam-Dong Dang: tablet block system	Tablet Block system	Tablet block system
	Facility Conditions	Much deterioration due to war damage and aging; some sections liable to flooding to falling rocks	Good track conditions	Much deterioration due to war damage and aging	Good track conditions	Relatively good track conditions as it is not an old line	

Item		Hanoi - Ho Chi Minh	Hanoi - Haiphong	Hanoi - Lao Cai	Hanoi - Lan Son - Dong Dang	Kep - Ha Long	Dong Anh - Quan Trieu
Facilities	Overall Features	Traverses most major cities ad industrial zones in Vietnam from north to south; an important line playing a crucial role in Vietnam's economic development and the social and cultural integration of the North and South; both passenger and freight services of medium-distance transportation between cities are dominant.	Linking the capital of Hanoi and the major international port city of Haiphong, the line should play an important role in freight transportation to and from Port Haiphong and in passenger transportation between the two cities.	Serves as a lifeline for people living along the route due to the lack of a road network; disregarding international transportation, the present capacity can meet extra demand, making it possible to improve the line with a small amount of investment; a detailed study is required on the implications of possible mining development along the route on the railway transportation demand.	Neither the population nor industrial activities along the route are large; due to the good road network, profitable railway operation is difficult for both passenger and freight services; minimum investment should be made to maintain the current service level.	With the future expansion of Port Cai lan as a major international port to create a triangular zone formed by Hanoi, Haiphong and Quang Ninh (Ha Long) as a key development area, the volume of cargo passing through Port Cai Lan will increase; improvements should be made in line with the timing and scale of the estimated demand increase; the likely demand increase of tourists visiting Ha Long should also be considered.	The transportation volume is relatively small in terms of both the passenger and freight services; emphasis should be placed on investment to maintain a reasonable service level vis-a-vis the actual demand.

5.3 Current Situation of Ha Noi - Ho Chi Minh Railway

5.3.1 Management and Operation

(1) Management

The Hanoi - Ho Chi Minh Railway is a symbol of Viet Nam's national unification and the regular through train services between Hanoi and Ho Chi Minh City have both a social and national significance far beyond that of simple profitability. Nevertheless, the management of the Railway under a market economy should try to achieve the highest level of efficiency in operating assets under given conditions. For example, it is necessary to examine whether or not the strictly central controlled management of this narrow gauge, single track railway which is more than 1,700 km in length is the best way of achieving maximum management efficiency from the viewpoint of operating a profit-making business and seeking the most appropriate business size for it. As a state-run enterprise, the VNR's biggest challenge is to skilfully balance the seemingly contradictory requirements of serving national interests and seeking maximum profit of an entrepreneur.

The Hanoi - Ho Chi Minh Railway serves 3 regions in Viet Nam, i.e. north, centre and south, with different economic structures. Flexible management practices to meet regional needs will certainly improve the trust of local people in the Railway and will stimulate the further use of the railway services with increased profit for the Railway. The consolidation of local/regional train services is, therefore, as equally important as the speeding up of the services between Hanoi and Ho Chi Minh City. It is fortunate that the actual operation of the railway services is in the hands of 3 Unions and it should not prove too difficult for each of these Unions to have good control over the profitability of operating those railway sections for which it is basically responsible and to prepare several scenarios to maximise this factor. In this case, the VNR's Head Office should be responsible for coordination between the 3 Unions and for the planning of through trains across areas controlled by these Unions. In particular, the selection of cargo to be transported should, in principle, be made by the Union Offices. All these arguments imply that it is unnecessary for the VNR to have a huge central organization which is responsible for all transportation work along the entire route. Each Union can be trusted to manage its own sections and should be made responsible for maintaining a profitable business. The main aim here is to activate the overall business of the Hanoi - Ho Chi Minh Railway through vigorous local activities.

Note: Many lessons can be learnt from the history of the Japan National Railways for rationalisation of the VNR's management. Particularly useful are the historical process of the breaking-up and privatisation of the JNR and the successful introduction of third sector management for those routes which were abandoned by the JNR on the grounds of their non-profitability. It is further recommended that the VNR learn useful lessons by studying the history of productivity improvement in terms of km-tons/employee and efficient rolling stock operation methods.

(2) Financial Structure

It is strongly hoped that the new accounting system referred to in the Prime Minister's "Conclusion" will soon come into existence. The financial statements prepared by the VNR are rather old-fashioned and require a radical revision in view of their acceptance by the international community, taking the opportunity of the financial independence of the VNR being allowed by the government. Such modernisation of the present accounting system is, in fact, a precondition for the VNR to raise investment funds on its own initiative. The clear distinction between capital and funds and between own capital and borrowed capital and the clear display of management realities and responsibilities by means of statement of appropriations or statement of disposition of deficit are particularly important. Together with consolidated statements of assets and liabilities and profit and loss statements, both of which cover the VNR's entire operation, financial statements should be prepared for each sector. In the case of the transportation sector in particular, financial statements should be prepared for each Union. The present conditions of the VNR's fixed assets and the depreciation method used are unclear and the re-assessment of all assets is desirable.

Operation expenses are only shown in such rough categories as wages, social securities, raw materials, fuel and power, etc. As the budgetary allocation by spending purposes is not clear, it is almost impossible to determine a means of reducing the internal expenses.The actual allocation of the budget, expressed as the value obtained by multiplying the unit cost by the amount of work, allows us to understand how the personnel cost and material cost, etc. are actually allocated for each of such general operation items as track maintenance, rolling stock maintenance, train operation, transportation, transportation management and asset management, etc. In the case of the maintenance cost of various assets, the reference values can be given by multiplying the original cost or book value by a certain factor which has been empirically established. In any case, it is essential that all involved in VNR management at both the central and local levels are fully aware that the firm establishment of cost consciousness lies at the basis of independent management.

New accounting laws and rules were promulgated in Viet Nam in October, 1989. It appears that these laws and rules were rushed through in response to the need to control foreign enterprises establishing production bases in Viet Nam and, as a result, they are basically general principles and rules and no enforcement details have been introduced. The common practice under these circumstances is to abide by international accounting standards. For example, such countries in Southeast Asia as Singapore and Malaysia which have established a fairly advanced market economy generally follow international accounting standards in their business management even though they have more traditional accounting customs. Given this widely accepted practice, the VNR should urgently adopt the international method of accounting and effectively use it to achieve efficient management.

Note: For reference purposes, an asset and liability statement and profit and loss statement for the VNR (1990~1993 calender years, original in Vietnamese) are included in Appendix 5.3.1-2 of the present report.

(3) Organization

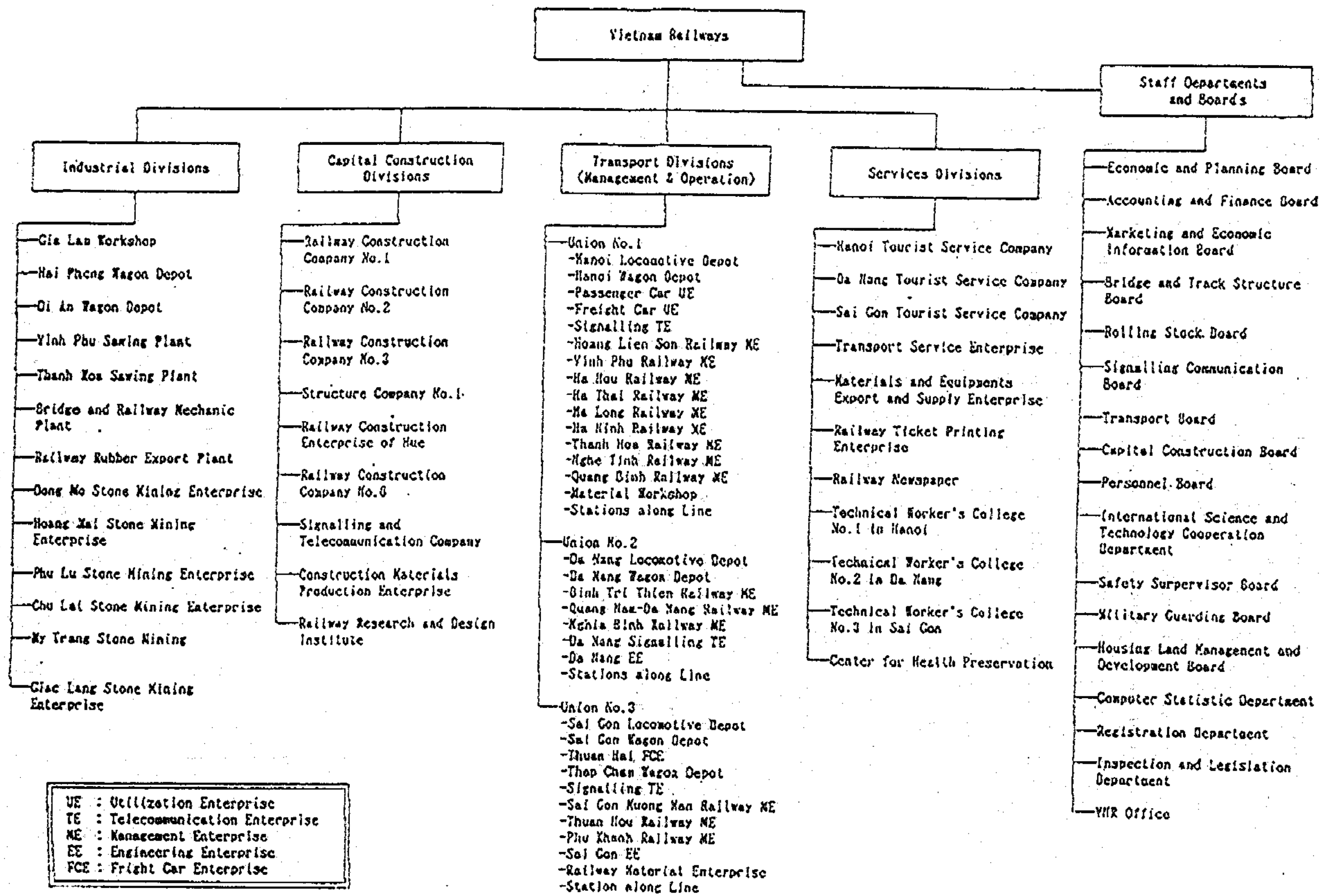
The organizational structure of the VNR is shown in Fig. 5.3-1. What is immediately noticeable is that the VNR is a kind of conglomerate, the business activities of which are not restricted to transport but including manufacturing, construction and service industries. This is why the VNR employs as many as 47,000 workers despite the modest railway track length of 2,600 km.

If the VNR intends to operate as a cost-conscious transport specialist under a market economy in the future, the gradual independence of divisions other than the transport division is quite desirable. Needless to say, it is essential that the VNR maintain closer communication and cooperate with these newly independent companies as the railway construction company, railway machinery and equipment manufacturing company and railway services management company, etc. which will still play an important role in railway operation.

Even though the privatisation of railway services is said to be a global trend, there are few successful cases. Because of the lingering severe damage caused by the war in Viet Nam, the VNR will remain a state enterprise for some time, requiring direct government assistance. Consequently, it may be inevitable that the VNR lacks certain flexibility in its basic management policies and both personnel and organizational issues. Nevertheless, it should be feasible for the VNR to establish a system whereby the Head Office and 3 Union Offices with certain decision-making freedom form a simple, united organization specialising in railway transportation with the flexibility to quickly respond to changes in the business environment.The best way for the VNR is presumably to seek to establish railway business operation with a healthy cost basis, while avoiding becoming an over-grown organization, which precisely responds to user requirements and to establish operational safety. These targets can be achieved by the swift introduction of train operation control, a ticket sale system, a freight information system and other systems supported by facilities and equipment of a high standard and also by the establishment of a personnel system whereby highly skilled staff assigned to the Head Office and Union Offices work in harmony.

A serious shortcoming of the VNR's current labour system is the lack of an established recruitment system which makes it difficult to provide an efficient organization of experts by assigning the right people to the right positions. This phenomenon is not isolated to the VNR but is common to all government ministries and state enterprises in Viet Nam, resulting in long delays in administrative work involving official approval or permission due to the lack of a smooth horizontal relationship between different government ministries and state enterprises. In the future, staff should be appointed through a nationwide general recruitment process and the labour management system should be flexible enough to allow the transfer of personnel to rationalise the organizational structure with little difficulty.

Fig. 5.3-1 Organizational Structure of VNR (1994)



(4) Manpower

As of May, 1994, the VNR employs the following staff.

Head Office	210
Transport Division	34,453
Industrial Division	4,277
Capital Construction Division	3,832
Service Division	4,320
Total	47,083

In the present study, the productivity comparison approach was used to estimate the appropriate manpower level in the future and the process of which is explained in 6.4.4. In short, the present productivity of the VNR based on the current manpower level described above is approximately 1/17 of that of the JNR. The Master Plan intends improvement of the VNR's productivity to some 1/6.6 of that of the JNR by 2010 through capital investment and organization-wide efforts as a primary requirement to make railway business commercially practicable. In anticipation of surplus manpower in the future due to rationalisation of the VNR, proper care should be taken to deploy the possible surplus employee to VNR-related new business and to provide further education and training for the purpose of shifting the employees to the other fields of VNR.

(5) Education and Training

A new training centre is currently under construction at Dia Lam and Ho Chi Minh City with completion in 1996. The education and training functions of the present training centre in at Vinh Phu near Hanoi in the north will be transferred to the new Dia Lam Centre upon its completion and, in fact, one course out of 5 has already been transferred. The existing centres in the centre and south of Viet Nam are located at Da Nang and Ho Chi Minh City respectively although the centre at Da Nang is only a branch centre of the latter. With the completion of the new centre at Ho Chi Minh City, all the courses at these centres will be transferred to the new centre. The future catchment areas of the Dia Lam Centre will be north of Da Nang while the catchment area of the Ho Chi Minh Centre will be south of Da Nang. While the construction of the buildings at these new centres is self-financed, foreign financial assistance is being sought for the procurement of educational and training facilities and equipment.

In the case of the Vinh Phu Centre, some 800 trainees are undergoing 5 courses lasting from 2 months to 2 and a half years.

Senior Staff Training Courses (2 Courses)

Higher education for 2 or 2 and a half years providing graduate status equivalent to that of university graduates (approximately 640 trainees)

General Training Courses (3 Courses)

- Technical Re-Training of General Staff : one year
- Administrative Training of General Staff : 2 and 3 months

(approximately 160 trainees)

In regard to the recruitment of senior staff, the establishment of an external recruitment system for university graduates is desirable in addition to internal promotion. The necessity to recruit new staff on a wider basis applies to all other government ministries and state corporations in Viet Nam as management staff under a market economy are required to have a wide range of knowledge and expertise. It will be necessary to send prospective senior engineers abroad to learn the latest technologies in industrialised countries at appropriate times so that their new knowledge can contribute to improving business operation and so that they can act as instructors vis-a-vis junior staff. In the case of the education and training of general staff, streamlined curricula directly relating to the manpower plan should be prepared so that the right people can be assigned to the right positions. A likely incentive is a qualification system under which successful trainees are awarded a specific qualification for each type of skill mastered during a course. Moreover, initial preparations should be made to respond to the future requirements for special training necessitated by the progress of information technologies and equipment and also for special education for those requiring new employment as a result of rationalisation of the VNR's organization.

5.3.2 Marketing

(1) Marketing System

The total length of the VNR's railway lines is approximately 2,650 km, of which the Hanoi - Ho Chi Minh Railway accounts for 1,726 km (65% of the national total). The operation performance in terms of passenger and cargo transportation volumes, etc. is shown in Tables 5.3-1~3.

1) Passenger Transportation

The passenger transportation volume has been showing a declining trend since 1987 with the Hanoi - Ho Chi Minh Railway accounting for some 47% of railway passengers. In terms of persons/km, however, the Hanoi - Ho Chi Minh Railway is by far the most important line in the country, accounting for 80% of the national total. The average travelling distance has been annually increasing to some 220 km for the national average and 380 km for the Hanoi - Ho Chi Minh Railway.

2) Cargo Transportation

The cargo transportation tonnage has been showing an increasing tendency and the tons/km figure has also been generally increasing. The Hanoi - Ho Chi Minh Railway accounts for some 50% of the cargo volume and 62% of the national tons/km figure. The transportation distance is approximately 300 km for the national average and approximately 400 km for the Hanoi - Ho Chi Minh Railway and both figures are showing an increasing trend.

3) Parcel Transportation

In the field of parcel transportation, the Hanoi - Ho Chi Minh Railway accounts for some 60% of the nationwide railway transportation of parcels and 90% of the total tons/km. The transportation distance is 300 km for the national average and 450 km for the Hanoi - Ho Chi Minh Railway, indicating the importance of the latter in long distance parcel transportation.

4) Operating Income

The operating income for the fourth quarter of fiscal 1993 and the first quarter of fiscal 1994 is given in Table 5.3-4.

Table 5.3-4 Operating Income

(Unit: 1,000 Dong)

	Fourth Quarter, Fiscal 1993	%	First Quarter, Fiscal 1994	%
Gross Income	63,500,000	100	64,600,000	100
Passengers	23,600,000	37	28,300,000	44
Cargo	36,750,000	58	33,700,000	52
Parcels	2,150,000	3	1,600,000	3
Miscellaneous	1,000,000	2	1,000,000	1

The income ratios of the VNR's cargo operation and passenger operation are 60% and 40% respectively.

Table 5.3-1 Passenger Transportation Volume of VNR

Year	Nationwide			Hanoi - Ho Chi Minh Railway		
	1,000 persons/year	1,000 persons·km/year	Index	1,000 persons/year	1,000 persons·km/year	Index
1980	33,815	4,487,707	100	18,263	3,380,590	100
1981	21,682	3,011,708	67	9,908	2,150,521	64
1982	18,692	2,962,919	66	9,332	2,263,276	67
1983	21,201	3,009,750	67	9,435	2,157,424	64
1984	23,728	3,628,591	81	10,602	2,688,519	80
1985	19,120	3,358,684	75	9,396	2,638,676	78
1986	21,127	4,195,605	94	11,110	3,445,866	102
1987	24,042	4,884,071	109	12,152	3,965,516	117
1988	17,750	3,505,558	78	8,632	2,857,365	85
1989	11,768	2,109,341	47	5,282	1,656,141	49
1990	10,443	1,912,957	43	5,057	1,544,440	46
1991	9,158	1,767,060	39	4,567	1,424,316	42
1992	8,719	1,751,669	39	4,358	1,436,202	43
1993	7,793	1,720,984	38	3,675	1,400,530	41

Notes: 1. Compiled on the basis of data provided by the VNR.
2. The indices base year is 1980 (=100).

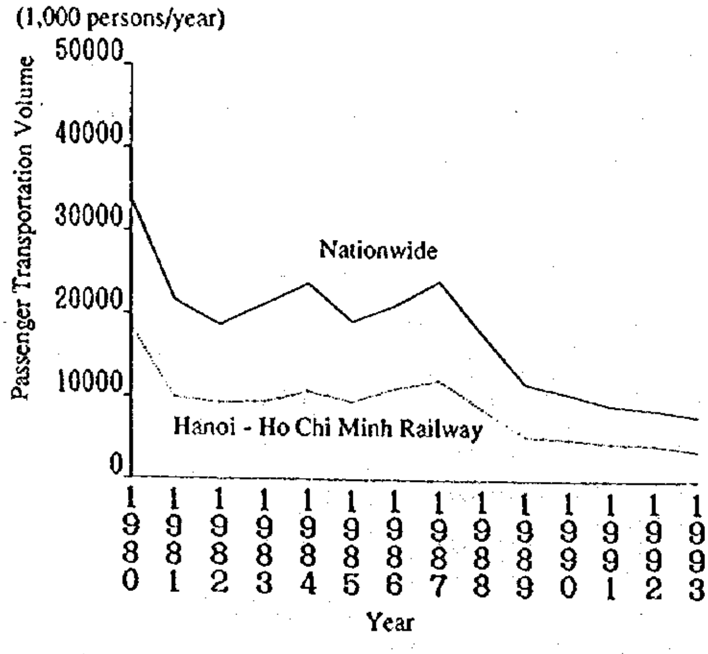


Fig. 5.3-2 Transition of Passenger Transportation Volume

Table 5.3-2 Cargo Transportation Volume of VNR

Year	Nationwide			Hanoi - Ho Chi Minh Railway		
	1,000 tons/year	1,000 ton-km/year	Index	1,000 ton/year	1,000 ton-km/year	Index
1980	3,509	752,080	100	1,275	402,411	100
1981	3,420	786,765	105	1,361	491,153	122
1982	3,235	650,331	86	1,222	378,946	94
1983	4,209	757,652	101	1,566	424,944	106
1984	4,146	838,314	112	1,525	485,912	121
1985	4,050	868,785	116	1,582	518,103	129
1986	4,137	960,601	128	1,663	571,256	142
1987	4,003	1,001,173	133	1,521	588,591	146
1988	3,928	1,015,575	135	1,432	582,083	145
1989	2,432	743,329	99	915	422,973	105
1990	2,341	847,023	113	992	489,337	122
1991	2,567	1,103,309	147	1,215	707,293	176
1992	2,774	1,076,879	143	1,298	689,796	171
1993	3,187	978,132	130	1,581	601,797	150

Notes: 1. Compiled on the basis of data provided by the VNR.
2. The indices base year is 1980 (=100).

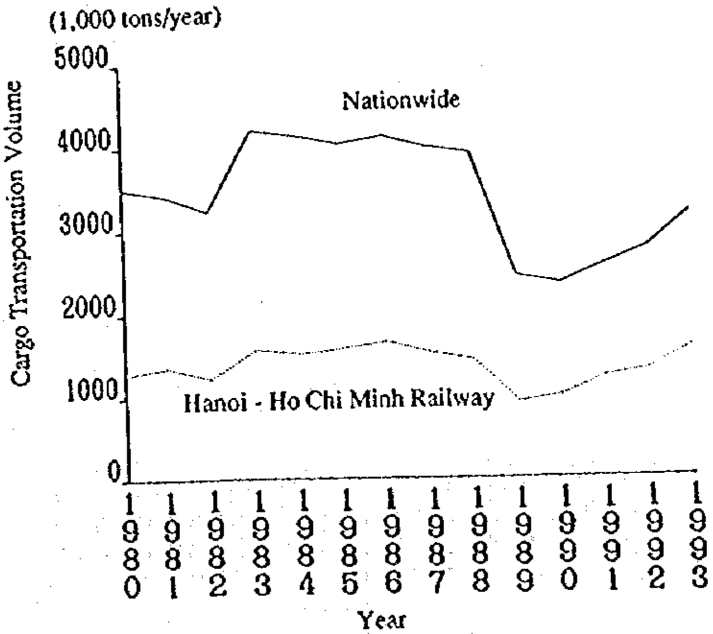


Fig. 5.3-3 Transition of Cargo Transportation Volume

Table 5.3-3 Parcel Transportation Volume of VNR

Year	Nationwide			Hanoi - Ho Chi Minh Railway		
	1,000 tons/year	1,000 ton·km/year	Index	1,000 tons/year	1,000 ton·km/year	Index
1980	258	41,614	100	161	33,291	100
1981	115	21,896	53	75	17,518	53
1982	147	23,525	57	77	18,820	57
1983	220	36,756	88	133	29,429	88
1984	252	42,262	102	121	33,810	102
1985	204	42,643	103	101	34,114	103
1986	212	47,432	114	119	37,946	114
1987	279	50,933	122	151	64,746	195
1988	218	45,554	110	113	36,443	110
1989	171	30,043	72	84	23,720	71
1990	165	37,017	89	93	31,440	94
1991	177	44,126	106	97	37,300	112
1992	178	54,459	131	108	48,635	146
1993	154	48,052	115	92	42,715	128

Notes: 1. Compiled on the basis of data provided by the VNR.
2. The indices base year is 1980 (=100).

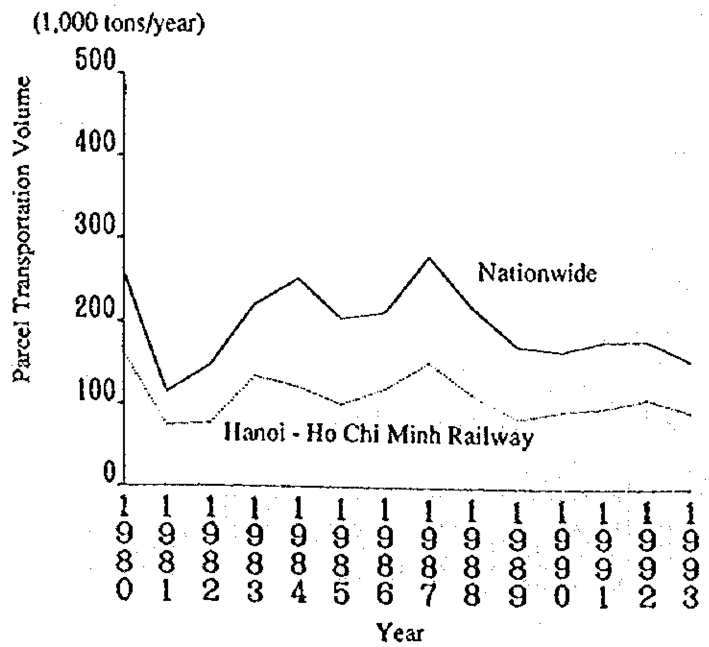


Fig. 5.3-4 Transition of Parcel Transportation Volume

5) Marketing System

The marketing system of the VNR is moving towards self-supporting accounting by each Union while the Head Office is run by a small number of staff as in the case of many other sectors. Consequently, the active marketing of railway services is not conducted. It is important for the VNR to establish a national railway network and to centrally control transportation services and their marketing. Moreover, consolidation of the central office is urgently required in order to proceed with modernisation of the communication network, development of the railway service marketing network and improvement of services vis-a-vis passengers and consignors.

(2) Fare System

1) Passenger Fares

Passenger fares are basically determined by multiplying the travelling distance by the unit fare and adding the insurance premium and the unit fare gradually decreases in accordance with the travelling distance. A particular element of the passenger fare is the combined additional fee of the express charge and sleeping berth charge, etc. which is set for each type of train. The system is rather complicated and, therefore, it is difficult for passengers to calculate the train fare themselves. The fare table displayed at each station shows the all inclusive fare by destination and train type. This system is very inconvenient as it necessitates those passengers travelling on more than one train with possibly different classes to purchase new tickets each time they change the train and/or class. Table 5.3-5 gives an example of the unit passenger fare table by train types while Table 5.3-6 shows the passengers fares for an S1 type train from Hanoi to Ho Chi Minh City.

Table 5.3-5 Passenger Fare Table. (1993)

(Unit: Dong/km)

Seating Class/Train Type	S7/8 and 9/10	CM5/6	S3/4
Standard Seat	132	-	-
First Class Seat	143	155	169
Standard Berth (Upper)	150	168	191
Standard Berth (Middle)	174	191	217
Standard Berth (Lower)	200	215	235
First Class Berth	230	250	-
Special Berth	230	270	-

Table 5.3-6 Fare Table for S1 Type Trains

(Unit: 1,000 Dong, as of April 1st, 1994)

Destination	Seat			Compartment (6 berths)			Compartment (6 berths, air-conditioned)			Compartment (2 berths)
	4 Seater	Soft	Hard	Lower	Middle	Upper	Lower	Middle	Upper	-
Hue	193	116	108	162	149	132	202	180	158	199
Da Nang	222	134	124	186	172	151	233	207	182	229
Dieu Tri	307	185	171	258	238	209	322	287	251	317
Nha Trang	403	243	225	338	312	275	423	376	330	416
Saigon	483	292	269	406	375	330	508	452	396	499

Notes 1. Child fares for 5 - 10 year olds are approximately half of the adult fares.
2. Fares for foreigners are 3 times higher than those given in the table.

The fare for hand luggage is calculated at a rate of 45 Dong/km for upto 100 kg and an insurance certificate (100 Dong) must also be purchased. A sum equivalent to 10 US$ (approximately 100,000 Dong) appears to be charged for stop-overs. A discount system appears to exist but is not clearly defined.

2) Cargo Fares

a) General Cargo

The fares for general cargo are divided into 5 categories and the unit fare gradually declines in accordance with the transportation distance as shown in Table 5.3-7 while the items classified under each category are shown in Table 5.3-8.

Table 5.3-7 Unit Fares for Cargo Transportation

(Unit: Dong/tons/km)

	1 - 200 km	201 - 500 km	501 - 900 km	- 1,400 km	1,401 km or more
Category 1	190	175	165	155	150
Category 2	215	195	180	170	165
Category 3	238	215	205	135	190
Category 4	257	235	220	210	205
Category 5	282	255	240	230	225

Table 5.3-8 Cargo Categories

	Item
Category 1	coal, mining ores, apatite, soil/stone, bricks, ice/water and paper/wood chips, etc.
Category 2	rice, rice bran, maize, packaged foodstuffs, sugar/sugar cane, vegetables, cotton/linen/other fibres, gravel/shaped stone/plaster, logs, roof tiles/tiles, petrol/kerosene, vegetable oils, asphalt, rubber, metal construction materials and chemicals, etc.
Category 3	salt, fertiliser, cement, machinery, tyres/tubes, agrochemicals and timber, etc.
Category 4	high class foodstuffs (ham and cheese, etc.), alcoholic drinks, coffee, cigarettes, silk, fur, watches, cameras, televisions and works of art, etc.
Category 5	foreign fruits, flowers, foreign cigarettes/alcoholic drinks, crystal glass, gold, silver, jewellery, high class clothing, cosmetics, birds/goldfish, money/cheques and explosives, etc.

b) Wagon-Loaded Cargo

The fares for wagon-loaded cargo are also determined based on the category of the item to be transported by wagon as well as the destination distance (see Table 5.3-9). Special unit fares apply for transportation distances of upto 30 km and 100 km.

Table 5.3-9 Unit Fares for Wagon-Loaded Cargo Transportation

(Unit: Dong/tons/km)

	1 - 200 km	201 - 500 km	501 - 900 km	- 1,400 km	1,401 km or more
Category 1	176.4	150	144	136	135.6
Category 2	292	169	156	152.4	150
Category 3	216	195	176.4	172.3	170.4
Category 4	234	200.4	190.3	186	183.6
Category 5	256.8	220.8	211.2	206.4	204

Table 5.3-10 Unit Fares for Wagon-Load Cargo (Short Distance)

	Upto 30 km	31 - 100 km
Category 1	7,200 Dong/ton	148.8 Dong/ton/km
Category 2	7,800 Dong/ton	163.2 Dong/ton/km
Category 3	8,520 Dong/ton	186.0 Dong/ton/km
Category 4	9,360 Dong/ton	200.5 Dong/ton/km
Category 5	9,960 Dong/ton	223.2 Dong/ton/km

In addition, the special fare provisions listed below exist.

- A 10% surcharge is imposed for specially sealed items.
- A surcharge of 200 Dong/ton/km is imposed for goods transported via specific loss-making routes.
- A 30% reduction of the standard fare applies in the case of the transportation of stone and gravel, etc. for road repair or to prevent typhoon/flood damage.

c) Export Goods and Transit Cargo (Wagon-Loaded)

The special fares shown in Table 5.3-11 apply to export goods and transit cargo.

Table 5.3-11 Unit Fares for Export Goods and Transit Cargo

	Upto 1,000 km	1,001 km or more
Category 1	0.025 US$/ton/km	0.024 US$/ton/km
Category 2	0.030 US$/ton/km	0.029 US$/ton/km
Category 3	0.035 US$/ton/km	0.034 US$/ton/km
Category 4	0.040 US$/ton/km	0.039 US$/ton/km
Category 5	0.045 US$/ton/km	0.041 US$/ton/km

With regard to export goods and transit cargo, the special fare provisions described below are applied.

- A 50% surcharge is imposed for small consignments.
- A 20% surcharge is imposed when a wagon is connected to a passenger train.
- A 10% surcharge is imposed when a wagon is connected to a freight train.
- A 200% surcharge is imposed when a cold wagon is required.
- A container can be used when the cargo volume is at least 75% of the container capacity.
- Cleaning of a wagon costs 30,000 Dong/wagon (to transport goods prone to rust).
- There are additional provisions relating to the designation of a specific category and/or the possibility of a fare discount for certain items.

(3) Current Problems and Direction for Improvement

The present problems of the railway network in Viet Nam which have been discussed so far are summarised here. Firstly, the development and modernisation of the communication network and other components of the railway infrastructure should be achieved as soon as possible together with the following improvement work. In particular, those items which do not require new investment should be urgently put into practice with proper care.

① Strengthening of the marketing department of the VNR's Head Office.

② Early publication of a nationwide train timetable and vigorous public relations activities to promote railway transportation.

③ Review of the passenger fare system (separation of standard fares and special charges) and addition of a new fare system to the timetable.

④ Modernisation of the ticket sale and gate operations (introduction of automatic ticket dispensers and excursion tickets, etc.)

⑤ Integration of cargo operation (unification/withdrawal of cargo handling stations).

⑥ Strengthening of through cargo services and introduction of a train designation system, etc.

⑦ Speeding-up of freight car yard operation (review of yard operation procedure following the introduction of Class 1 electric relay interlocking devices).

5.3.3 Train Operation

(1) Outline of Railway Operation Routes

The current operation routes of the VNR are shown in Fig. 5.3-5. The total track length is approximately 2,650 km, of which 94% (2,490 km) use 1m gauge (including a 222 km section mixed with 1,435mm gauge). the total track length using 1,435 mm gauge is approximately 160 km which will be totally replaced by 1m gauge in the future.

The subject section for the M/P and F/S is 1,726.2 km between Hanoi and Ho Chi Minh City and 3 lines (52.9 km in length) branching from the main route.

As of April, 1994, the safety system for the subject section consists of the token-less block system for some 400 km between Hanoi and Hoa Duyet and the tablet block system for the remainder which will be equipped with the token-less block system by December, 1995.

(2) Train Operation

Train operation in Viet Nam is illustrated in Fig. 5.3-6. As far as the Hanoi - Ho Chi Minh Railway is concerned, train operation along the entire route was resumed in 1976 at the end of the war and the train speed has been gradually improved following rehabilitation and improvement of the track and bridges, etc. devastated by the war.

1) Passenger Trains

Particular efforts have been made to shorten the travelling time of limited express trains between Hanoi and Ho Chi Minh City and the travelling time now stands at 36 hours (as of April, 1994) as shown in Table 5.3-12. Table 5.3-13 shows the departure times of express passenger trains.

Table 5.3-12 Shortest Travelling Time by Limited Express Train Between Hanoi and Ho Chi Minh City

	1980	1988	1989	1991 CM 6/7	1993 S 3/4	1994 S 1/2	Remarks
Travelling Time	72.00	52.00	48.00	42.00	38.00	36.00	2 trains each way/week
Maximum Speed	60 km/hr	60 km/hr	60 km/hr	70 km/hr	70 km/hr	80 km/hr	
Average Speed	24 km/hr	33 km/hr	36 km/hr	41 km/hr	45 km/hr	48 km/hr	
No. of Inter-mediate Stations	–	–	–	7	6	6	

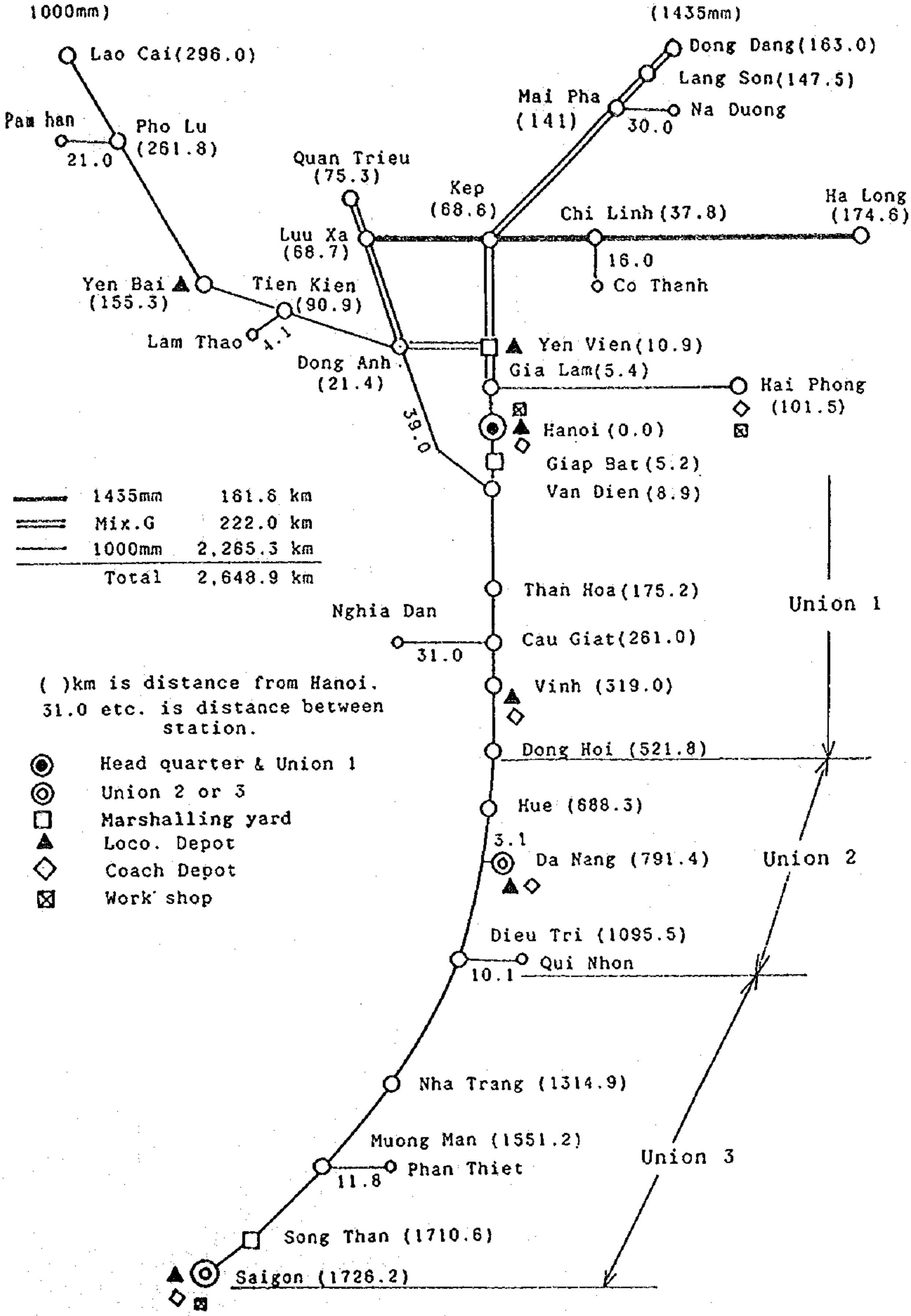
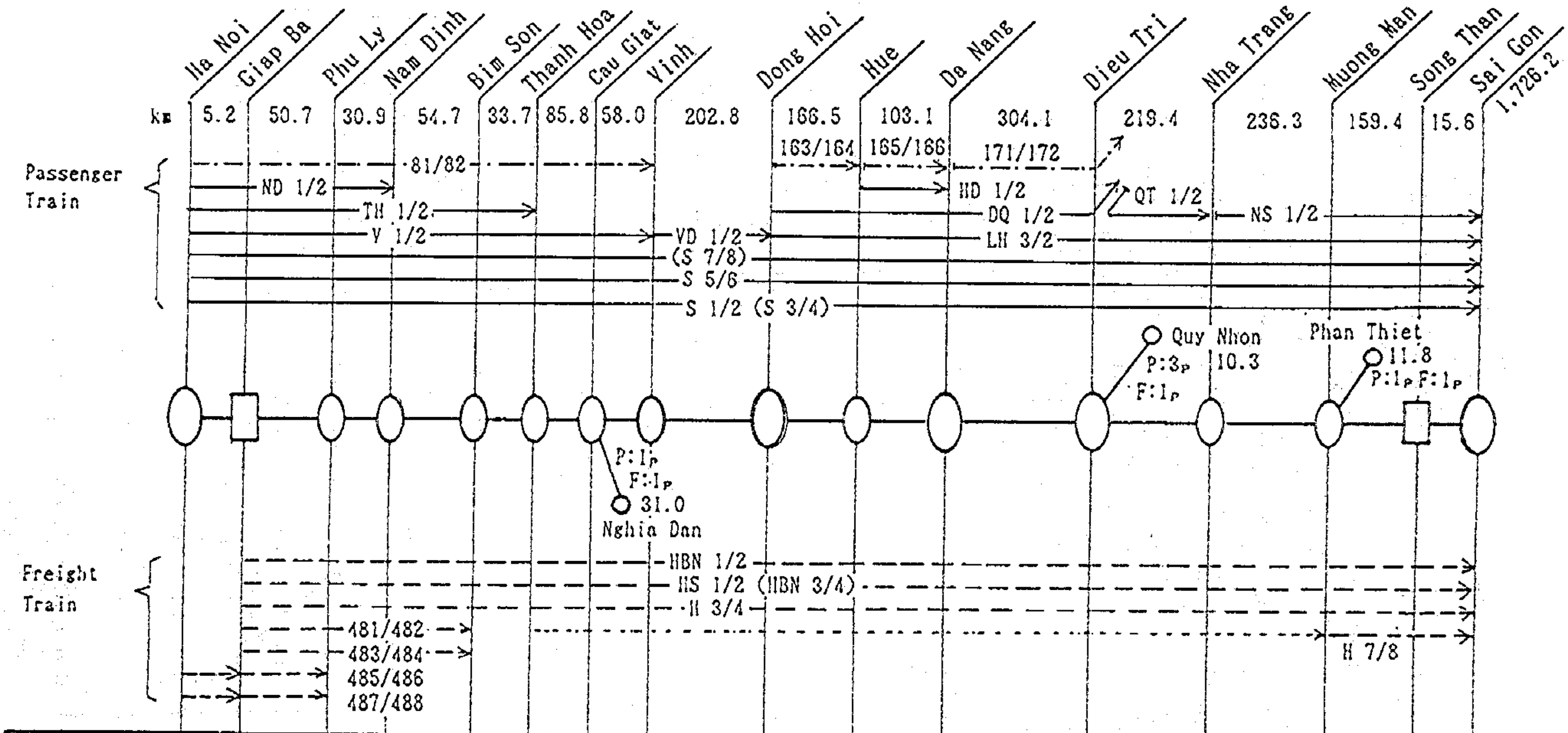


Fig. 5.3-5 Railway Route and Commercial Distance (VNR)



	Ha Noi–Giap Ba	Giap Ba–Phu Ly	Phu Ly–Nam Dinh	Nam Dinh–Bim Son	Bim Son–Thanh Hoa	Thanh Hoa–Vinh	Vinh–Dong Hoi	Dong Hoi–Hue	Hue–Da Nang	Da Nang–Dieu Tri	Dieu Tri–Nha Trang	Nha Trang–Muong Man	Muong Man–Song Than	Song Than–Sai Gon
Pas. Train (Pair)	7	7	7	6	6	5	3	6	7	6	5	5	5	5
Fre. Train (Pair)	2	7	5	5	3	4	4	4	4	4	4	4	4	4
Total (up&down)		28	24	22	18	18	14	20	22	20	18	18	18	18
Track Capa.	40				32		20	36	22	30		24		

Notes 1. ——— Express passenger train —·—·— Local passenger train — — — Freight train - - - - Local freight train (new diagramme since April, 1994)
2. Those trains in brackets run when normal trains are not running.
3. A mixed train (mainly passenger cars) usually operates on the Nghia Dan branch line and freight trains are introduced when required. (1p means one return trip)

Fig. 5.3-6 Train Operation Volume by Section and Track Capacity

Table 5.3-13 Travelling Time of Express Passenger Trains (April, 1994)

Section \ Train	S1 Mondays & Fridays	S2 Mondays & Thursdays	S3 Daily except Mondays & Fridays	S4 Daily except Mondays & Thursdays	S5 Daily	S6 Daily	S7 (Reserve Trains) (almost Daily)	S8
Hanoi	19:00	07:00	19:40	12:40	08:30	05:30	20:30	18:30
↕	↓	↑	↓	↑	↓	↑	↓	↑
Ho Chi Minh	07:00	19:00	12:40	19:40	05:30	08:30	18:30	20:30
Travelling Time (hours)	36	36	41	41	45	45	46	46

2) Freight Trains

The nearest freight terminal to Hanoi is Giap Bat and all freight trans on the Hanoi - Ho Chi Minh Railway depart from Giap Bat. There are 3 direct freight trains to Ho Chi Minh City every day as shown in table 5.3-14

Table 5.3-14 Travelling Time of Direct Freight Trains (April, 1994)

Section \ Train	HBN1 Daily	HBN2 Daily	HBN3 (when there is a sudden demand increase)	HBN4	HS1 (Daily but not when HBN3s or HBN4s are running)	HS2	H3 Daily	H4 Daily
Giap	22:00	03:11	12:30	14:46	15:20	13:58	00:00	18:50
↕	↓	↑	↓	↑	↓	↑	↓	↑
Ho Chi Minh	04:10	21:00	14:40	12:30	13:20	22:00	02:00	00:30
Travelling Time (hours)	54 hrs 10'	54 hrs 11'	74 hrs 10'	74 hrs 16'	94 hrs 00'	87 hrs 58'	98 hrs 00'	90 hrs 20'

The maximum travelling speed of a freight train is 60 km/hour for direct freight trains and 50 km/hr for others. Train operation is suspended between certain hours as described below at some sections, especially near Hanoi Station, due to urban traffic problems (to ensure smooth traffic at level crossings).

Subject Sections : Gia Lam - Hanoi - Giap Bat

Subject Hours : (morning) 06:30 - 08:30 (2 hours)

: (evening) 16:00 - 19:30 (3.5 hours)

3) Hauling Capacity

The current hauling capacity by section is shown in Fig. 5.3-7.

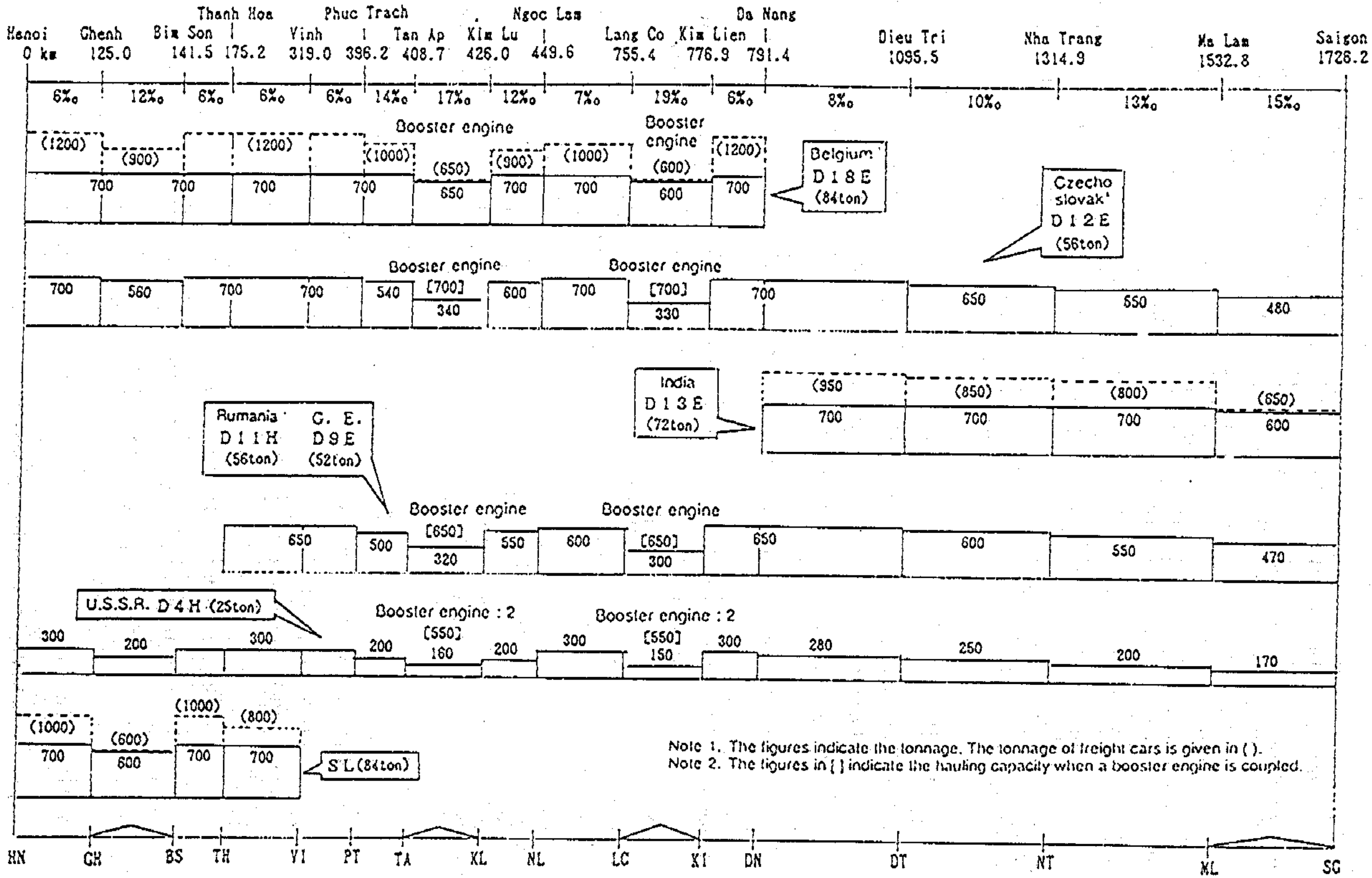


Fig. 5.3-7 Hauling Caoacity by Locomotive Type

4) Train Composition

a) Passenger Trains

S1/2 (pulled by D12E: same applies for all S class passenger trains)

1HC	+	3A	+	2BN	+	1BN (air-conditioned	....	7 cars
(Buffet)		(1st Class Coach) 64 P/car		(2nd Class Sleeper) 32 P/car		(2nd Class Sleeper) 42 P/car		(300 passengers/train)
43 tons		44 tons		43.5 tons		43.5 tons		(300 tons/train)

S3/4

1HC	+	1B	+	3A	+	2BN	+	1AN	+	1BV	......	9 cars
(Buffet)		(2nd Class Coach) 78 P/car		(1st Class Coach) 64 P/car		(2nd Class Sleeper) 48 P/car		(1st Class Sleeper) 24 P/car		(Postal)		(390 passengers/ train)
43 tons		43 tons		44 tons		43.5 tons		43 tons		43 tons		(390 tons/ train)

S5/6/7

1HL	+	1HC	+	4B	+	2A	+	2BN	+	1AN	+	1BV	......	12 cars
(Wagon)		(Buffet)		(2nd Class Coach) 78 P/car		(1st Class Coach) 64 P/car		(2nd Class Sleeper) 48 P/car		(1st Class Sleeper) 24 P/car		(Postal)		(560 passengers/ train
44 tons		43 tons		43 tons		44 tons		43.5 tons		43 tons		43 tons		(520 tons/train)

Other passenger trains have 4 - 7 cars, consisting of 3 - 5 second class coaches and 1 - 2 wagons. A DH4 locomotive is usually used to pull these trains. Each train has 2 drivers/engineers (one may be an assistant driver) and 0 - 1 inspector. A long distance train has 1 - 2 pairs of engineers as alternate drivers. In the case of a limited express train, a passenger train has a chief conductor, a conductor for each car and a number of service staff in the buffet car and sleepers. Including security guards, the total number of staff on board a train is as many as 24 - 25.

b) Freight Trains

A freight train is mainly pulled by a D18E locomotive and consists of 20 - 22 freight cars. A local freight train which is only operated when the cargo transportation demand is particularly large usually has just over 10 freight cars as locomotives other than D18Es are small and have less traction power. All freight trains have a brake van at the rear where the conductor works. One train is run by 3 pairs of engineers whose work shifts are determined in accordance with the operation of the particular locomotive to which they are assigned.

(3) Operation Safety System

The system employed by the VNR to ensure the safety system of train operation is described below.

1) Block System

The Hanoi - Ho Chi Minh Railway currently employs the token-less block system between Hanoi and Hoa Duyet and the tablet block system for the rest of the route. The latter will be replaced by the token-less block system in 1995.

2) Signalling System

Some stations use multiple colourlight signals while others use semaphore signals. The signalling system is the two-way system of G (Go) and R (Stop). Distant signals are provided in some places but are not currently used. Some colourlight signals use the three-way signalling system. The signals are coordinated at each station by the single line-through system and a single home signal serves all tracks. Consequently, the Y-Y indication method is used to allow a train to enter a subsidiary main track. When a train is guided onto a track which is not usually used, a white light is switched on by the auxiliary signals (which does not usually give any indication) installed below the home signal to distinguish this particular manoeuvre from ordinary access to the main track. This system appears to be very effective to simplify this type of manoeuvre.

3) Interlocking System

Some stations are equipped with the Class 2 electrical interlocking system while others are equipped with the Class 2 mechanical interlocking system. In the case of the Class 2 mechanical interlocking system, the points and signals are controlled near the furthest points at both ends of the station yard and interlocking between these points/signals is indirectly achieved by the use of a key. The study team has, therefore, decided to describe this system as the quasi-Class 2 mechanical interlocking system. To prevent serious accidents due to over-running, a long safety siding is provided at stations in sloping areas (Khe Net and Hai Van Pass). At the station yard, the home signal is located quite far from the nearest point and this long distance provides protection against over-running. To prevent the over-running of the departure signal and to ensure proper train stoppage at the stop line, 2 yellow signals light up when the train enters a subsidiary main track. If the train speed instructed by the signal is slow enough (for example, 25 km/hr or less), this reasonably prevents undesirable over-running.

4) Other Safety Facilities

Such advanced safety facilities as the ATS (automatic train stopping) system and falling rock warning system have not yet been installed. In the case of level crossings, an operator is assigned to each major level crossing where there is heavy road traffic and/or where the width is particularly wide in order to completely shut down the level crossing in question. No warning system, however, is installed. Safety workers are also assigned to some bridges and tunnels to ensure the extra safety of train operation.

(4) Operation Control System

Train operation is controlled by the dispatching room at the Head Office and those at the Union offices. The dispatching room at the Head Office is manned by one dispatcher while the dispatching room of each Union office is basically manned by a chief dispatcher, a train operation dispatcher and a locomotive operation dispatcher. As the train operation dispatchers record the operation results on blank recording paper based on standard train diagrammes, it is questionable whether or not they conduct their main duties, i.e. judgement of and instructions on train operation, in a speedy and accurate manner. In addition, the direct dispatcher telephone system to communicate with dispatchers working at different stations has deteriorated to the point that the communication of instructions or information is often disrupted, making renewal of the system extremely urgent.

(5) Accidents

The VNR has the following 6 categories of railway accidents and compiles its statistics based on these categories.

Category 1 : Extremely Serious Accident
- Disruption of services : 24 hours or more
- Casualties : 2 or more people killed
- Damage to car(s) : severe damage

Category 2 : Serious Accident
- Disruption of services : 12 - 24 hours
- Casualties : upto 2 people killed
- Damage to car(s) : moderate damage

Category 3 : General Accident
- Disruption of services : upto 12 hours
- Casualties : no-one killed
- Damage to car(s) : none

Category 4 : Other Accidents

Category 5 : Accidents involving Violation of Regulations

Category 6 : Minor Technical Fault

The number of accidents/faults recorded in the 5 year period between 1989 and 1993 is given in Table 5.3-15.

Table 5.3-15 Railway Accidents in Viet Nam

Year	Accident Category							%
	1	2	3	4	5	6	Total	
1989	7	7	143	267	40	3,804	4,268	100.0
1990	2	11	141	269	20	2,737	3,180	74.5
1991	3 (3)	4 (2)	99 (80)	288 (261)	25 (15)	2,031 (1,864)	2,450 (2,225)	57.4
1992	0	5 (5)	58 (38)	198 (180)	16 (11)	2,040 (1,574)	2,317 (1,808)	54.3
1993	0	1 (1)	55 (33)	201 (150)	20 (12)	1,602 (1,284)	1,879 (1,480)	44.0

Note: The figures in brackets are the number of accidents on the Hanoi - Ho Chi Minh Railway.

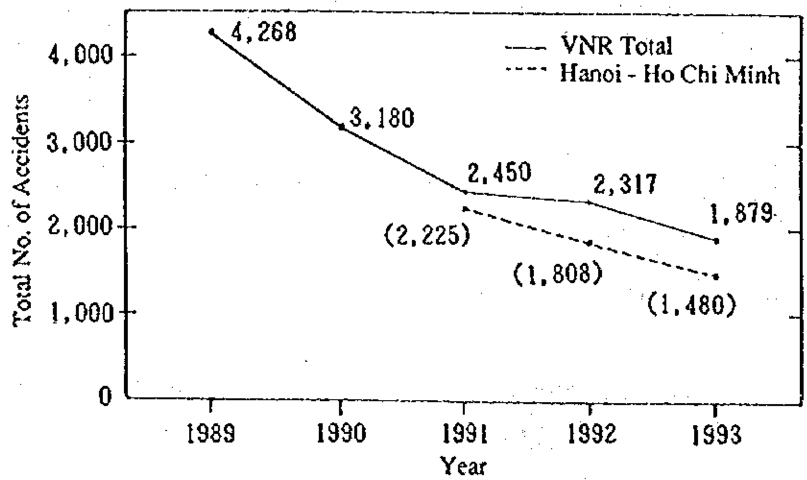


Fig. 5.3-8 Total Number of Railway Accidents

The total number of accidents has been declining as shown in the above table and figure. The main types of accidents are rolling stock-related (assumed to be mechanical breakdowns) which account for 60% of all accidents and external cause accidents (assumed to be level crossing accidents) which account for 30% of all accidents. The number of accidents involving the track and others is unexpectedly low.

The fact that accidents on the Hanoi - Ho Chi Minh Railway account for approximately 80 - 90% of all accidents suggests a higher likelihood of accidents on this major trunk line in view of its 60% share of the nationwide transportation volume. In particular, almost all serious accidents occur on this line even though the number has been declining. As trains are expected to operate at a higher speed in the near future, further safety measures must be planned and implemented. The breakdown of accidents by cause in 1993 is shown in Table 5.3-16.

Table 5.3-16 Railway Accidents in Viet Nam (1993)

Accident Causes	Accident Category							%
	1	2	3	4	5	6	Total	
a) Station	0	0	6	0	10	111	127	7
b) Locomotive	0	0	2	0	5	360	367	20
c) Track/Bridge	0	0	12	0	1	43	56	3
d) Rolling Stock	0	0	4	0	1	713	718	38
e) Signalling/ Communication	0	0	0	0	0	28	28	1
f) Track Maintenance	0	0	4	0	2	16	22	1
g) External Causes	0	1	25	201	1	331	559	30
h) Cause Unknown	0	0	2	0	0	0	2	–
Total	0	1	55	201	20	1,602	1,879	100

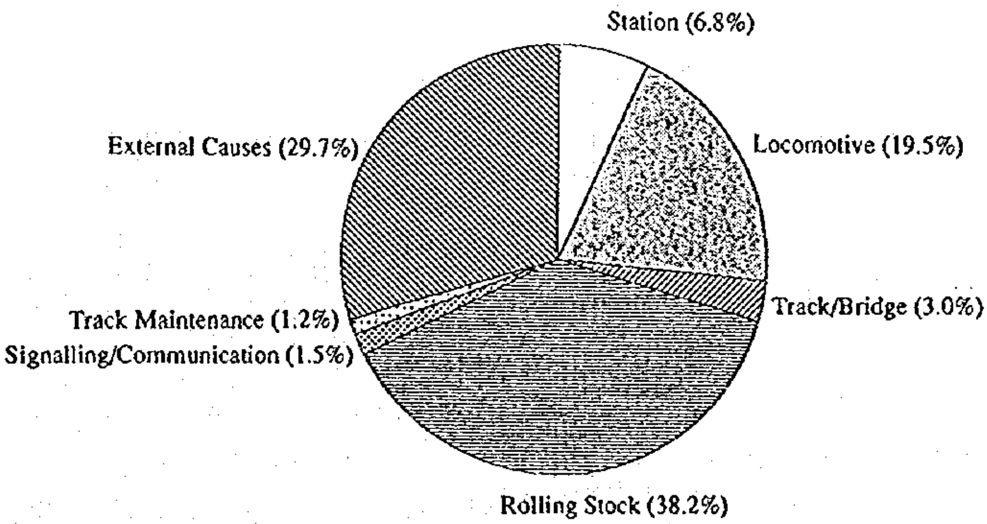


Fig. 5.3-9 Breakdown of Railway Accidents by Cause (1993)

(6) Track Capacity

The lowest track capacity at present is 20 trains/day due to the local travelling time in sloping sections due to slow speed and the huge distance between stations where those trains running in opposite directions can pass each other to continue travelling on a single track. The sub-section with the lowest track capacity in each section of the Hanoi - Ho Chi Minh Railway is listed in Table 5.3-17.

Table 5.3-17 Current Lowest Track Capacity by Section

Section	Sub-Section with Lowest Track Capacity	Distance (km)	Track Capacity (trains)	Remarks
Hanoi - Bim Son	Nam Dinh - Nui Goi	14.0	40	
- Vinh	Ng. Trang - Thanh Hoa	14.2	32	
- Dong Hoi	Tan Ap - Kim Lu	17.3	20	sloping section
- Hue	Thu. Lam - Sa Lung	15.5	36	
- Da Nang	H.V. Bac - H.V. Nam	10.9	22	sloping section
- Dieu Tri	Bong Son - Van Phu	15.7	30	
-	La Hai - Chi Thanh	16.0	30	
- Nha Trang	Hoa Son - Dai Lanh	12.1	30	
- Muon Man	Ka Rom - Thap Cham	26.3	24	longest section
- Ho Chi Minh	Dau Giay - Trang Bom	25.9	24	longest section

(7) Current Problems and Improvement Policy

The following issues must be reviewed and improved in order to establish successful railway services in Viet Nam in the 21st century.

1) Transportation Control System

The railway industry is an integrated system of various components. The current conditions of the railway lines (track and track layout in station yard, etc.) and the operating length are not clearly known and the lack of basic data creates a series of problems for efforts to prepare improvement plans. The early provision of various basic data is, therefore, essential to consolidate the basis for such planning.

The integrated system of the railway industry has train diagrammes as its sole form of merchandise. Safe and reliable train operation based on these diagrammes will greatly contribute to the development of Viet Nam. Because of this important prospect, each Union, as well as the Head Office of the VNR, must prepare diagrammes and timetables for all lines and trains in view of the proper control of the actual operation of each train and groups of trains. Train dispatchers should, therefore, prepare a daily operation diagramme in addition to the standard diagramme to enable them to regulate and coordinate train operation which is their essential assignment. The recording of operation results on blank paper is simply the recording of data and does not constitute the control which is required of dispatchers. Given the above observation, strengthening of the transportation control department of the VNR's Head Office is deemed essential.

2) Train Operation

Train operation by train crews, particularly engineers/assistant engineers, in strict accordance with the timetable is necessary. Against the background of increased train speed, a momentary loss of concentration may lead to a signal instruction or slow speed sign being missed, in turn leading to a serious accident.

In terms of facilities, introduction of the ATS is required in order to automate information exchange between ground facilities and the trains in operation. The drivers and crew members of the trains should each be given a pocket timetable to ensure punctual train operation. In addition, speed limit signs and other clear instructions should be placed at the beginning and end of all slow speed sections.

3) Promotion of Accident Prevention Measures

In addition to those measures mentioned in 2) above designed to prevent accidents due to human (engineer) error, a general system should be established to effectively conduct accident investigations, to analyse the causes of accidents and to establish remedial measures.

Although the number of railway accidents in Viet Nam has been declining, there are still accidents involving fatalities. Given the large number of accidents involving outsiders (accidents with external causes), most of which presumably take place at level crossings, the stepping up of railway safety campaigns and improvement of the awareness of the general public and drivers in particular are extremely important.

4) Operation Safety System

The block system of the Hanoi - Ho Chi Minh Railway will soon be integrated to the token-less block system throughout which should be capable of handling train operation on the line until around 2010. If further modernisation is required to meet an increased train operation volume, the token-less block system can be upgraded to the special automatic blocking system or the more advanced CTC (centralised traffic control) system. Together with improvement of the block system, various warning systems should also be integrated to establish a reliable disaster prevention system.

5.3.4 Railway Infrastructure

(1) General

1) Track Standards

a) General

The infrastructure for the Hanoi - Ho Chi Minh Railway was originally constructed in the period between 1899 and 1936 and is now showing a high degree of deterioration due to general ageing and damage caused by the war, requiring substantial investment to rehabilitate the entire functions.

Separate track standards are upheld for the standard gauge and meter gauge. The Hanoi - Ho Chi Minh Railway is, in fact, the major line, using the meter gauge and details of the line standards are given below.

- Maximum Speed : 70 km/h
- Gauge : 1,000 mm
- Minimum Radius of Curve : 97 m
- Speed Limit at Curve : $V = 3.5\sqrt{R}$
- Super-Elevation : $h = \frac{6.6 \times V^2{}_{Max}}{R}$
- Maximum Cant : 95 mm
- Maximum Slack : 25 mm
- Maximum Grade : 17‰
- Vertical Curve Radius : 5,000m or 3,000m inserted at grade change over 4%

b) Roadway Diagraph

The roadway diagraph for the Hanoi - Ho Chi Minh Railway is shown in Fig. 5.3.4-1.

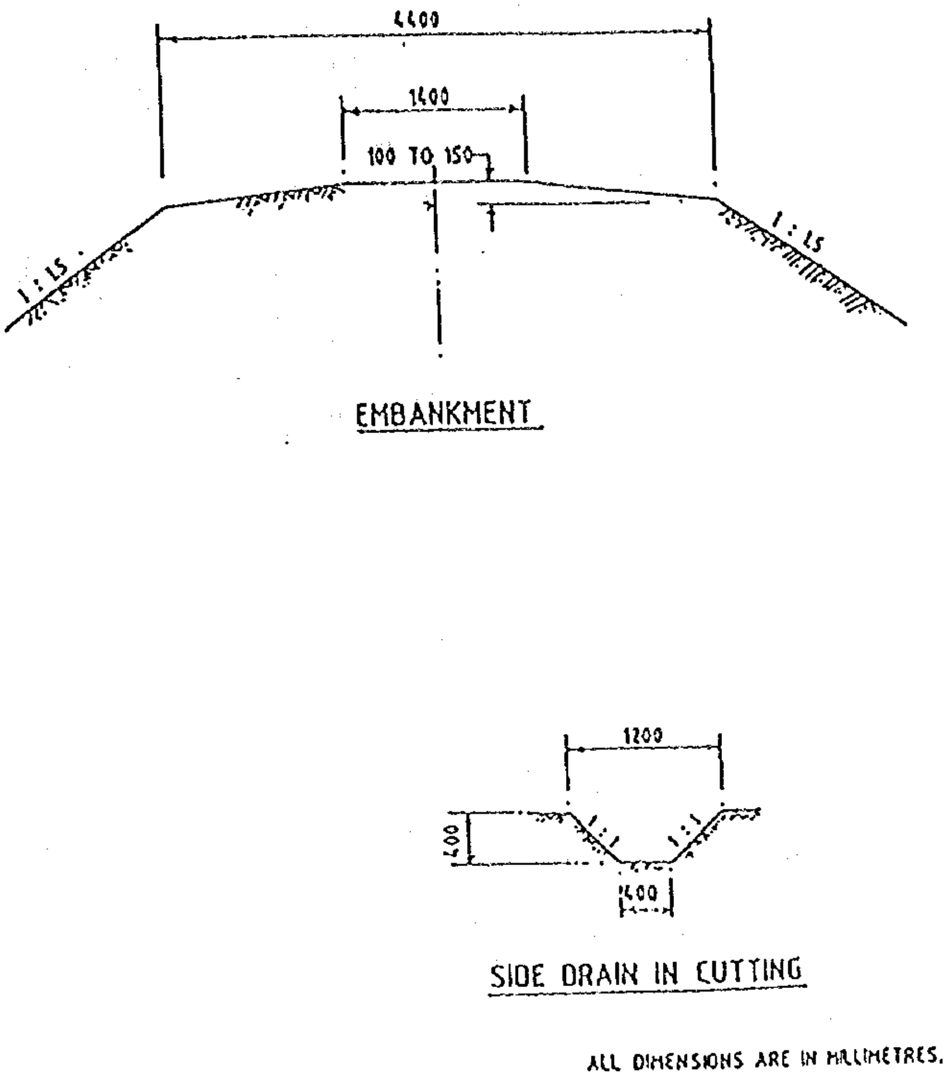
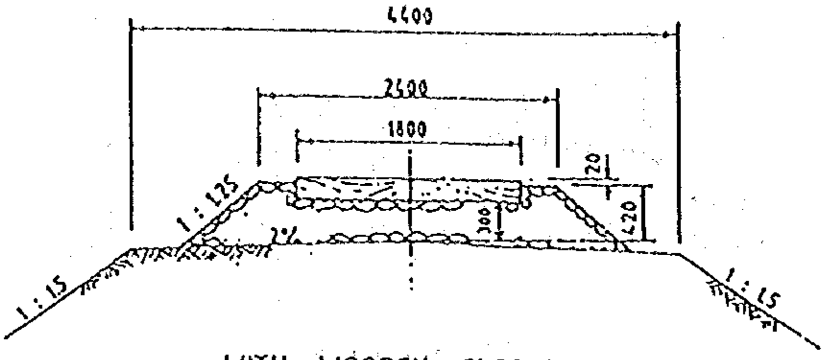
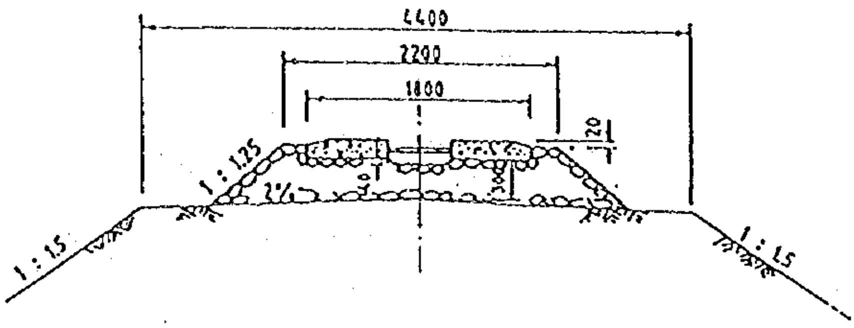


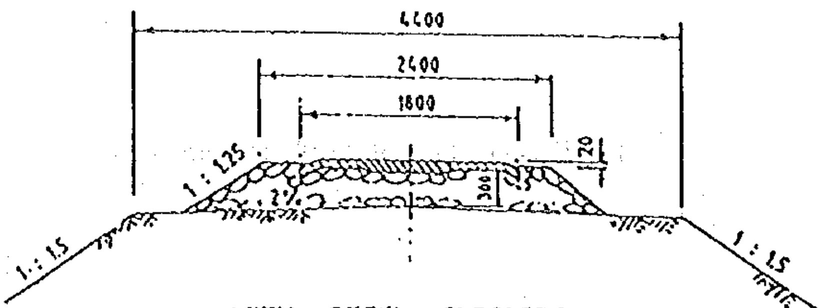
Fig. 5.3.4-1 Typical Profile of Formation



WITH WOODEN SLEEPERS



WITH TWO BLOCK CONCRETE SLEEPERS



WITH STEEL SLEEPERS

Fig. 5.3.4-1 Typical Profile of Formation (Continued)

2) Construction Gauge and Car Gauge

The currently employed construction gauge and car gauge are shown in Fig. 5.3.4-2 and Fig. 5.3.4-3 respectively.

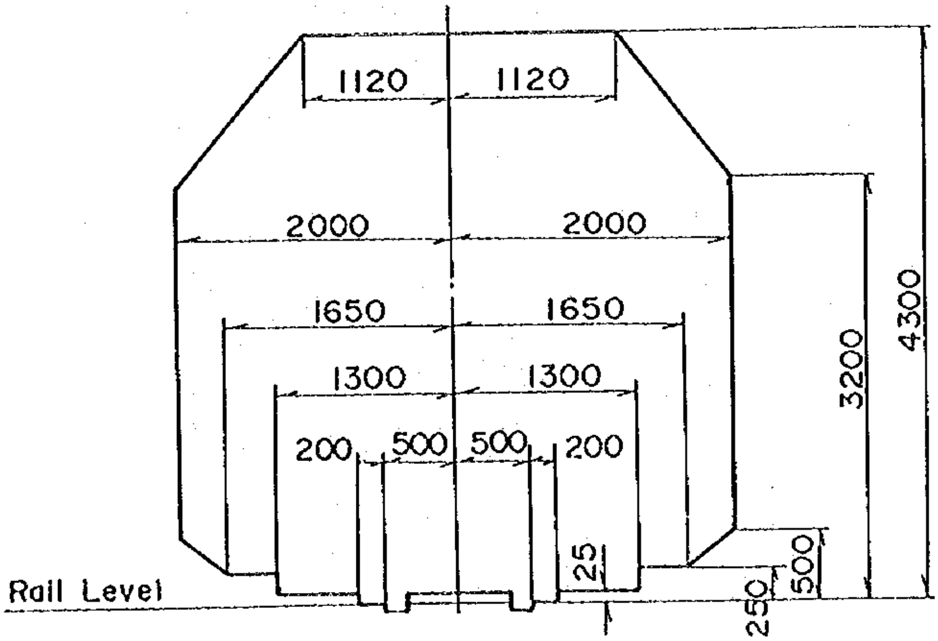


Fig. 5.3.4-2 Construction Gauge (mm)

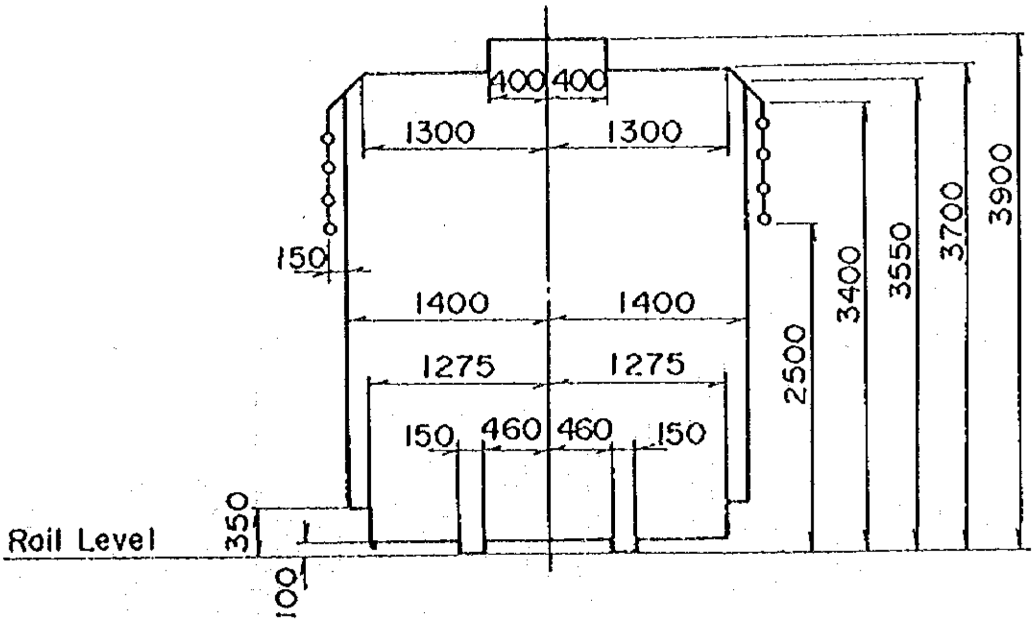


Fig. 5.3.4-3 Car Gauge (mm)

3) Train Load

Due to the complex historical background, the existing rolling stock consists of cars manufactured by many different countries with different train loads. In the future, however, unification of the rolling stock will be gradually conducted. The axle load and wheel base of the main locomotives currently in use are shown below.

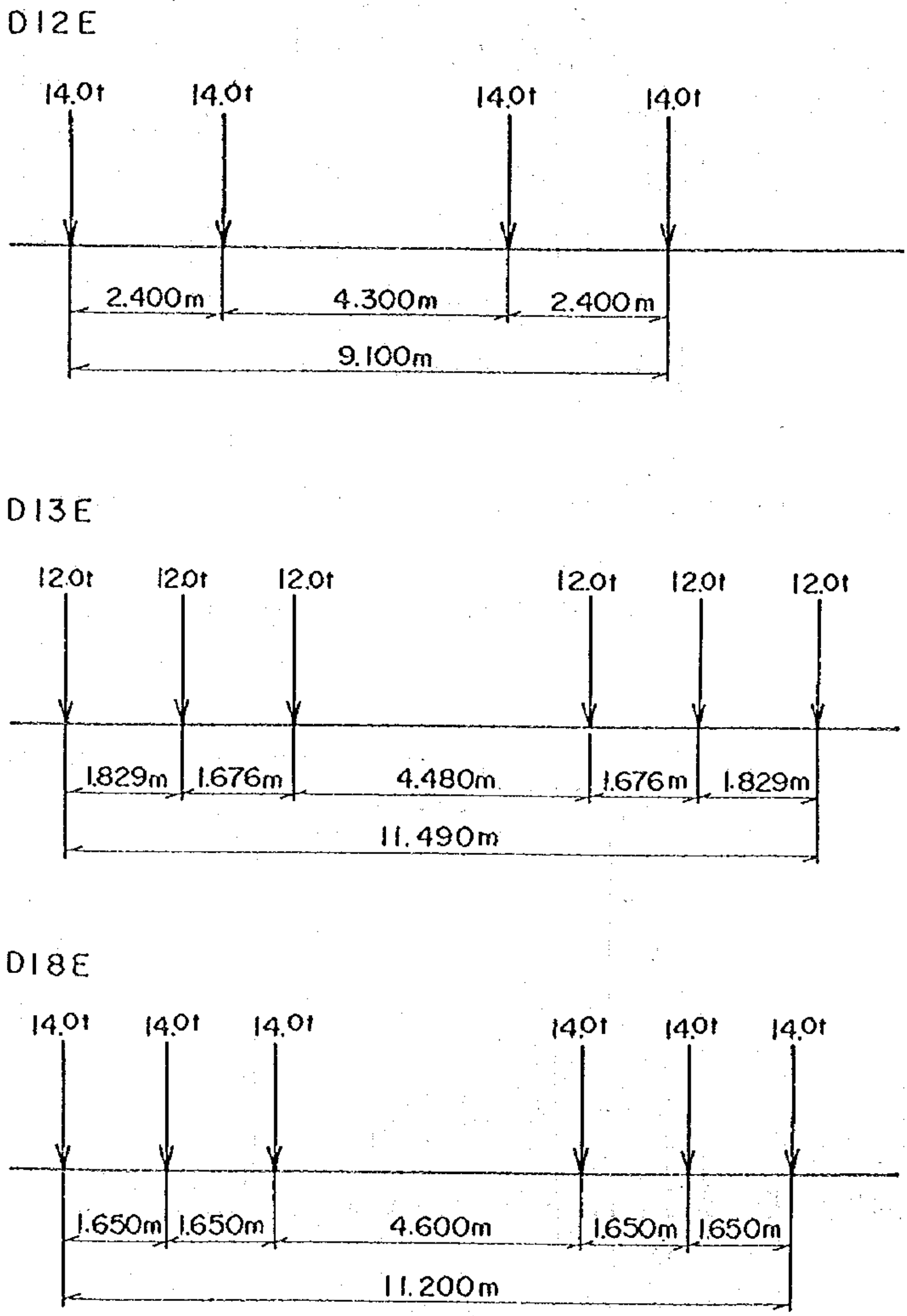


Fig. 5.3.4-4 Axle Load and Wheel Base of Locomotive

(2) Bridges

The following bridge descriptions are based on data provided by the VNR and TEDI, results of interviews with the counterpart and field survey findings.

1) General

There are as many as some 690 bridges (TEDI data) of various sizes on the 1,726 km long Hanoi - Ho Chi Minh Railway. The total length of these bridge sections is approximately 24,000m, accounting for 1.4% of the total track length. There is an average of one bridge every 2.5 km and the average length is approximately 35m. Table 5.3.4-1 classifies the bridges by length.

Table 5.3.4-1 Bridge Classification by Length and Respective Percentage

Bridge Length	L < 20	20≦L <50	50≦L <100	100<L<200	200≦L<500	500 ≦L	Total
Number	379	189	66	32	17	3	686
Percentage	55.2	27.6	9.6	4.7	2.5	0.4	100.0

The bridges are made of either steel or concrete. There are more steel bridges among bridges with a span of 20m or more. Concrete bridges mainly have a short span. No PC bridge is currently in use as a railway bridge. Table 5.3.4-2 classifies the bridges by construction material.

Table 5.3.4-2 Bridge Classification by Material

Girder Material	No. of Bridges		Total Length (km)	
Steel Girders	391	(57%)	16.3	(68%)
Concrete Girders	256	(37%)	4.2	(17%)
Steel and Concrete Girders	28	(4%)	3.0	(13%)
Others	11	(2%)	0.6	(2%)
Total	686	(100%)	24.1	(100%)

For reference purposes, the classification of bridges by construction material in Japan is shown in Table 5.3.4-3, excluding those bridges on Shinkansen routes (super express train routes). The bridges considered here are those for conventional 1,067 mm gauge track. The data is as of 1986 and is, therefore, slightly old. Although the unit for tabulation is the number of girders, it is believed that the table shows the basic trend of railway bridge construction in Japan.

Table 5.3.4-3 Bridge Classification by Material in Japan

Girder Material	No. of Girders	Ratio (%)
Steel	43,118	53.3
Truss	1,247	1.6
Concrete	35,849	44.3
Others	644	0.8
Total	80,858	100.0

The current conditions of railway bridges in Viet Nam are not particularly good. Many bridges are corroded and have other problems which even threaten the very safety of some bridges. These problems are caused by natural ageing, salt damage in coastal sections, relatively high humidity, destruction/damage by war, flooding in the rainy season, temporary girders and piers placed as an emergency measure and poor maintenance, etc. The VNR appears to have limited options to solve these problems. The actual measures taken range from minor repairs and slowing down of the train speed to 24 hour monitoring by full-time watchmen.

Table 5.3.4-4 Classification of 20m or Longer Bridges by Speed Limit

Speed Limit	15 km/hr	30 km/hr	40 km/hr	50 km/hr	60 km/hr	None	Total
No. of Bridges (%)	20 (6.5)	104 (33.9)	17 (5.5)	115 (37.4)	42 (13.7)	9 (3.0)	306 (100.0)
Total Length (m) (%)	5,134 (24.5)	6,892 (32.9)	999 (4.8)	5,240 (25.1)	1,726 (8.3)	924 (4.4)	20,916 (100.0)

Note: The number of bridges with a speed limit of 15 km/hr includes those for which the speed limit is less than 15 km/hr.

The current poor conditions of railway bridges on the Hanoi - Ho Chi Minh Railway is underlined by the fact that bridges with a length of 20m or more and with a speed limit of upto 30 km/hr account for 40.4% in terms of number and 57.4% in terms of the percentage of the total length of bridges. In extreme cases, the speed limit is as slow as 5 km/hr.

Another major problem is the submergence of bridges and road beds during the rainy season. Although rather old, the TEDI data put the number of train service interruptions due to flooding of the railway track at 23.6 times/year on average for the period between 1977 and 1983. The total duration of service interruptions was an average of 331 hours/year.

In short, the long travelling time caused by the slow operation speeds resulting from slow speed limits having become a regular feature at many bridges and the long interruption of train services due to the submergence of bridges and track during the rainy season are fatal shortcomings of the Hanoi - Ho Chi Minh Railway in view of the 3 basic requirements of any railway operation, i.e. safety, speed and punctuality. Fundamental improvements are required to achieve safe, high speed and punctual train services in the future.

2) Design Load

While there was no standard design load for bridges in the past due to the complex history of the railway in Viet Nam, the design load illustrated in Fig. 5.3.4-5 is currently used as the standard design load for bridges although these figures do not take the use of multiple locomotives for a single train into consideration.

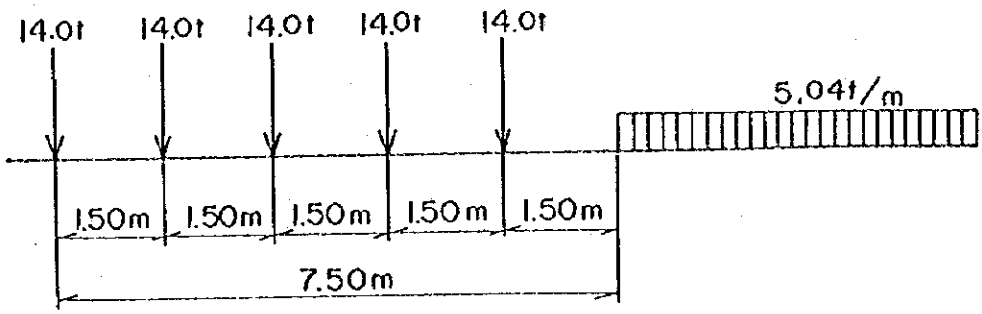


Fig. 5.3.4-5 Design Load for Bridges

3) Bridge Problems

Bridges on the Hanoi - Ho Chi Minh Railway currently have many problems, including those described below.

a) Ageing

Most of the bridges are more than 60 years old and such deterioration as corrosion is visible at many bridges. The present situation in which almost all bridges have their own speed limit poses a serious problem vis-a-vis the entire operation. The main causes of deterioration are salt damage and flood damage in the rainy season as the route follows the coastline. The general climate, such as high humidity and high temperatures, along the route is another factor contributing to bridge deterioration.

Examples of deterioration include saw-toothed corrosion of the members of steel bridges, flattened rivet heads due to corrosive abrasion and cracks/exfoliation of the concrete girders. The abutments and piers also have cracks and some of the foundations show signs of scouring.

As described earlier, most of the bridges have a speed limit to ensure safe train operation. The classification of bridges by age is shown in Table 5.3.4-5.

Table 5.3.4-5 Classification of Railway Bridges by Age and Ratios

(for bridges of 20m in length or more)

Age (years)	0-5	5-15	15-25	25-35	35-45	45-55	55-65	65-75	75-85	85-95
Number	3	2	6	0	0	0	183	28	13	71
Ratio	1.0	0.6	2.0	0	0	0	59.5	9.2	4.3	23.4

Table 5.3.4-6 shows the similar classification of bridges by age in Japan, excluding those bridges on Shinkansen routes. As the data was compiled in 1986, these bridges are now 8 years older.

Table 5.3.4-6 Classification of Railway Bridges by Age in Japan (as of 1986)

Age (years)	Less than 10	10-20	20-30	30-40	40-50	50-60	60-70	70 or More
Number of Girders	8,919	10,493	9,494	8,160	11,818	12,696	9,632	9,646
Ratio	11.0	13.0	11.8	10.1	14.6	15.2	11.9	11.9

b) War Damage

The prolonged war in the past savaged the railway lines which were the main means of transportation. Those bridges of which the destruction would cause major disruption of the war effort and of which the rehabilitation would take a long time were particularly targeted and were severely damaged. While most of the damaged bridges were temporarily repaired after the war, full-scale rehabilitation is still far from being a reality. War damage is still highly visible in terms of both the superstructure and substructure of many bridges.

c) Flooding (Submersion)

The heavy bombing during the prolonged war and excessive felling in the post-war restoration period severely depleted Viet Nam's forests. As a result, increased river flooding now occurs, particularly during the rainy season, causing much damage everywhere. The Government of Viet Nam is fully aware of the serious implications of the present situation and is earnestly conducting afforestation, the intended achievements of which have not yet to be seen.

The railway bridges are severely affected by river flooding to the extent that many are actually submerged. In some cases, bridges are actually washed away. The subsequent interruption of railway operation obviously greatly disrupts the passenger and freight services.

The railway has several advantageous vis-a-vis other modes of transportation, notably safety, speed and punctuality. The fact that the Hanoi - Ho Chi Minh Railway, by far the most important artery of Viet Nam's railway network, is forced to suspend operation for weeks or nearly one month is a serious problem. The vulnerability of railway bridges to flooding must be urgently rectified together with the necessary improvements to raise the existing speed limits for bridges. Table 5.3.4-7 shows the number of bridge submersions during the period between 1977 and 1983.

Table 5.3.4-7 Submersion of Railway Bridges

Year	1977	1978	1979	1980	1981	1982	1983	Average
Number of Occurrences	18	20	14	26	24	15	48	23.6

d) Long Use of Temporary Girders

Ageing/deterioration and the damage caused by the war and flooding have made many girders unsafe. Temporary measures to restore the safety and usability of these girders include the joining of existing girders to make the girder span longer, joining of different type of girders, laying of existing girders on top of others, conversion from road bridges and the use of military assembly girders. By definition, these make-shift girders are of a temporary nature but have, in reality, been used for a long period of time.

e) Reinforcement Using Temporary Piers

As in the case of the superstructure, the substructure of railway bridges has been weakened due to ageing and deterioration. Some bridges have temporary piers between the original piers for reinforcement. The use of temporary piers disrupts the flow of river water and can magnify the damage at the time of flooding, including damage to the bridge itself. The existence of these temporary piers in sections vulnerable to flooding poses a grave problem for railway operation and improvement work is urgently required for bridges using temporary piers in these sections. In the case of some bridges where a temporary pier was introduced at the centre of the span to supplement the weakened strength of the superstructure due to deterioration, the rails are undulated due to the delayed introduction of the said temporary pier after the girder was already bent.

f) Combined Rail and Road Bridges

Due to the inadequate provision of road bridges, combined rail and road bridges have been constructed in places where no road bridge exists despite the existing of a road nearby a railway bridge. There are 2 types of this type of combined bridge, i.e. the railway track is also used as a road and the railway track is completely separated from the road on the same bridge. The railway track of the former type of bridge is naturally subjected to damage by road traffic, resulting in track distortion. Moreover, road traffic on the track can hamper train operation to the point of seriously disrupting the train schedule. This possibility is particularly relevant in the case of long bridges. In view of the likely increase of the train speed and train service frequency in the future, this serious obstacle to the punctuality of railway operation must be removed.

Some of the combined bridges were not originally designed and constructed as such but were later combined. Some of the members of this type of bridge show signs of fatigue because of the frequent imposition of different live loads as well as the vibration characteristics from the vehicles.

g) Insufficient Maintenance

All bridges deteriorate in accordance with time due to various causes and appropriate daily maintenance is essential to prevent rapid deterioration in order to ensure safe bridge conditions for train operation. Maintenance of the Hanoi - Ho Chi Minh Railway has so far been insufficient, presumably because of the adverse impacts of the war, shortage of repair materials and lack of an adequate maintenance and repair budget.

① Inadequate Repainting

As most of the girders are made of steel, painting is essential to combat corrosion which is likely to occur given the unfavourable conditions of the girders being exposed to salt in coastal sections and relatively high temperatures and humidity. However, the inadequate budget means that only a few girders are properly painted and members covered by rust are not unusual. If this situation is allowed to continue, the girder strength will be reduced in accordance with the progress of the corrosion.

② Use of Ordinary Bolts for Member Joints

Although the members of steel girders should normally be welded and jointed using rivets/high tension bolts, the material shortage in the past meant the use of ordinary bolts which have not yet been replaced. The use of ordinary bolts over a long period of time has tended to cause member displacement because of the inadequate fastening strength of these bolts, leading to possible bridge destruction. Consequently, the ordinary bolts currently in use should be replaced by high tension bolts or the joints should be welded. In fact, the current repair work of the VNR commonly uses high tension bolts but there are many bridges where the ordinary bolts have not been replaced.

③ Members of Insufficient Strength

At many bridges, the members which have been corroded over the years are still in use despite the lack of a sufficient cross-sectional area. The corroded members of a small number of bridges have, however, been replaced and reinforced by additional members. Some members lack a sufficient cross-sectional area or are deformed due to holes created by bombing or shelling during the war. The foundations of the abutments and/or piers of many bridges have been weakened due to scouring by flowing water.

h) Inconsistent Design Load

Because of the varying background of railway construction in Viet Nam in the past, different design loads for bridges have been adopted from time to time. The design loads adopted in the past are mainly between T-10 and T-13 although the design load for some newer bridges is more than T-14. This inconsistency in bridge design load creates inefficient transportation as operation is regulated by the lowest design load of T-10 and, in principle, any locomotive with a higher load than T-10 cannot be used. A uniform design load of T-14 for bridges was adopted in April, 1994 and has been in use since then.

i) Existence of Trains with Excessive Axle Load

Bridge design is not necessarily determined by the axle load alone. Strictly speaking, the wheel base, number of axles and number of locomotives connected together, etc. must be taken into consideration. Locomotives with a maximum axle load of T-14 are currently used in certain sections of the Hanoi - Ho Chi Minh Railway. As explained earlier, most of the bridges are old and have a design load of T-10~T-13. While the simple view is that the train load exceeds the design load at many bridges this is why the train speed must be restricted at most bridges. The implementation of regular inspections is, therefore, essential with a view to promptly introducing appropriate reinforcement measures to prevent accidents caused by fatigue failure over a long period of use.

j) Posting of Look-out Men

Although efforts have been made to repair/renew the deteriorated parts of bridges, they fall very short of the required level to meet all repair/renewal needs, making the introduction of a speed limit at most bridges necessary. As the introduction of speed limits is far from being a perfect solution, bridge look-out men are permanently posted at all important bridges and bridges with a high safety risk to secure bridge safety. Unfortunately, however, the communication link between these look-out men and nearby stations is inadequate. This situation in which train operation safety on the main trunk route is maintained by the posting of permanent look-out men and their reporting to stations cannot be described as normal and is a serious challenge for the VNR.

k) Maintenance System

As in the case of track maintenance, bridges on the Hanoi - Ho Chi Minh Railway are maintained by 11 maintenance enterprises. The preparation of maintenance manuals which are appropriate vis-a-vis the current railway bridge conditions in Viet Nam is necessary to ensure efficient and appropriate maintenance. Regular inspections must then be conducted on all structures and members in accordance with these manuals to maintain all bridge structures in good working order.

l) Others

Few bridges have a footpath or refuge bay to efficiently and safely conduct patrols and maintenance work. The provision of footpaths and refuge bays is necessary to cope with the likely increase of maintenance work in view of the expected increase of the train speed and number of trains in the future.

Corrosion of the steel members by human waste is also noticeable. In addition to daily maintenance to prevent such corrosion, measures to stop the dumping of human waste should also be considered.

(3) Tunnels

The following analysis and description of tunnels on the Hanoi - Ho Chi Minh Railway are based on data obtained from the VNR and TEDI, results of interviews with the Viet Namese counterpart and field survey findings as in the case of bridges.

1) General

The Hanoi - Ho Chi Minh Railway has a total of 27 tunnels, the total length of which is approximately 8.4 km. The longest tunnel is 1,190m and the shortest is 61m with an average length of approximately 310m. These tunnels have usually been dug out of high quality, hard rock, such as granite. Some tunnels are unlined while others are constructed at geologically unsuitable sites.

All of the tunnels are quite aged and the inner rock or concrete surface generally shows a high degree of deterioration due to weathering. Many surfaces have cracks and water leakage and there is a risk of falling rocks and exfoliated concrete. Some of the tunnels have even been deformed in parts. Gaps as large as 60 cm in diameter and 1 - 2m in depth, presumably caused by falling rock, are round in the ceilings of some tunnels. Reinforcement has been conducted at some sections by arch centres and steel plates to prevent rock falls and tunnel deformation.

As in the case of bridges, the problems of tunnels are caused by general ageing, salty air in coastal sections, seepage water originating from torrential rain during the rainy season and inadequate maintenance. The currently employed remedial measures including minor repairs, train speed restrictions and monitoring by full-time look-out men as in the case of bridges. The current conditions of tunnels are shown in Table 5.3.4-8 which classifies tunnels by the speed limits enforced.

Table 5.3.4-8 Classification of Tunnels by Speed Limit Enforced

Speed Limit	15 km/hr	30 km/hr	35 km/hr	40 km/hr	Total
Number of Tunnels (%)	10 (37.0)	11 (40.8)	1 (3.7)	5 (18.5)	27 (100.0)
Total Length (%)	2,801 (33.3)	3,164 (37.6)	1,190 (14.2)	1,250 (14.9)	8,405 (100.0)

Those tunnels with a speed limit of upto 30 km/hr account for 77.8% of all tunnels and 70.9% of the entire tunnel length. Together with the fact that no tunnel allows a train speed of more than 40 km/hr, it is not difficult to infer that these tunnels are in a poor condition. Again, as in the case of bridges, the poor tunnel conditions currently limit the safety of train operation and train speed and their improvement will likely result in improved train operation safety and faster train speeds. Like bridge improvement, fundamental improvement of the tunnels is essential to the future development of Viet Nam.

2) Tunnel Cross-Section

The current cross-section of tunnels on the Hanoi - Ho Chi Minh Railway is shown in Fig. 5.3.4-6.

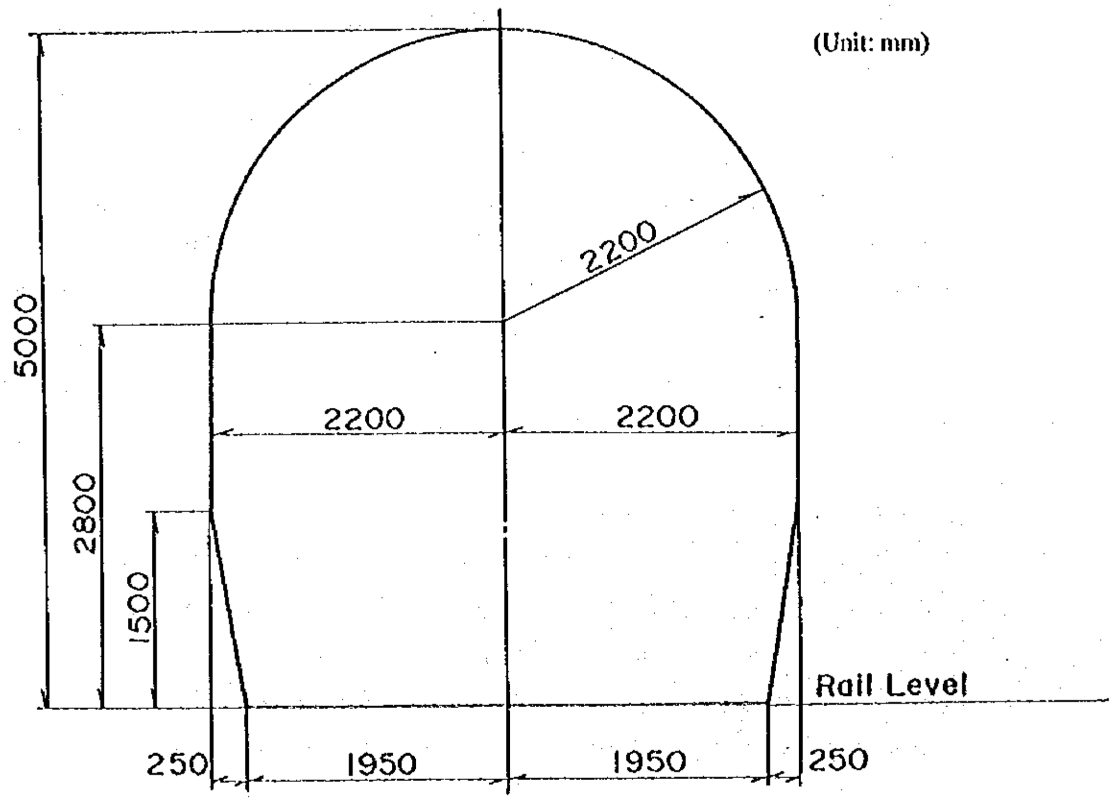


Fig. 5.3.4-6 Tunnel Cross-Section

3) Tunnel Problems

The following problems of tunnels on the Hanoi - Ho Chi Minh Railway are commonly observed.

a) Ageing

The newest tunnel was constructed as long ago as 1936 and is almost 60 years old while the oldest tunnel is 70 years old. During these years, the inner rock and concrete surfaces of the tunnels have considerably weathered and varying speed limits have been introduced for all tunnels to ensure the safe passage of trains as described earlier.

The deterioration of the inner surface is epitomised by numerous cracks, exfoliation of the rock and concrete, serious water leakage during the rainy season and deformation of weak ground, etc. Alterations of the clearance caused by repair work also pose another problem. The deterioration of the inner surface of some tunnels is so bad that touching by hand with only slight force can cause rock falls or exfoliation of the concrete. Table 5.3.4-9 classifies the tunnels by age.

Table 5.3.4-9 Classification of Tunnels by Age

Age (years)	58	59	....	67	68	69	70	Total
Number of Tunnels (%)	2 (7.4)	11 (40.8)		8 (29.6)	5 (18.7)	0 (0)	1 (3.7)	27 (100.0)
Total Length (m) (%)	1,568 (18.7)	2,867 (34.1)		2,954 (35.1)	951 (11.3)	0 (0)	64 (0.8)	8,404 (100.0)

Table 5.3.4-10 shows the similar classification of railway tunnels in Japan by length, excluding those on Shinkansen routes. The data used was collected in 1986 and is 8 years old.

Table 5.3.4-10 Railway Tunnel Length by Age in Japan

Age (years)	Less than 10	10-20	20-30	30-40	40-50	50-60	60-70	70 or More
Total Length (km)	203.6	227.8	154.3	133.8	186.0	186.6	136.4	166.8
Ratio (%)	14.6	16.3	11.0	9.6	13.3	13.4	9.8	12.0

b) Falling Rocks

The rocks and lining concrete of the inner tunnel surface have begun to fall or exfoliate with progressive deterioration over a long period time, causing a safety risk vis-a-vis train operation. The repair and preventive work so far conducted at some tunnels include the fresh cementing of mortar and the placement of steel plates in arched sections supported by rail centres. The repair work is, however, far from satisfactory. Traces of falling rocks can be observed at many tunnels and some sites are quite dangerous due to holes at the crown of the tunnel.

c) Deformation

With the passing of time, the heavy soil pressure acting on the tunnel lining in geologically weak ground has deformed the shape of some tunnels. Rail centres have been inserted inside the concrete lining of some tunnels to prevent further deformation. As the insertion of rail centres is only a provisional measure, however, complete replacement of the concrete lining is necessary to fundamentally solve the problem of tunnel deformation.

d) Water Leakage

The torrential rain in the rainy season is believed to cause fierce water leakage through the cracks as well as openings of the inner tunnel surface caused by deterioration, falling rocks or exfoliation of the lining concrete. This leakage worsens the cracks in the concrete lining and accelerates the deterioration of the said lining. The overflow of the leakage water from the drainage ditches inside the tunnel deteriorates the roadbed and track conditions. In addition to the provision of drainage ditches inside the tunnels, measures to contain water leakage must be employed.

The drainage water from the ditches and leakage water from the tunnel ceiling and walls, etc. discharge sediment and small size gravel from the ground and, over the years, hollow spaces have been created in the backfilling areas. The appearance of these hollow spaces is considered to be one of the causes of tunnel deformation together with deterioration of the ground stability. Consequently, the inspection of possible tunnel deformation and new backfilling are required to prevent further deterioration.

e) Flooding

There are assumed to be 2 causes of tunnel flooding. One is the increase of the leakage water volume due to heavy rain in the rainy season which in turn exceeds the insufficient drainage capacity of the existing drainage ditches, causing flooding. The other is the result of the flooding of a nearby river.

To prevent the former type of flooding, the introduction of proper leakage prevention measures is essential together with improvement of the drainage capacity. While viable methods of preventing the latter type of flooding depend on the tunnel location, river improvement work and/or tunnel relocation are basically required.

f) Lack of Drainage Ditches

A drainage ditch is provided on both sides of the track in most tunnels. However, the cross-sectional area of these ditches in some tunnels is not sufficiently large to cope with the increased drainage demand resulting from more than usual leakage water and water inflow into the tunnel caused by heavy rain in the rainy season. As a result, the track is flooded. In addition to improving the waterproofing performance of the tunnel lining, measures to prevent water inflow from both ends of the tunnel should also be implemented.

g) Inadequate Tunnel Clearance

The tunnel clearance appears inadequate at some sections of certain tunnels. This inadequacy is presumably caused by tunnel deformation and shrinkage of the cross-sectional area due to reinforcement work using rail centres to prevent further deformation. The walls of some tunnels show traces of physical contact. Based on the car gauge and cross-sectional area of the tunnels in question, it is assumed that the walls were hit by unsecured or loosely fastened cargo on uncovered freight cars.

Although not directly related to inadequate tunnel clearance, another point is worthy of attention. In Viet Nam, over-crowded passengers sometimes hang onto a travelling train with part of their bodies actually outside the train. To prevent these passengers hitting the tunnel, resulting in serious or even fatal accidents, a mock tunnel clearance model made of rubber is erected before the tunnel entrance so that those passengers bulging out of a train are aware of the impending danger as they hit the rubber model before entering the tunnel.

h) Landslides at Tunnel Ends

Many tunnels on the Hanoi - Ho Chi Minh Railway are dug out of hard rock and the cut slopes at both ends of the tunnels are usually very steep. In general, a concrete retaining wall has been erected at the bottom of the cut slopes but the rocks at the upper end of the slopes which are subject to weathering can be very fragile. There is, therefore, a danger of landslides or rock falls from the upper section, particularly at the time of heavy rain in the rainy season. Indeed, some slopes have collapsed in the past. There is concern in regard to the increased likelihood of landslides or rock falls as the weathering process naturally continues.

i) Inadequate Maintenance

As described so far, many problems are associated with the current conditions of tunnels on the Ho - Chi Minh Railway. In general, the measures implemented so far to solve these problems are inadequate and have failed to maintain undisrupted train operation throughout the year. Needless to say, inspections must be regularly conducted and must be followed by repairs and any other maintenance work found necessary to ensure the long working life of the tunnels.

j) Posting of Look-out Men

Under the present circumstances, full-time look-out men are posted at both ends of the tunnels (at just one end in the case of shorter tunnels) to ensure the safety of train operation, as in the case of bridges. If a look-out men finds any irregularity which could affect train operation, he immediately informs the nearby station and/or offices related to train operation to stop trains from entering the tunnel.

k) Maintenance System

The description given in 5.3.4 -(2)-3)-k - Maintenance System also applies here.

l) Others

At present, lighting and emergency communication facilities are not available at all tunnels.

(4) Other Civil Engineering Structures

1) General

The roadway of the Hanoi - Ho Chi Minh Railway is mainly composed of such civil engineering structures as cutting and banking which account for 98% of the entire route with a small proportion of bridges and tunnels (approximately 2% of the total length of the railway route). As described in the UNDP report and the TEDI report disasters occur every year at these cutting and banking sections due to torrential rain and/or flooding during the rainy season. In addition, some sections constructed next to dry riverbeds in valleys have been flooded for several days or even weeks. Those sections which are particularly vulnerable to flooding are listed in Table 5.3.4-11.

Table 5.3.4-11 Sections Vulnerable to Flooding

Kilometre		Extension	Remarks
From	To		
329 km 650m	372 km 606m	42 km 956m	Vinh (319.0) - Chu Le (380.6)
372 km 900m	385 km 100m	12 km 200m	Thanh Luyen (369.6) - Huong Pho (386.8)
385 km 740m	388 km 990m	3 km 250m	Chu Le (380.6) - Phuc Trach (396.2)
391 km 500m	397 km 600m	6 km 100m	Huong Pho (386.8) - La Kye (404.4)
402 km 600m	406 km 250m	3 km 650m	Phuc Trach (396.2) - Tan Ap (408.7)
420 km 350m	426 km 900m	6 km 550m	Tan Ap (408.7) - Kim Lu (426.0)
429 km 050m	436 km 800m	7 km 750m	Kim Lu (426.0) - Dong e (436.3)
441 km 800m	443 km 175m	1 km 375m	Dong Le (436.3) - Ngan Lam (449.6)
448 km 950m	473 km 670m	24 km 720m	Dong Le (436.3) - Minh Le (481.8)
478 km 400m	482 km 250m	3 km 850m	Le Son (467.1) - Minh Le (481.8)
484 km 800m	486 km 000m	1 km 200m	Minh Le (481.8) - Ngan Son (488.8)
488 km 175m	489 km 625m	1 km 450m	Ngan Son (488.8)
508 km 450m	510 km 450m	2 km 000m	Tho Loc (498.7) - Phuc Tu (510.7)
531 km 350m	532 km 150m	0 km 800m	Le Ky (529.0) - Long Dai (539.2)
549 km 050m	557 km 450m	8 km 400m	Long Dai (539.2) - Phu Hoa (558.5)
558 km 750m	560 km 100m	1 km 350m	Phu Hoa (558.5) - My Trach (565.1)
562 km 975m	563 km 775m	0 km 800m	Phu Hoa (558.5) - My Trach (565.1)
564 km 400m	566 km 575m	2 km 175m	My Trach (565.1) - Thuong Lam (572.2)
613 km 900m	619 km 400m	5 km 500m	Ha Thanh (609.5) - Dong ha (622.2)
624 km 300m	629 km 350m	5 km 050m	Dong Ha (622.2) - Quang Tri (633.9)
631 km 350m	633 km 700m	2 km 350m	Dong Ha (622.2) - Quang Tri (633.9)
640 km 000m	642 km 150m	2 km 150m	Quang Tri (633.9) - Dien Sanh (624.7)
658 km 700m	659 km 640m	0 km 940m	My Chanh (651.7) - Pho Trach (659.8)
670 km 210m	671 km 890m	1 km 680m	Hien Sy (669.8) - Van Xa (678.1)
676 km 500m	684 km 625m	8 km 125m	Hien Sy (669.8) - Hue (688.1)
706 km 300m	707 km 200m	0 km 900m	Huong Thuy (698.7) - Truoi (715.3)
733 km 700m	734 km 600m	0 km 900m	Cau Hai (729.4) - Thua Luu (741.6)
736 km 100m	736 km 800m	0 km 700m	Cau Hai (729.4) - Thua Luu (741.6)
749 km 900m	752 km 100m	2 km 200m	Thua Luu (741.6) - Lang Co (755.4)

Many disasters, such as roadway collapse, slope collapse or scouring and retaining wall damage, etc., also occur due to torrential rain and/or flooding in other sections. The temporary repair of most of the damaged structures has been conducted to maintain their original functions.

2) Earth Structures

As the Hanoi - Ho Chi Minh Railway runs through several mountain ranges and swampy areas, there are many high cutting or high banking sections. The aggregate length of sections with high cutting of 6m or more is approximately 18 km while the aggregate length of sections with high banking of 6m or more is approximately 30 km. Few of these sections are protected by retaining walls or slope protection works. A lack of protection is also noticeable at sections with cutting of less than 6m and sections with banking of less than 6m. The slope shoulder and face are damaged at many banking sections due to people walking on top of them while soil erosion is occurring or is likely to occur in the near future at some cutting sections.

3) Disaster Prevention Facilities

As described in 2) above, the roadway is seldom protected. Even though some sections are protected, many of the protective structures have subsided and become deformed. In particular, there is little protection against falling rocks. Those sections which are liable to suffer from falling rocks are listed in Table 5.3.4-12.

Table 5.3.4-12 Sections Liable to Suffer from Falling Rocks

Kilometre		Extension	Remarks
From	To		
749 km 650m	775 km 150m	25 km 500m	Thua Luu (741.6) - Kim Lien (776.9)
984 km 000m	996 km 500m	12 km 500m	Thuy Thach (977.1) - Tam Quan (1,004.3)
1,134 km 500m	1,135 km 500m	1 km 000m	Van Canh (1,123.6) - Phuoc Lanh (1,139.3)
1,217 km 300m	1,224 km 800m	7 km 500m	Phu Hiep (1,209.6) - Dai Lanh (1,232.2)
1,437 km 800m	1,438 km 200m	0 km 400m	Ca Na (1,436.3) - Vinh Hoa (1,453.7)

4) Drainage Facilities and Others

Side drainage ditches have been constructed along cutting and banking sections but the total length of these ditches is presumed approximately 10 or 20% of the total length of these sections. While the standard measurements of these ditches are 40cm in width and 40 - 60 cm in depth, many of the existing ditches do not meet the standards. Moreover, due to the absence of sediment basins, some ditches are blocked by sediment to the point that they have lost their drainage function. There are virtually no cross-sectional drainage ditches or vertical drains.

5) Maintenance System

The civil engineering structures and drainage ditches, etc. are regularly inspected twice a month and also before and after the typhoon/rainy season and the inspection results are compiled in the track inspection register. Special inspections are conducted when the regular inspection results suggest a need for extra inspection. The inspection records are strictly stored by the offices responsible for inspection. An annual maintenance programme is prepared based on the inspection records which are submitted in the third quarter of the previous fiscal year.

(5) Track and Level Crossings

1) General

In the northern and southern plains, the Hanoi - Ho Chi Minh Railway has long straight sections and the radius of the curve in these areas is 300m or more. In contrast, there is a series of sharp curves and steep slopes in the central area where the Hanoi - Ho Chi Minh Railway traverses hillsides and mountain ranges. The impossibility of securing a straight section between the curved sections or transition curves in this area is a bottleneck vis-a-vis transportation and safety.

Tables 5.3.4-13 and 5.3.4-14 show the number of curved sections by curve radius and the total length respectively. Similarly, Tables 5.3.4-15 and 5.3.4-16 show the number of sloping sections by grade and the total length respectively.

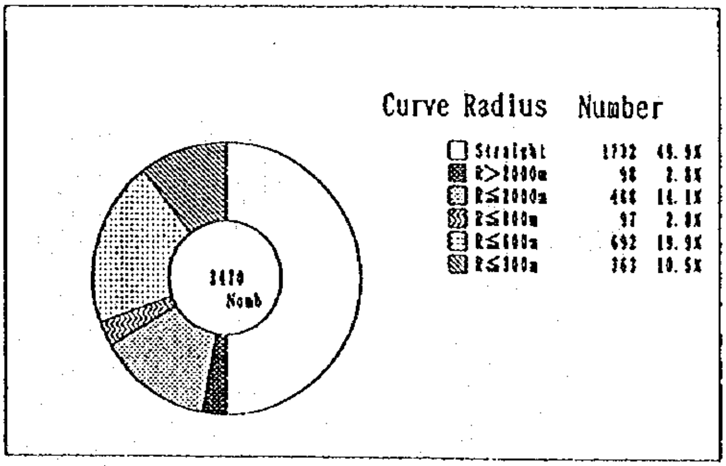


Table 5.3.4-13 Number of Curved Sections by Curve Radius

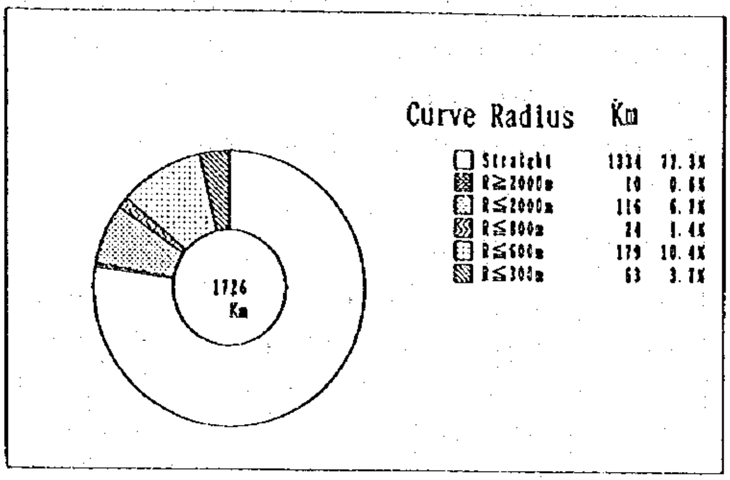


Table 5.3.4-14 Total Length Respectively of Curved Sections by Curve Radius

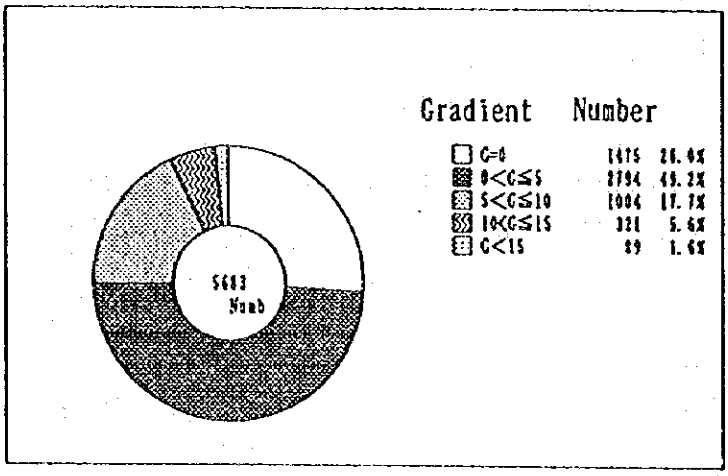


Table 5.3.4-15 Number of Sloping Sections by Grade

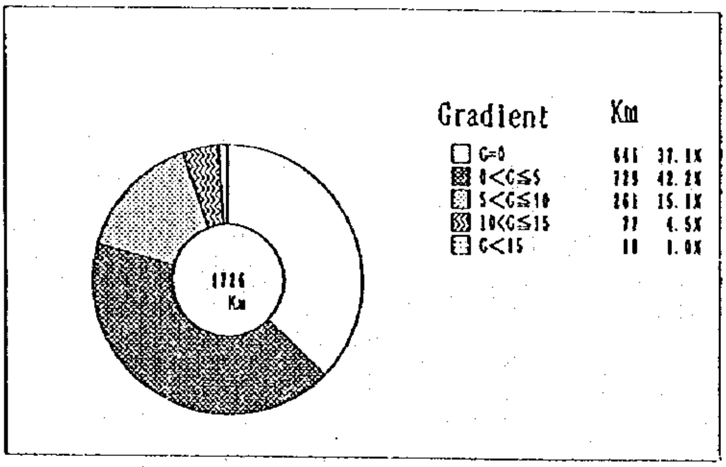


Table 5.3.4-16 Total Length Respectively of Sloping Sections by Grade

Table 5.3.4-17 shows those sections which are a bottleneck for transportation and safety due to continuous sharp curves and steep slopes.

Table 5.3.4-17 Sharp Curve and Steep Slope Sections

Kilometre		Extension	Remarks
From	To		
134 km 000m	138 km 300m	4 km 300m	Don Giao (133.6) - Bim Son (141.5)
414 km 975m	421 km 584m	6 km 609m	Tan Ap (408.7) - Kim Lu (426.0)
750 km 300m	777 km 600m	27 km 300m	Thua Luu (741.6) - Thanh Khe (788.3)
1,299 km 600m	1,231 km 000m	1 km 400m	Hoa Son (1,220.1) - Dau Lanh (1,232.2)
1,667 km 750m	1,670 km 500m	2 km 750m	Dau Giay (1,661.3) - Trang Bom (1,677.5)

The cant for a curved section is determined based on the maximum train speed to ensure passenger comfort. Nevertheless, the required transitional curve length has not been secured at some sections given the current maximum speed. The number of these sections is expected to increase with the increased operation speed in the future.

2) Rails

The types of rails and their total rail extension by type are shown in Table 5.3.4-18.

Table 5.3.4-18 Types of Rails and Total Extension

Rail Type	Extension	%	Remarks
43 kg/m Rail	1,354 km	78	Standard Length = 12.5m
30 kg/m Rail	350 km	20	Standard Length = 12.0m
27 kg/m Rail	22 km	2	Standard Length = 12.0m
Total	1,726 km	100	

a) 22% of the rails are more than 60 years old 30 kg/m or 27 kg/m rails which are highly abrased and cracked due to long and hard use. Most of these rails are found in the area controlled by Union 3.

b) Because the standard length of the 43 kg/m rails is 12.5m, there are many joints which comprise weak points on the track. With the expected increases of the train speed and passing tonnage on the track in the future, joint maintenance work, accounting for a large proportion of the track maintenance work, will also increase.

c) The rail replacement interval at some sharp curved sections at the Hai Vinh Pass and other sites is as short as 6 months. Although the use of head-hardened rails is generally desirable, further consideration is required because of the adverse effect of these rails on the car wheels.

3) Sleepers

The types of sleepers and their total extension by type are shown in Table 5.3.4-19.

Table 5.3.4-19 Types of Sleepers and Total Extension

Sleeper Type	Extension	%	Remarks
2-Block Concrete	603 km	35	
Iron	921 km	53	
Wood	202 km	12	
Total	1,726 km	100	

a) As the ties for the 2-block concrete sleepers only penetrate some 200 mm into the concrete blocks, it is questionable whether or not they resist lateral resistance in harmony with the concrete blocks. While the fastener (K3 type) uses a T bolt, brace, spring washer and nut to fasten the tie plate to the rubber pot, its low elasticity is likely to cause loosening.

b) Both corrosion and abrasion of the iron sleepers are observed.

c) The standard number of sleepers at present is 1,440 sleepers/km for straight sections and 1,600 sleepers/km for curved sections. The expected increases of the train speed and passing tonnage on trains necessitate improved track strength and additional sleepers should be introduced for all curved sections without exception.

4) Ballast

The standard ballast thickness adopted by the VNR is 30 cm below the sleepers. In many sections, however, the ballast thickness is less than 20 cm and in some sections hardly any ballast exists or the sleepers shoulders are exposed. The ballast diameter currently used can be as large as 10 cm. Without quality control of the ballast size, the volume of track maintenance work will increase with the expected increases of the train speed and passing tonnage on the track.

5) Turnouts

The types and turnout numbers currently in use are shown in Table 5.3.4-20

Table 5.3.4-20 Types and Turnout Numbers in Use

Rail Type	Turnout Numbers				%	Remarks
	1:9	1:10	1:12	Total		
43 kg/m Rail	22	396	5	423	66	
40 kg/m Rail	6	0	0	6	1	
38 kg/m Rail	3	0	0	3	1	
30 kg/m Rail	0	0	207	207	32	
Total	31	396	212	639	100	

The standard passing speed on the main straight line at a turnout is set at 70 km/hr for a trailing turnout and 60 km/hr for a facing turnout while the standard speed on a branch line is set at 30 - 35 km/hr. At many turnouts, however, the train speed is limited to less than the standard speed because of the deterioration of these turnouts.

6) Level Crossings

a) There are some 850 level crossings on the Hanoi - Ho Chi Minh Railway and gate-keepers are assigned to those with heavy traffic to operate the gate. Unmanned level crossings have no level crossig warnings.

b) While those level crossings which constitute part of a highway or major road for car traffic are paved, most others are unpaved.

7) Other Track Facilities

In some areas, including Hanoi, the railway track is laid between a highway and private houses and the people living in these houses or in the neighbourhood freely cross the track to reach the road. Soil has been dumped onto the track at some sites to create more permanent passageways. In many other areas, people freely cross the track as a short cut. While it may be difficult to completely prohibit use of the track as a passage in those places where it is necessary for people to cross the track to maintain their lives, fencing to prevent trespassing on the railway track should be erected in places where alternative crossings are available.

8) Maintenance System

The track of the Hanoi - Ho Chi Minh Railway is maintained by 11 railway management enterprises as shown in Table 5.3.4-21.

Table 5.3.4-21 Railway Management Enterprises

Union	Name of Enterprise	Section in Charge			Remarks
		From	To	Extension	
Union 1	Ha Noi	0.0 km	12.0 km	12.0 km	
	Ha Ninh	12.0 km	130.0 km	118.0 km	
	Thanh Hoa	130.0 km	240.5 km	110.5 km	
	Nghe Tinh	240.5 km	407.0 km	166.5 km	
	Quang Binh	407.0 km	526.0 km	119.0 km	
Union 2	Binh Tri Thien	526.0 km	756.2 km	230.2 km	
	Quang Nam-Da Nang	756.2 km	903.0 km	146.8 km	
	Nghia Binh	903.0 km	1,096.2 km	193.2 km	
Union 3	Phu Khanh	1,096.2 km	1,378.2 km	282.0 km	
	Thuan Hai	1,378.2 km	1,546.0 km	167.8 km	
	Saigon Muong Man	1,546.0 km	1,726.2 km	180.2 km	
Total				1,726.2 km	

Track maintenance work is mainly manually conducted although machines are used in some areas. Table 5.3.4-22 shows the track maintenance instructions.

Table 5.3.4-22 Track Maintenance Instructions

Item	Instruction	Remarks
Gauge	+ 4 mm - 3 mm	
Level	± 5 mm	
Alignment	10 mm (1‰)	(with 20m long string)
Longitude	10 mm (1‰)	(with 20m long string)

Track inspection of the gauge, level, alignment and longitudinal disorders are manually conducted as in the case of most other inspections. The regular inspection schedule and main inspection items are listed in Table 5.3.4-23.

Table 5.3.4-23 Regular Inspection Schedule

Inspection Schedule	Inspection Items	Remarks
Twice/Month	• Gauge, level, longitudinal disorders, alignment, ballast, level crossings, track signs • Turnouts on main track and departure/arrival track	
Monthly	• Main turnouts, departure/arrival track • Sidings	
Feb., May, Aug. and Nov. (Manual Work) Monthly (Mechanised Work)	• Rails and rail fasteners	

Special inspections are conducted when the need arises due to the findings of the above and other regular inspections.

6) Stations

1) General

There is a total of 162 stations on the Hanoi - Ho Chi Minh Railway with an average distance between stations of 10.7 km. The shortest and longest distance between stations is 3.1 km and 26.3 km respectively. The fiscal 1993 operation results show that 2 stations handled passengers only, 22 stations handled cargo only and 6 stations handled neither. The number of stations by passenger handling volume and freight handling volume is given in Table 5.3.4-24 and Table 5.3.4-25 respectively.

2) Passenger and Freight Facilities

While some stations have a station square which adds to the attractiveness of the station area, the existing station squares do not function as a focal point for the local transport network. The number of buses and taxes serving the stations is currently rather small and both services are somewhat arbitrary. In the future, station squares should be upheld as a focal point for the local transport network.

All the platforms have a low floor height. The platforms at major stations are paved while those at intermediate stations are unpaved.

As Table 5.3.4-25 shows, most stations handle only a small freight volume. While it may be possible for some stations to increase the freight handling volume, it is preferable to integrate freight handling at a small number of stations, taking the estimated freight transportation volume into consideration. Coordination with road transportation is also required.

3) Train Operation Facilities

A safety siding is available at some stations (Hai Van Nam and others). More stations should be provided with a safety siding in the future to prevent serious accidents caused by over-running and other reasons.

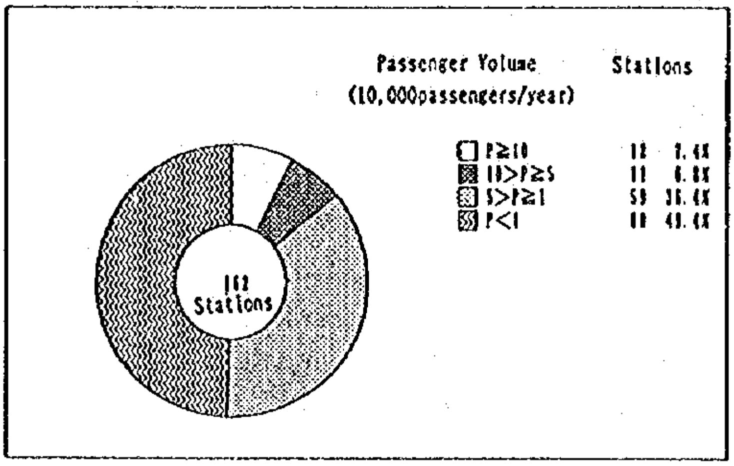


Table 5.3.4-24 Number of Stations by Passenger Handling Volume

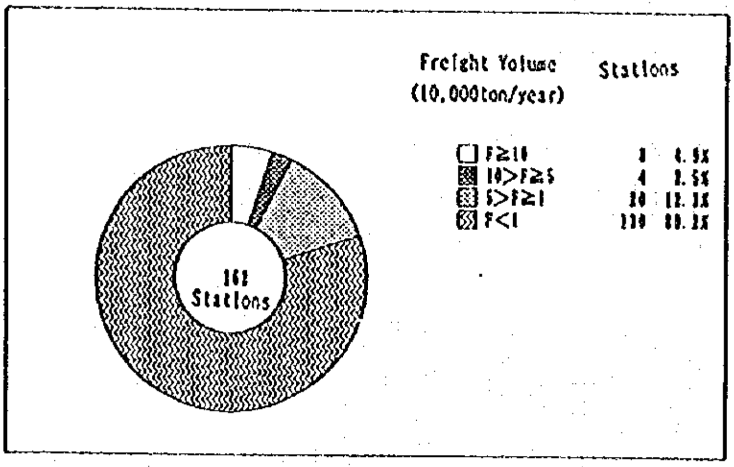


Table 5.3.4-25 Number of Stations by Freight Handling Volume

5.3.5 Electrical Facilities

(1) Power Supply and Distribution Facilities

Out of the 162 stations (excluding one station which has no building at all) between Hanoi and Saigon, only 47 stations receive power supply. Stations without power supply are particularly noticeable in the Union I and Union II areas as shown in Table 5.3.5-1.

Table 5.3.5-1 Stations with Power Supply by Union

Area	No. of Stations	With Power Supply	Without Power Supply	Ratio of Stations Without Power Supply (%)
Union I	55	12	43	78
Union II	54	8	46	85
Union III	53	27	26	49
Total	162	47	115	71

At those stations without power supply, the facilities usually requiring power for their operation are kept to a minimum and are operated by batteries. As the electric power company does not lay electric cable to small users, the distribution line to minor station must be laid by the VNR. This practice may have prevented power supply to some stations to which power supply does not appear difficult to arrange. The installation of power supply and distribution facilities should be given the highest priority as these facilities are the basis for the improvement of the signalling and communication systems. According to a plan prepared by the electric power company, power supply will be available in all open field areas by 1996. With the construction of distribution networks, power supply to all stations on the Hanoi - Ho Chi Minh Railway will become possible.

(2) Signalling Facilities

1) Block System

At present, the Hanoi - Ho Chi Minh Railway uses the token-less block system for sections between Hanoi and Hoa Duyet, between Lang Co and Da Nang and between Bien Hoa and Saigon, including sections where system installation is in progress, and the tablet block system for all other sections. According to the existing plan, all sections will have the token-less block system by December, 1995. The current conditions of the block system are shown in Fig. 5.3.5-1.

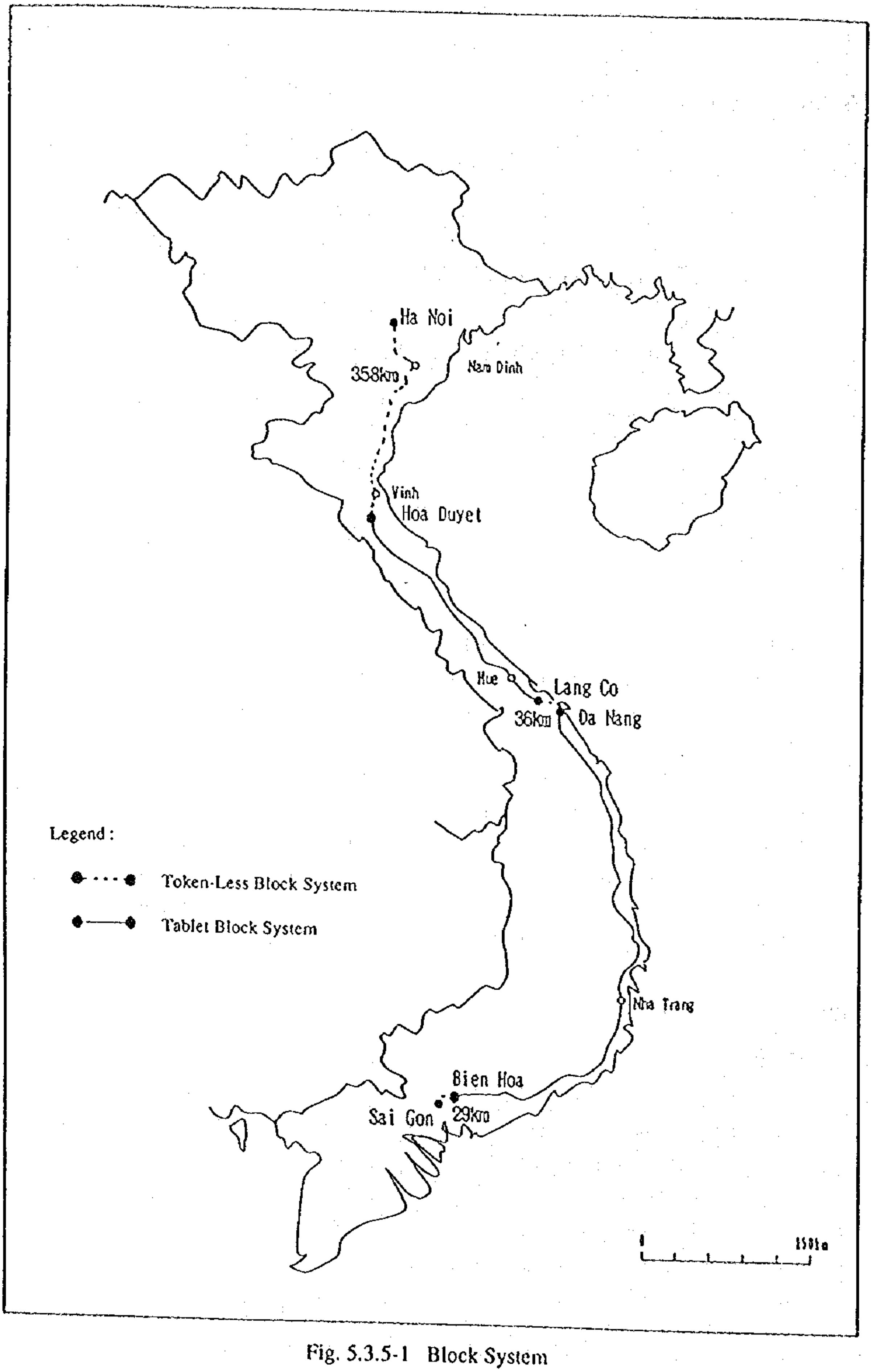


Fig. 5.3.5-1 Block System

2) Signal Divices

Departure and home signals are provided at sections using the token-less block system while only home signals are provided at sections using the tablet block system. The type of signals used are semaphore signals at stations without power supply and multiple colourlight signals at stations with power supply. An oil lamp is used for semaphore signalling at night. However, as it is difficult to confirm the indication by this method, the introduction of colourlight signals is urgently required.

The different indications of the colourlight signals are shown in Table 5.3.5-2. In the cause of a fault due to a power cut or other reasons, a white light located below the home signal is lit and the train is allowed to enter the station at a speed of less than 10 km/hr as in the case of shunting.

Table 5.3.5-2 Signal Indications

Type of Train	Track to Enter	Home Signal	Departure Signal
Stop Train	Main Track	Y	R
	Side Track	YY	R
Through Train	Main Track	G	G

3) Interlocking Devices

Class 2 interlocking devices integrated to the block system are used at sections using the token-less block system. Class 2 relay interlocking devices are used at stations with power supply. At sections using the tablet bloc system, indirect interlocking system by manual key is used.

4) Point Switching Devices

All point switching devices are operated at site and none are centrally controlled. At sections using the token-less block system, all point switching devices are equipped with an electric lock for interlocking with the signals for improved safety.

5) Track Circuits

Track circuits are not available at sections using the tablet block system while short track circuit is independently installed at both ends of a station using the token-less block system. The actual circuits are illustrated in Fig. 5.3.5-2.

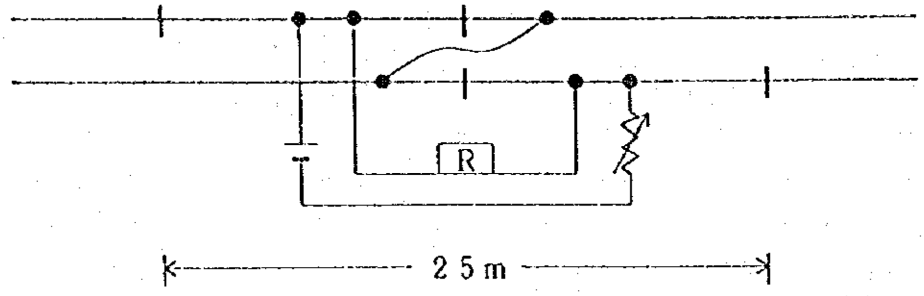


Fig. 5.3.5-2 Track Circuits

6) Power Units

Power for the signals is supplied by batteries at stations located in those sections using the token-less block system. These batteries are regularly replaced for charging purposes. The power unit at stations with power supply consists of a rectifier equipment and batteries. An emergency generator is provided at major stations to maintain the signalling and communication functions. All these equipment are fairly deteriorated and requires urgent renewal.

(3) Communication Facilities

1) Communication Line

The railway communication line between Hanoi and Saigon almost exclusively consists of a bare wire line and underground cable extends for only a total of 29 km, mainly at some station yards. The line has 5 - 10 circuits which are used for the dispatcher telephone circuit, block circuit and carrier circuit, etc. The bare wire (3 mm in diameter) made of hard copper has been used but now it is replaced by copper covered iron wire because of the frequent theft of the copper wire. The copper coating of these wires has become very thin due to aging and rust on the iron core is visible. The poles are concrete poles and can continue to be used for some years.

According to 1993 statistics, there were a total of 78 faults in that year, most of which were associated with the bare wire, and 80% of the faults occurred in the Union I area. The dominant faults were short circuits and grounding caused by contact between the bare wire and foreign matter. The typhoons which hit Viet Nam in mainly June and July also cause electrical faults. The predominance of faults in the Union I area may be explained by the fact that the railway route passes through a number of urbanised areas with a higher likelihood of undesirable contact between the bare wire and foreign matter.

Apart from faults, the line is often rendered useless due to theft of the bare wire, making the adoption of theft prevention measures important. There are no communication facilities on the way between stations except at manned level crossings and the correspondence to an emergency is concernned. Based on the above observations of the current conditions of the communication line, the following problems can be pointed out.

- Most of communication facility faults are communication line faults. Namely, this communication line requires many man power and expenses for maintenance. Given the progressive aging, the demand for manpower and financial input for maintenance purposes is likely to increase in the future.

- The line quality is already declining and its restoration/improvement of the present facilities is impossible.

- The current communication line will not be able to cope with an increased communication demand to respond to train speed up and to improve passenger services.

2) Transmission Devices

The bare wire carrier tranamission equipment with 1, 3 or 12 channels is currently used for long distance communication and the sections using this system are shown in Fig. 5.3.5-3. All the facilities are aged and some spare parts are in short supply. Due to the small number of channels, it is impossible to adopt a new means of communication which requires additional channels.

Radio communication along the entire railway route is possible but most of the equipment is out of service due to aging. The working equipment only covers a short distance. The emergency radio communication equipment is in working order at Hanoi, Da Nang, Saigon and major stations in each Union.

The primary problem is the aging of equipment. Spare parts are no longer available from the original manufacturers and appear to be purchased from the retired stock of communication companies or the military which use the same equipment. It appears that the best that the VNR can do is to maintain the present conditions rather than to improve line quality.

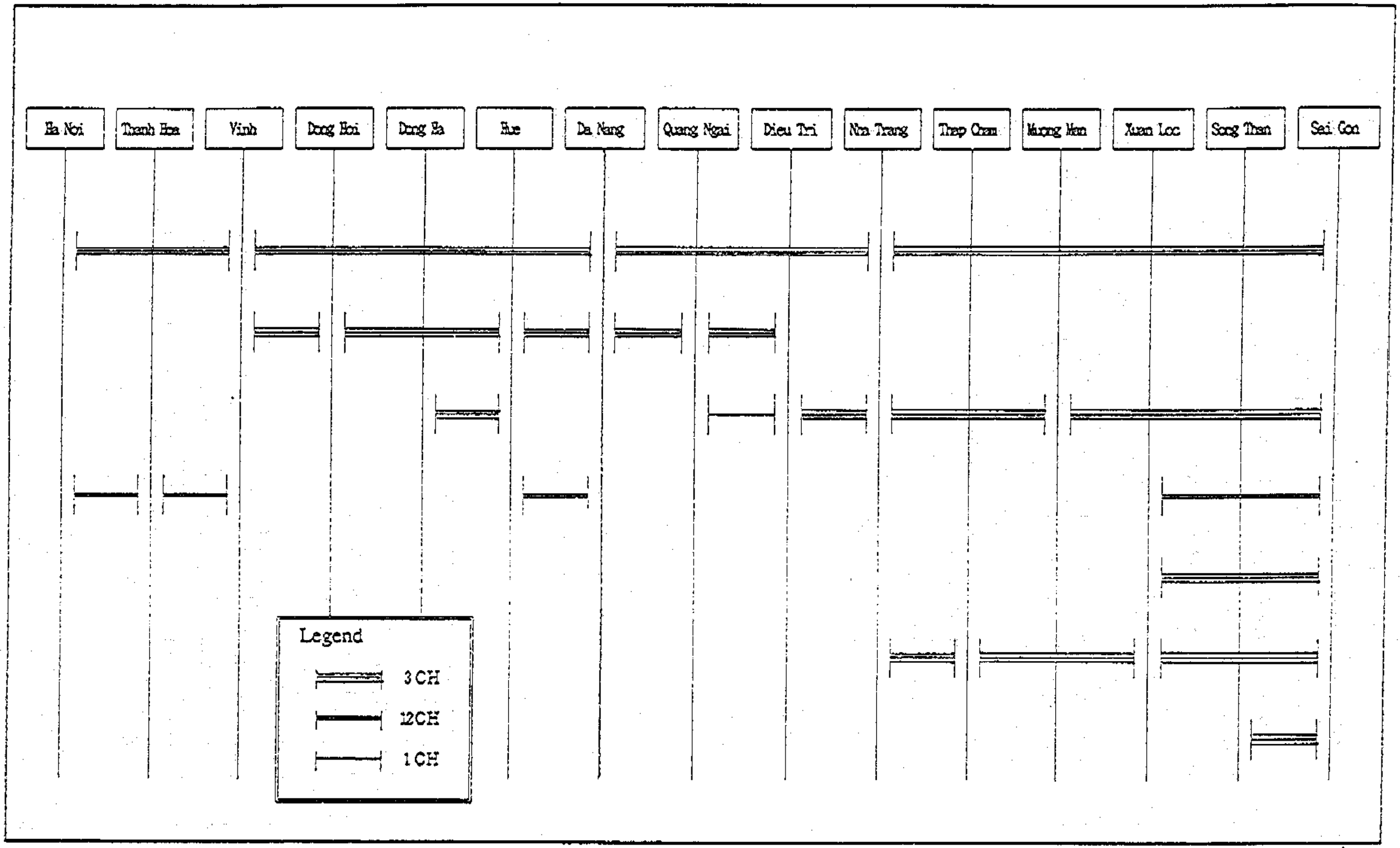


Fig. 5.3.5-3 Carrier Communication Network

The second problem is the capacity shortage to accommodate an increased communication demand. Most of the equipment in use has only 3 channels (few channels per equipment) and the installation of additional channels is difficult due to communication line limitations.

As most radio communication takes the form of facsimile transmission, it may be a good idea to renovate the exchange network as a facsimile network.

3) Telephone Exchanges

A total of 21 telephone exchange equipment are installed between Hanoi and Saigon, of which 4 (Hanoi, Da Nang, Nha Trang and Saigon) are digital PBX while the remainder are mainly manually operated common battery systems. These exchange equipment are connected by only 1 - 4 inter-exchange channels and direct calls cannot be made. There is only one inter-exchange linking Hanoi, Da Nang and Saigon and, therefore, the system does not constitute a network. Most of the stations without exchange equipment also lack a telephone. The urgent installation of at least one telephone at each station as well as each office is necessary to create a nationwide telephone exchange network for direct distant calls.

The lack of automation means the absence of a coordinated local dialling code programme which is essential for a nationwide direct distant call network. As a result, arbitrary dialling codes are used whenever a new exchange equipment is installed to cover a certain area. The preparation and implementation of a coordinated local dialling code programme for the entire country is essential.

4) Terminal Facilities

A dispatcher telephone using the frequency call system is installed at all stations and related offices. This dispatcher telephone is used between the terminals and central unit at the control room in each Union to relay instructions and messages relating to train operation. All the facilities are aged and the VNR plans to renew them by 1995.

The station telephone system is used for communication between the operation room at the stations and those in charge of points and signals on the station premises, and level crossing gate-keepers. Magnetic telephones are used for terminals while a centralised telephone system is used at the operation room. These facilities are also aged and urgent renovation is required for the operational safety of the railway service. A public address system is installed at some main stations for passenger information and communication within station yard.

5) Power Units

The carrier and radio communication facilities use AC 220V while the telephone exchange equipment use DC 24V or DC 48V. The power for these facilities is supplied by the electricity company. The direct current is supplied via a rectifier and a battery unit is installed as an emergency power unit. At some major stations, an alternative current engine generator is installed as an emergency power unit and is commonly used for the telecommunication system and signalling system at the time of an emergency.

All the facilities are fairly aged as in the case of the other facilities discussed so far. The batteries in particular require urgent replacement in view of the frequent electricity failure in Viet Nam, as their real capacity appears to have considerably declined. The engine generator is manually started at the time of electricity failure and, therefore, some time is required for recovering power supply.

(4) Maintenance System

The maintenance of the signalling and communication facilities is conducted by a maintenance company controlled by each Union. There are 4 companies which are based at Hanoi, Vinh, Da Nang and Ho Chi Minh which work independently. The actual maintenance is carried out by maintenance offices located at 16 main stations and each office is responsible for approximately 10 stations. Shift workers are posted at each station to provide a 24 hour maintenance service. The work follows the maintenance guidelines which specify the inspection interval for each item. Many items require daily inspection.

Although workers are posted at each station, the head office of each company is responsible for the overall work control. The maintenance records and data kept at these head offices appear to be insufficient. In the future, it will be necessary to increase the local maintenance control offices to improve the work efficiency.

Regardless of the uniform rules on the inspection interval for each item, the actual inspection interval should be flexible enough to take failures, breakdowns and work loads of the equipment, etc. into consideration. In this context, the official inspection intervals should be reviewed from time to time.