8.3 Transportation Plan

8.3.1 Current Train Operation and Other Conditions

(1) Train operation situation

The north-south running line that links the capital Hanoi in the north to Saigon, the largest city in the south, stretches for 1,726.2 km and is the most important railway line in Vietnam.

Passenger transportation on this main line, having reached its peak in and around 1987, had slightly fallen off by 1993, however, the annual number of around 3,675,000 passengers still accounts for approximately 50% of the combined passenger transportation in the whole country. The average passenger trip distance of 380 km on this line is also long compared to the national average of 220 km.

After the war in 1980, when services on the line were reopened, it took 72 hours for trains to link Hanoi to Saigon, however, with maximum speeds having increased from 60 km/h to 80 km/h, direct express trains (S1, etc.) now run this line in 36 hours or half the aforementioned time in 1980.

With regard to freight transportation, this increased by 25% in the 1980s to reach 1,581,000 tons, or half of the combined freight rail transportation in the whole country, and the average freight transportation distance is 380 km, which again is longer than the national average of 300 km.

The transportation time on the line ranges from 56 to 58 hours by direct freight train (HBN1, etc.), and the commercial speed of freight trains is 30 km.

Between 20 and 28 trains operate both ways on the line daily, however the line is single track meter gauge throughout with the average distance between stations relatively long at 11 km. Moreover, some station intervals reach as long as 16 km, there are sharp curves (R: 100 m), and there are also steep gradients (15‰ or more), and line capacity is barely able to manage the passing train loads on such sections.

Fig. 8.3.1 outlines in timetable form the train operating situation on the Hanoi - Saigon Line.

Passenger train formations are indicated in Table 8.3.1. Moreover, Appendix 8.3.1 outlines the line by showing a rough drawing of track layout for each station and indicating track capacity, and so on.

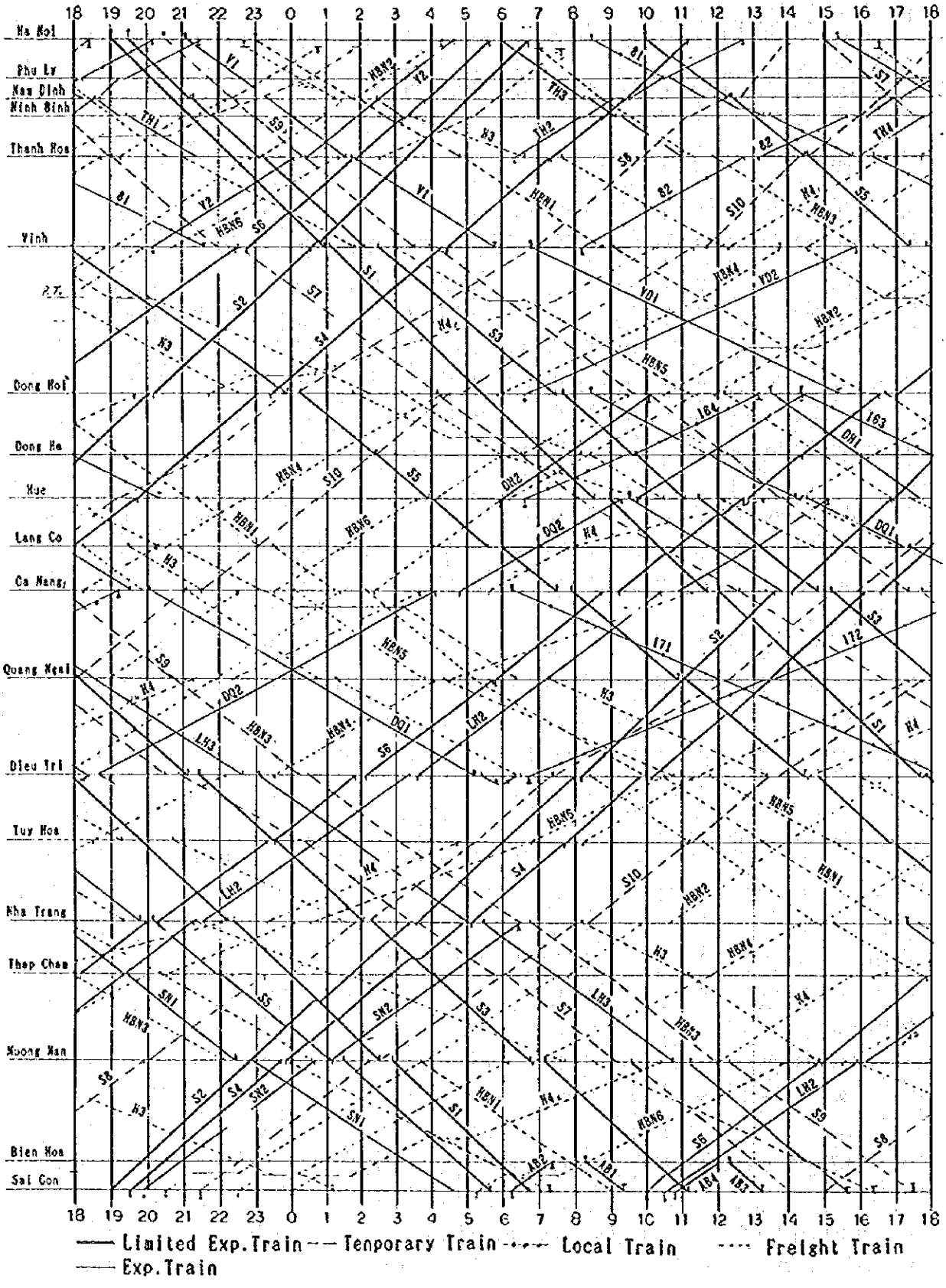


Fig. 8.3.1 Train Diagram (1995)

Table 8.3.1 Passenger Train Formations

Train Category, etc.		Seating (A)			Sleepers (B)			Restaurant, luggage, mail cars	(C) Total	B/C %	Traction Load (ton)
		3rd	2nd	1st	3rd	2nd	1st				
Express	Cars	–	–	3	1	1	1	1	7		
DEL traction S1	Passengers			64	42	32	24		98/290	34	300
Express	Cars	–	1	3	2	–	1	2	9		
DEL traction S3	Passengers		78	64	48	–	24		120/390	31	390
Express	Cars	–	3	2	2	–	1	3	11		
DEL traction S5	Passengers		78	64	48	–	24		120/482	25	480
Express	Cars	1	2	4	2	–	–	2	11		
DEL traction LC1	Passengers	80	78	64	48				96/610	16	480
Express	Cars	1	–	6	–	–	–	1	8		
DEL traction YB1	Passengers	80		64 24					– 490	–	350
Express	Cars		3	1	2			2	8		
DEL traction V1	Passengers		78	64	48				96/394	24	350
Local	Cars	4		3				1	8		
DEL traction V1	Passengers	80		64					512		350
Local	Cars	2		3				1	6		
DEL traction 81	Passengers	80		64					352		260

(2) Operation control system

As well as rolling stock and railway facilities such as track, etc., a train operation and security system to act as a comprehensive system for ensuring the safe and accurate operation of trains is an indispensable requirement for the operation of trains on a railway.

The control of train operations between Hanoi and Saigon is carried out by the VNR Head Office and the dispatching rooms of each union. In this sense, it can be said that the same kind of system that is adopted throughout the world is in use here.

The dispatching-related equipment (dispatching telephones) is old and deteriorated, however, renewal work is continuously carried out to maintain functions.

In terms of the contents of dispatch work, it is necessary to study the methods of utilizing train diagrams, etc. in the years upto 2000 in order to cope with the increase in the number of trains. With regard to this, the sections on problem points and countermeasures give a detailed account.

(3) Operation safety system

1) Blocking system

The tablet block system is still in use on part of the line, however, it is planned to renew the whole line to the tokenless block system by the end of 1995.

2) Signaling system

Mechanical semaphore signals are in use, however, these are gradually being converted to electric colorlight signals in the interests of safety.

The signal aspect method consists of (G) for go and (R) for stop, and three aspects are used in the case of the electric colorlight signals.

Incidentally, there are many stations where starting signals are not in place, and the installation of these signals is urgently required for safety reasons.

3) Interlocking system

Class 2 mechanical interlocking devices are generally in use, however, Class 2 relay interlocking devices have been adopted on some sections. In either system, the points are individually handled on site. (See M/P).

4) Other safety facilities

Automatic train stopping systems and other warning equipment, required for ensuring train operation safety, are yet to be installed. It is particularly necessary to immediately install warning equipment in important areas in line with the increased train speeds in future.

The sections on problem points and countermeasures give a detailed account on the measures required to counter the over-running, etc. of trains.

(4) Passenger and freight loads, and transportation-related staffing setup at each station

Table 8.3.2 indicates the transportation staffing setup. Moreover, Appendix 8.3.1 shows the passenger and freight handling situation and the staffing setup at each station as of 1993.

Regarding passengers, there are many stations where boarding and alighting passengers number 20 to 30 each day, and there are a large number of stations in the south where there are no boarding and alighting passengers at all. This is considered to be due to the fact that local passenger trains have not been run. In 1995, however, local passenger trains have resumed services in and around Ho Chi Minh.

Table 8.3.2 Transportation-related Staffing Setup (1993)

Head Office 220	Union Offices	Dispatching Personnel: 5	Freight: 4	Passenger: 4	Operation: 4	Management: 3	Transport-related: 20 (staff)

Union	① Office	Dispatching Staff		② Station		③ Drivers	④ Conductors		⑤ Total	⑥ Other (track, signals, etc.)
		North-south Line	North Part	North-south line	North Part		Passenger	Freight		
I 21,000	342	14	58	2,267	1,670	363	600	506	5,748	15,252
II 6,730	200	25	--	1,261		280	400		2,141	4,589
III 6,520	225	25	--	1,024		253	420 362	476	2,760	3,760
Grand Total 34,250	767	64 (122)	58	4,552	1,670	896	820 962 2,764	982	10,649	23,601

Note 1) Figures are provided by VNR (TEDI, VRDI).
2) Dispatcher gives a breakdown of the union office staff (①).
3) The station staff (②) shown is for the North-south Line, Lao Cai Line and Cai Lan Line only.
4) Drivers (③) and Conductor (④) numbers are for all lines.
5) The total (⑤) gives the combined total of ① to ④.
6) The grand total column gives the combination of ⑥ and ⑤ (track, bridge, signal and communication staff outside of Head Office).

(5) Operation accident, etc. situation and analysis

The improvement of safety and reliability levels is the most important point in railway and all other modes of transportation, and the analysis of past accident occurrences, combined with investigation of effective accident countermeasures in terms of both software and hardware, is vital.

The accident occurrence situation in the case of VNR is as indicated below.

1) Accident categories

Operation accidents that have occurred on VNR are divided into the following six categories.

Category 1: Extremely serious accidents: Transportation obstruction (24 hours or more)
Fatalities (two people or more)
Rolling stock damage (major damage)

Category 2: Serious accidents: Transportation obstruction (12 - 24 hours)
Fatalities (less than two people)
Rolling stock damage (damage)

Category 3: General accidents: Transportation obstruction (less than 12 hours)
Fatalities (none)
Rolling stock damage (none)

Category 4: Other accidents

Category 5: Accidents due to breach of regulations

Category 6: Technically light accidents

2) Accident occurrence situation

Table 8.3.3 shows the total number of accidents, by category, that occurred between 1989 and 1994.

Table 8.3.3 Accident Occurrence Situation (all accident)

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	4	99	288	25	2,031	2,450	57.4
1992	0	5	58	198	16	2,040	2,317	54.3
1993	0	1	55	201	20	1,602	1,879	44.0
1994	2	1	61	214	16	1,354	1,648	38.6

The number of accidents is steadily declining and has reached as low as 40% of the number in 1989. This can be said to be a reflection of efforts made.

However, accidents involving fatalities and other tangible damage (categories 1 to 4), have hardly shown any decline at all. Appendix 8.3.2 shows the accidents and consequent train delays that have occurred in the past two years.

Category 4 accidents are largely due to externally caused factors (level crossing accidents and damage).

Accidents in Category 1 to Category 3 comprise train collisions and derailings. Table 8.3.4 and Table 8.3.5 give breakdowns of such accidents by section and cause for 1993 and 1994 respectively.

Table 8.3.4 Section and Cause-separate Accident Occurrence Situation

(1993) (Accident categories: 1, 2 and 3)

Category	Type	Cause	North-south Line	Lao Cai	Çai Lan	Other Lines	Total
Internal	Collision	Station	4	2			6
	Derailing	Locomotive	2				2
		Rolling Stock	3	1			4
		Track	4	3		5	12
		Signaling					
		Works		1		3	4
	Subtotal		13	7	–	8	28
External	Disaster		1				1
Unknown (derailing) Total			1	1			2
Derailing Accident Total			15	8	–	8	31
External	Level Crossing		20				20
	Obstruction, etc.		5				5
Total							56

Note: All data provided by VNR.

Table 8.3.5 Section and Cause-separate Accident Occurrence Situation

(1994) (Accident categories: 1, 2 and 3)

Category	Type	Cause	North-south Line	Lao Cai	Cai Lan	Other Lines	Total
Internal	Collision	Station	2	1		2	5
	Derailing	Locomotive	1	1			2
		Rolling Stock	3	5		1	9
		Track	6	2		1	9
		Signaling	1				1
		Works	3				3
	Subtotal		16	9	–	4	29
External	Disaster		1				1
Unknown (derailing) Total			5	1		1	7
Derailing Accident Total			22	10	–	5	37
External	Level Crossing		20				20
	Obstruction, etc.		7				7
Total							64

Note: All data provided by VNR.

From Table 8.3.4 and Table 8.3.5, it can be seen that locomotive or rolling stock derailings account for many of the accidents, and many such accidents occur on the North-south Line and the Lao Cai Line. On the Lao Cai Line in particular, even though its length is one-sixth that of the North-south line, the number of accidents on its is approximately half of the number on the North-south Line, and a further strengthening of track improvement and other countermeasures is thus desired.

Almost all of the externally caused accidents (Category 4 accidents) occur on level crossings. Moreover, almost all accident-caused fatalities, which amount to more than 200 people each year, occur in level crossing accidents. It is therefore necessary to install level crossing safety mechanisms and advance software side measures such as PR campaigns, etc. to the public, in addition to taking track improvement measures.

The disaster-caused accidents are as follows.

- September 18, 1994: Mud and sand flowed onto the North-south Line at the 1,249 km point following heavy rain and this led to the overturning of an S8 locomotive and two cars. Locomotive large-scale repair cost 500 million dong, the minor rolling stock damage amounted to 100 million dong and the lost time due to line restoration was 34 hours (800,000 dong/ hour).

- May 17, 1994: Sudden flooding at the 1,509 km point of the North-south Line between Song Luy and Long Thanh destroyed 144 m of track, and a HBN train together with eight freight wagons overturned. The locomotive and three wagons were badly damaged and five wagons had to be scrapped. The cost of the repairs and the line restoration time are unknown.

Table 8.3.6 Cause-separate Fatalities (Category 4)

Cause	Number of Accidents	Fatalities	Injured	Total
Level crossing accidents (pedestrians)	192	87	123	210
Fall accidents	5	2	3	5
Boarding of moving trains	3	2	1	3
Stone throwing	2	–	2	2
Train fires	–	–	–	–
Others	12	8	4	12
Total	214	99	133	232

Note: All data provided by VNR.

8.3.2 Problem Points and Direction of Countermeasures

(1) Operation control system

As train speeds become faster, operating train numbers increase and train types become more diverse, the management of trains over the whole line becomes more and more important in raising the quality of rail transportation. It is thus necessary to give full examination, from the basics up, to the purposes and methods of transportation control.

(a) Regarding dispatching duties for transportation control

In order to effect the comprehensive management of trains, it is necessary to have a thorough grasp of daily operation plans including field bodies. It is thus important for not only station staff but also level crossing personnel, etc. to be aware of the operation plans of trains, and so on. The Head Office should know the operation plans for all trains on all lines and the union offices should adopt similar setups. The dispatching rooms should maintain daily train diagrams and have an accurate grasp of all areas relating to train operation such as the setting of line closures, and so on.

The basic train diagram is the diagram that is used and acted upon by dispatchers. The main duty of dispatcher is not just the keeping of operation records, but is the control of non-regular train operations, train cancellations, train stand by, interchange revisions and other operation ordering work. In order to enable the staff to perform such important duties, they should not be using train diagrams of a blank form but should be provided with execution diagrams that give the operating plans for each day. The preparation and utilization of such train diagrams is a matter requiring urgent attention.

(b) Improvement of train operation reliability and appropriate handling

Having an accurate grasp of train operation conditions is extremely important (in terms of operation control, too), especially at times of diagram confusion. On single track lines, as the number of operating trains increases, the slight delay of one train can have a great effect on other trains. It is therefore necessary for neighboring stations to maintain close communications and always have an accurate grasp of operating conditions, and to be able to take immediate measures in cases where, for example, slight train delays are expected.

Train conductors need to carry each day's timetable and take care to help prevent operating accidents and delays, etc. In particular, the VNR drivers are highly skilled, however, they should present portable timetables (filled with information on emergency slow running, daily instructions and points for attention, etc.) to the driving cab and take more detailed measures, in order to promote the more accurate operation of trains.

(2) Promotion of operating accident prevention measures

Based upon analysis of past accidents, the problem points and required improvements in the approach to accident prevention are considered in the manner described below.

(a) Study of operating accident categories and causes

The proper classification of accidents is required in order to carry out accident cause analysis and establish countermeasures.

In the case of VNR, accidents are classified into six categories depending on size (extent of damage), and this is a necessary measure. What is more important, however, is the classification of accidents into internally caused or externally caused accidents and, in particular, in the case of internally caused accidents, it is important to determine whether or not they have been caused by staff errors (whether or not they are staff responsible accidents).

Staff responsible accidents should be eliminated straight away, and it is necessary to thoroughly investigate causes and take urgent countermeasures in such cases. In such cases, rather than finding out who is responsible, investigating the true causes and using the gained results in forming prevention measures is more important. In software terms, accident prevention should be emphasized in education and training via on the job training and the education activities of the training centers, etc., and it is important to carry this out in unison with hardware countermeasures.

(b) Survey and processing of accidents

In addition to the establishment of an immediate action accident recovery setup and the immediate dispatch of tools, materials and staff to accident scenes, cause investigation in accordance with an accident survey manual is necessary.

Accident survey results should be recorded individually, used in the formation of countermeasures and also put to use in various statistical forms for judging the effects of countermeasures taken.

It is also necessary to give survey sheets a set format to ensure that no delays occur in the execution of surveys and the utilization of survey results.

(c) Establishment of operation regulations and development of an execution setup

With regard to train accidents caused by natural disasters such as flooding, etc., it is considered possible to prevent all but the most unexpected incidents through establishing

operation regulations and developing and strengthening a prevention setup. For this reason, a description shall be given of the policies laid down for the operation regulations of JR.

Operation regulations determine whether or not to cancel train services or limit train speeds in cases where there is a risk of accidents occurring due to heavy rain, strong winds or earthquake, and so on.

Appendix 8.3.3 describes the contents of the operation regulations of JR. The main forms of regulation are as follows:

a) Operation regulations due to heavy rain,

b) Operation regulations due to strong winds,

c) Operation regulations due to earthquake.

(d) Level crossing accident prevention measures

Except for putting railway lines onto different levels from their surroundings, there is no complete measure for preventing level crossing accidents, and such accidents form a major obstruction to railway transportation.

In the case of JR, too, the increased number of train services and rapid motorization that took place from the 1950s resulted in numerous level crossing accidents. In response to this situation, the Road Traffic Law was effected and level crossing improvement measures were implemented, and as a result, the number of level crossing accidents decreased.

The main measures for preventing level crossing accidents (excluding the construction of different levels) are listed below.

① Integration and abolition of level crossings.

② Installation of level crossing safety equipment (level crossing warning systems, installation and automation barrier, interlocking with signals, obstruction detection devices, installation of accident warning audible signals, fused signals and flash signals, level crossing protection switches, paving of level crossing roads and the appropriate setting of warning times, etc.)

Moreover, accident warning flash signals are also used in areas where rock fall warning devices are installed.

③ Stricter enforcement of temporary stopping by cars, etc. at level crossings.

④ PR activities directed at the general public.

8.3.3 Transportation Plan

(1) Basic conditions

Based on the fundamental philosophy of the Transportation Plan within the Master Plan, it shall aim to improve the reliability of transportation, achieve more frequent services and also contribute to railway business management improvement.

In order to achieve these goals, the following items shall be made the basic conditions for compilation of the Transportation Plan in 2000.

1) Project sections and line conditions

The Project lines shall be that between Hanoi and Saigon (1,726.2 km) and three other branch lines (53.1 km). In the F/S, priority improvements and business management improvement measures shall be carried out together with increased services on the following three sections in particular. The maximum train speed on these sections shall thus be 80 km/h.

① Hanoi - Thanh Hoa (176.2 km)

② Hue - Da Nang (103.1 km)

③ Muong Man - Saigon (175.0 km)

2) Operation safety system

The operating safety systems, which form the basic factor in train operation, shall be designed to increase safety levels and shall also allow modernization to be easily carried out in the future by giving consideration to the actual conditions and demand levels, etc. on the sections.

(a) Blocking system (see M/P)

The tokenless block system shall be adopted as a means of improving train operation reliability levels.

(b) Signaling system (see M/P)

A unified three-aspect system of electric colorlight (multiple colorlight) signals shall be adopted in order to again raise reliability and also improve efficiency.

(c) Interlocking system (see M/P)

The Class 2 relay interlocking system shall be adopted in order to raise the reliability of work on in station.

(d) Others

Warning systems such as level crossing warning devices and rainfall warning devices shall be introduced (see Appendix 8.3.3).

3) Business management improvement

Through carrying out marketing improvement measures, freight stations with only minor handling loads shall be absorbed into nearby major freight stations.

4) Train types and train operation, etc.

(a) Train types

The following table shows the types of trains that will be operating in 2000.

Table 8.3.7 Set Train Types and Operating Speeds

Train Type		Maximum Operating Speed	Remarks
Passenger Trains	Limited Express train	80km/h	New rolling stock (push-pull): 1 return
	Limited Express train	80km/h	D18E, D12E-W: Traction passenger trains
	Inter-regional express	80km/h	D18E, D12E-W: Traction passenger trains
	Local trains	75km/h	D12E-S: Traction passenger trains
Freight Trains	Through freight train	80km/h	D18E, D12E-W: Traction freight trains
	Inter-regional freight train	80km/h	D18E, D12E-W: Traction freight trains
	Exclusive freight train	70km/h	D18E, D12E-W: Traction freight trains

Note 1: D12E-W are multiple connected and D12E-S are single locomotives.
Note 2: D12E includes other engine types such as D13E, and so on.

(b) Train operation

Passenger trains shall be manned by drivers and conductors, while freight trains shall basically be manned only by drivers (including assistance driver).

5) Rolling stock and rolling stock performance

The limited express trains shall use new, fixed formation rolling stock (push-pull) on outward and inward trips. Other trains shall use existing rolling stock that has received improvements to accommodation, and so on.

Traction engines shall be the D18E (between Hanoi and Da Nang) and the D12E (including D13E, D11H, D9E and D4H). The D4H shall be improved models and shall be used as the local trains (70 km/h) for operating in and around Hanoi and Ho Chi Minh.

The operating performance for each train type will differ according to plan, however, Appendix 8.3.4 indicates the running resistance and other criteria. Engine output shall be 90% of the design output and, in the case of multiple connected engines, the auxiliary engine output shall be 95%

6) Boarding efficiency, etc.

Boarding efficiency, etc. shall basically be in accordance with the M/P and the main items shall be as follows:

① Boarding Efficiency: 80 - 85% (for handling transport waves of approximately 130%)

② Load factor: 85% (this shall be 100% on exclusive freight trains)

③ FC Return period: 8 days
(according to rolling stock operation for exclusive freight trains)

④ Empty car ratio: 30% (all wagons shall be loaded on exclusive freight trains)

7) Train operation on the three branch lines

Operations on the branch lines shall basically be covered using the main line local train rolling stock. Passengers trains (connected to freight wagons) shall make two or three return trips each day.

(2) Transportation Plan

1) Formation and hauling capacity, etc. by train type

(a) Passenger Trains

The formation of passenger trains shall be set upon giving consideration to running speeds through gradient sections, etc. Moreover, sleeping cars shall account for around 40% of total passenger capacity in the case of long-distance trains, based on careful consideration of the current ratio of sleeping cars.

Table 8.3.8 Formations and Car Capacities of Passenger Trains (2000) (Hanoi - Saigon)

Train Category, etc.		First Class Coach (A)			Sleeping Car (B)			Restaurant, luggage, mail cars	(C) Total	B/C %
		3rd	2nd	1st	3rd	2nd	1st			
Limited Express (push-pull)	Cars	–	2	2	–	3	1	1	10	
	Capacity	–	72	64	–	42	24		170/440	39
	Weight								350 ton	
Limited Express (D18E or D12E-W)	Cars	–	2	2	2	1	2	1	9	
	Capacity		72	64	48	42	24		160/430	37
	Weight								390 ton	
Express (D12E-S) (short- distance)	Cars	–	4	1	–	–	–	1	6	
	Capacity		78	64					370	0
	Weight								260 ton	
Express (D18E or D12E-W) (middle-distance)	Cars	–	3	1	3	–	1	1	9	
	Capacity		78	64	48		24		160/460	35
	Weight								390 ton	
Local (D12E-S, -D9E)	Cars	4	–	–	–	–	–	1	5	0
	Capacity	80							320	
	Weight								220 ton	
Local (D12E-S, -D4H)	Cars	3	–	–	–	–	–	1	4	0
	Capacity	80							240	
	Weight								180 ton	

(b) Freight trains

The gross tonnage and net tonnage of each type of freight train are indicated below:

- General freight trains: $X = A/36$ (X: Number of freight wagons), A: Gross tonnage)
  $[A = 0.7 \times (17 + 32 \times 0.85) + 0.3X \times 17)]$
- Exclusive freight trains: $X = A/47$ (X: Number of freight wagons, A: Gross tonnage)
  $[A = X\ (17 + 30)]$

(See Appendix 8.4.4)

2) Train operating times, etc.

The operating times and allowance times by train type are as indicated in the following table.

Table 8.3.9 Estimated Operating Times for Each Main Train Type

Station	Distance (km)	Express Passenger (P-P)		Express Passenger (DL)		Through Freight	
		Standard time	Stopping time	Standard time	Stopping time	Standard time	Stopping time
Hanoi							
	5.2						
G. Bat		2H 40'	–	2H 40'	–		
	170.0					3H 00'	
T. Hoa			5'		10'		30'
	143.8	2H 35'		2H 35'		3H 00'	
Vinh			5'		20'		60'
	202.8	4H 10'		4H 10'		5H 00'	
Do. Hoi			5'		10'		30'
	100.4					2H 00'	
Do. Ha		3H 15'	–	3H 15'	5'		30'
	66.1					1H 35'	
Hue			10'		10'		30'
	103.1	2H 25'		2H 25'		3H 05'	
Da Nang			20'		20'		60'
	136.5					2H 40'	
Q. Ngai		5H 15'	–	5H 15'	5'		30'
	167.6					3H 15'	
D. Tri			5'		10'		30'
	219.4	4H 05'		4H 05'		4H 40'	
N. Trang			10'		20'		30'
	236.3	4H 05'		4H 05'		4H 40'	
M. Man			5'		10'		30'
	159.4					2H 50'	
S. Than		2H 30'	–	2H 30'	–		
	15.6						
Saigon							
Total		1,860'	65'	1,935'	120'	2,165'	360'
Allowance time		55'		105'		235'	
G. Total	1,726.2	33 H		36 H		46 H	

Note: Times in the diagram are standard times and allowance times (maintenance, interchange allowance) are added.

3) Philosophy behind train setting and train operation plan

(a) Setting of passenger trains

The setting of passenger trains shall be done through setting transportation capacities to match with the cross-sectional transportation loads obtained from demand forecasts (see Appendix 8.3.6).

In particular, in the case of middle-distance and long-distance passenger transportation, examination needs to be made of passenger demands regarding day and night trains, limited express and express trains, seating carriages and sleeping cars, and also departure and arrival

times, and so on. Passenger demands in such areas change over time and this makes train settings very difficult, however, the results of examination made in the case of JNR shall be described for reference purposes.

① Day train and night train preference ratio

The susceptibility of passengers to prefer night trains in terms of the required traveling times of limited express and express trains is 50% when the traveling time is 10 to 12 hours and almost 100% when the traveling time exceeds 16 hours. This data is the result of surveys carried out in the 1960s and is partly no longer applicable to existing conditions.

In the case of VNR, as long traveling times will still be required even following the speeding up of trains, it will be necessary to increase the ratio of sleeping cars.

② Passenger demands regarding departure and arrival times

- 48% of passenger demands indicate a preference for between 8:00 and 10:00 for the departure time.
- The most preferred arrival times range between 07.00 and 10.00 with the demand for 08.00 arrival being especially strong. In terms of afternoon arrival, 90% of customers prefer between 16.00 and 18.00, indicating a stronger degree of concentration than in the case of morning arrival. (JNR Labor and Science Research Institute, Study Materials 71-20, etc.)

③ Limited express train preference ratio

It is said that middle-distance and long-distance railway passengers use limited express or express trains most of all, and the preference for such trains is stronger than the preference concerning day trains or night trains.

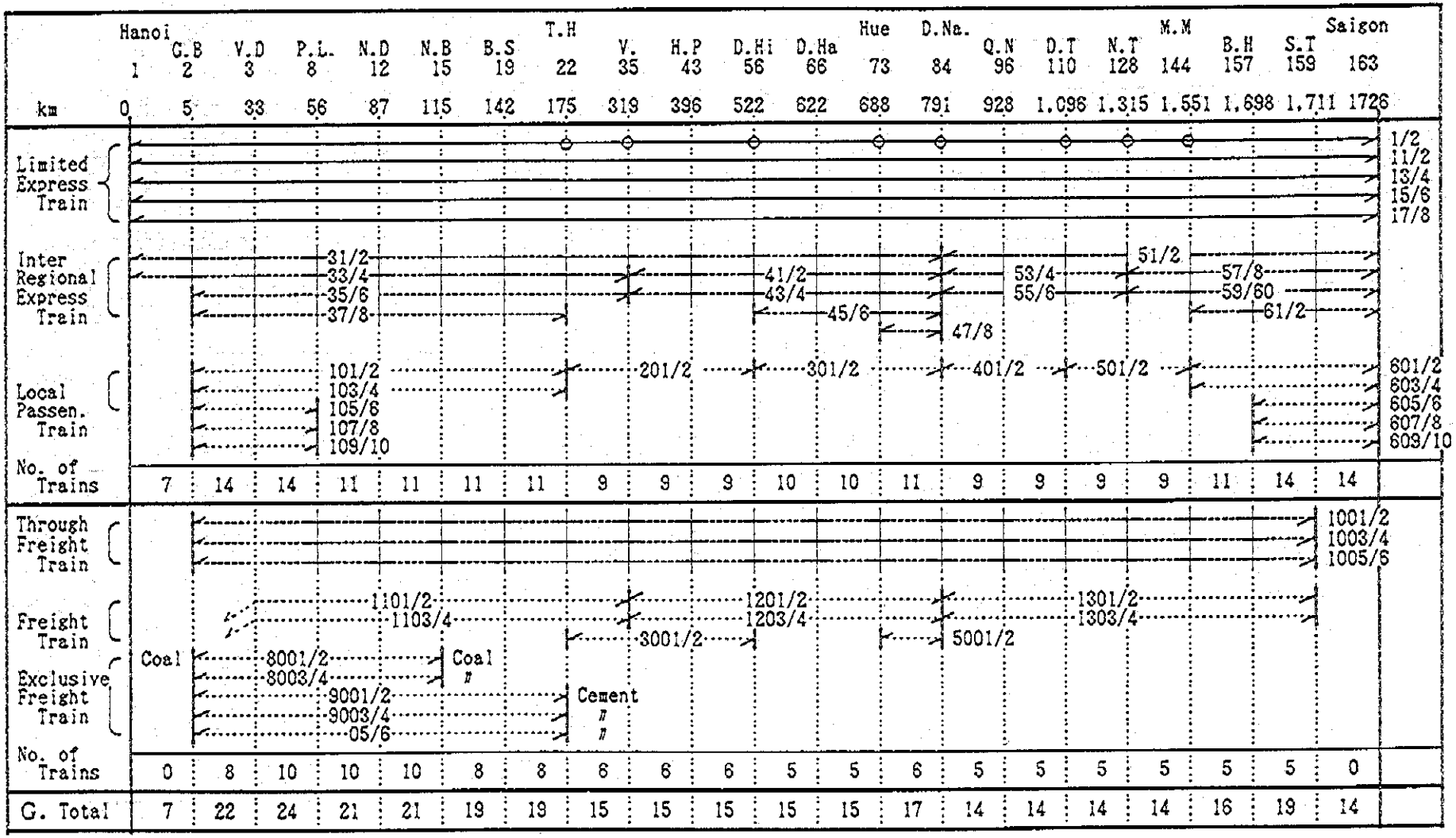
In the case of JNR, speeding up has been aimed for through the raising in status of semi-express trains to express trains, and so on, each time the timetable has been revised. Before the commencement of Shinkansen services, it is said that the preference for limited express trains on trips in excess of six hours was more than 50%. Moreover, depending on the ratio of actual trains running, the preference ratio, including the above -mentioned issues, is apt to fluctuate greatly.

The above points shall be given careful consideration in the setting of the train plans for VNR, however, the main emphasis shall be placed on achieving improved reliability, modernization and transportation efficiency based on the existing train services.

(b) Setting of freight trains

In the case of freight trains, choices do exist in wagon grade (including small loads), the use of containers and piggy-backs, etc., however, there is no useful data relating to preferences in these areas and so the planning shall be advanced with consideration mainly being given to operating as many exclusive freight trains as possible. Moreover, in the event of greater use of containers in the future, some direct freight trains shall be converted to container trains.

Based upon the above considerations, the Train Operation Plan shall be as indicated in Fig. 8.3.2 and Fig. 8.3.3.



○ : Stopping station

Fig. 8.3.2 Train Operation Plan (Hanoi～Saigon) : 2000

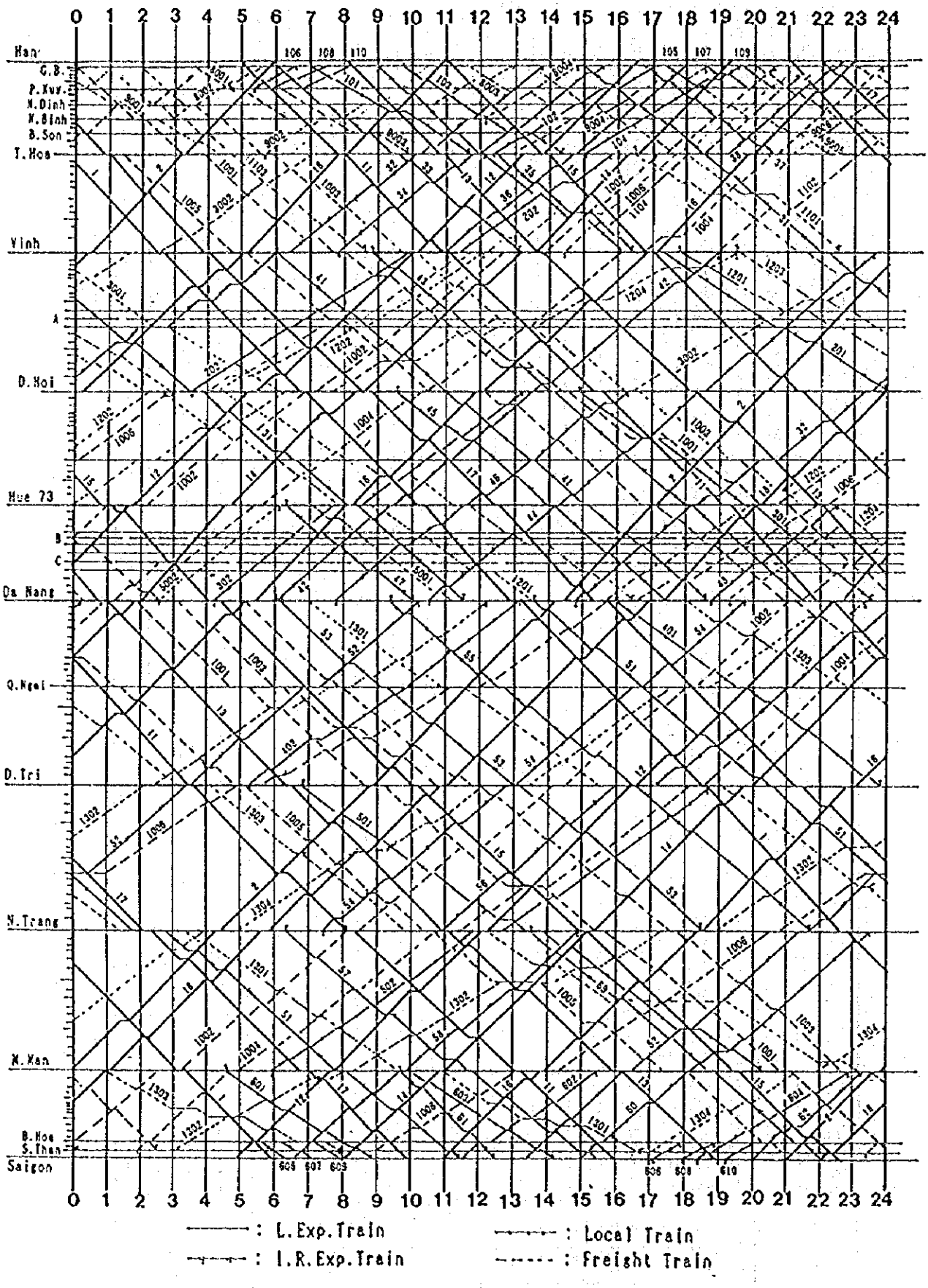


Fig. 8.3.3 Train Diagram Plan (2000)

4) Train kilometers and rolling stock kilometers

Train kilometers, etc., based on the Train Operation Plan, are as indicated in Table 8.3.11.

Table 8.3.11 Train Kilometers and Rolling Stock Kilometers (2000)

(Hanoi - Saigon) (Unit: km/day)

	Train Kilometers (km)	Rolling Stock Kilometers (km)					Remarks
		P-P	D18E	D12E, etc.	PC	FC	
Limited Express	3,460	3,460	–	–	34,600	–	P-P: 10-car formation
	13,810	–	6,330	14,960	124,290	–	PC: 9-car formation
Inter Regional Express	4,400	–	2,530	3,740	39,600	–	PC: 9-car formation
	7,410	–	–	11,980	44,440		PC: 6-car formation
Local Passenger	4,530	–	–		22,490	–	PC: 4 to 5-car formation
Subtotal	33,610	3,460	8,860	30,680	265,420	–	
Through Freight	10,360	–	4,750	11,220	–	360,220	
Ordinary Freight	7,820	–	4,070	7,480	–		
Exclusive Freight	1,510	–	1,510	0	–		Coal, cement
Subtotal	19,690	–	10,330	18,700	–	360,220	
Total	53,300	3,460	19,190	49,380	265,420	360,220	

5) Required rolling stock

The required rolling stock, based on the estimated train kilometers, etc. and outline train diagram setting, is as indicated in Table 8.13.12.

Table 8.13.12 Required Rolling Stock (2000)

(Hanoi - Saigon) (Unit: cars/wagons)

Train Type	D18E	D12E or D13H, D11H, D9E, etc.	PC				FC	Remarks
			Number of Trains	Cars/Wagons		Total cars		
				Passenger cars	Cafeteria, luggage cars			
Limited Express			5	45	5	50	–	10 cars: P-P
Limited Express	17	(D12, etc.)	20	160	20	180	–	9-car formation: Sleeping cars connected
Inter Regional Express		67 (D4H)	25	175	29	204	–	9-car formation: Sleeping cars connected 6-car formation: Seating cars only
Local passenger		8	20	70	20	90	–	
Subtotal	17	75	70	450	74	524	–	
Through freight	32	46	–	–	–	–	2,240	
Ordinary freight			–	–	–	–		
Exclusive freight			–	–	–	–	65 96	Coal wagons: 13-car formation Cement: 14-car formation
Subtotal	32	46	–	–	–	–	2,400	
Total	49	121	70	450	74	524	2,400	

6) Examination of improvements to be made in line with the train operation plan

Based on the Transportation Plan, compiled in accordance with transportation demand, it is imagined that the following kinds of improvements will be necessary.

(a) New installation of interchange station

Table 8.3.13 New Interchange Station Installation Sites and Track Capacity, etc.

Section	Facilities Improvement	Number of Trains (trains/day)	Track Capacity	
			2000	After improvement
① Tan Ap (46) - Kim Lu (47) (408.7km) (426.0km)	New installation of interchange facilities (near the 417 km point)	30	24	44
② Thau Luu (77) - Lang Co (78) (741.6km) (755.4km)	Same as above (near the 749 km point)	34	32	54
③ Hai Van Bac - Hai Van Nam (760.7km) (771.6km)	Same as above (near the 765 km point)	34	22	44

(b) In-station improvements

① New installation of short-circuit line at Van Dien station

Mainly in the area of freight transportation, utilization of the western suburban line is considered necessary as a route for linking the Lao Cai Line and the line coming from Yen Vien to the North-south Line. Use of this line is particularly important during the daytime when limitations are placed on the use of the Hanoi Station route.

The number of services on this section will differ according to the train timetable setting, however, this route should be utilized as a loop line for mutual freight distribution between the north and south. For this reason, a short-circuit line that directly links the North-south Line to the suburban line is necessary.

② Examination of freight relay facilities at Vinh station

As a terminal arrival station for passenger trains, the accommodation of three train formations (one 9-car formation and two 6-car formations) is assumed here. If these trains are kept on three sidings, it is thought that freight composition, decomposition and relay lines will be insufficient. A measure needs to be taken to overcome this problem.

In the case where an additional passenger train storage track is provided, there will probably need to be one additional siding.

(Freight handling: 15 arriving and departing formations in 1993, 30 arriving and departing formations in 2000)

③ Additional storage track (siding) at Dong Hoi station

It is considered that Dong Hoi Station will function as a terminal arrival station in the future. In the outline diagram for 2000, as the accommodation of three passenger trains at night will become necessary, the additional provision of one siding is considered necessary (for two 6-car trains).

④ Examination of passenger train storage track at Da Nang station

It is considered that Da Nang Station will come to act as an important base station in the central area for both passenger and freight transportation. In the outline train diagram for 2000, it is thought that the accommodation of four passenger trains at night will be necessary.

Presently, the No. 7, No. 8 , No. 9 and No. 13 lines are used as storage tracks for damaged rolling stock and it is considered possible to use these lines as storage tracks for passenger trains providing that they are prepared properly. If these lines cannot be secured, it will be necessary to secure alternative tracks on the port line, etc.

With regard to freight handling, too, if the 20 cars or so (including empty cars) currently arriving and departing are increased to around 50 cars by 2000, it will be difficult for the No. 11 and No. 15 lines currently used to be able to handle the increased load. It will thus be necessary to utilize the No. 13 line as a freight line and accommodate and store passenger trains in the sections, etc. Moreover, the No. 15 line should be used as a relay line for container transportation in the future (freight handling equipment will be necessary).

⑤ Additional storage track at Dieu Tri station

The line branches off in the direction of Qui Nhon at Dieu Tri Station and the station will require a storage track for the rolling stock on this section and also the two passenger trains from the main line.

There are currently two sidings (each 200 m long), and consideration will have to be given to freight handling (currently around five cars a day but estimated at 15 cars by 2000) in deciding whether or not passenger train storage is possible, with the provision of an additional siding also requiring examination.

⑥ Additional storage track at Muong Man station

Muong Man Station is where the branch line to Phan Thiet starts and is also a terminal arrival station for main line trains. It thus requires a passenger train accommodation and storage track (for the accommodation of one 6-car, two 5-car and also the branch line trains).

The capacity of the currently used No. 5 and No. 6 lines (each 300 m long) and a few stop tracks (100 m) is considered to be insufficient, and the addition of at least one more siding is thought to be necessary.

⑦ Securing of site land and addition of freight siding at Song Than station

Song Than acts as the base station for freight handling in the south of the country. Moreover, as freight handling should be suspended at Saigon Station and concentrated here, it is considered that this station's importance will further increase. Song Than will also act as an important base for container trains in the future.

It is therefore considered urgently necessary to secure site land for construction of an access road (approximately 100 m) from National Route 1 and construction of a freight yard, and also to expand freight sidings. Moreover, as all freight trains will turn around at this station, the provision of branch sections for locomotive and freight wagon expansion and also personnel accommodation facilities, etc. is considered to be necessary. (Locomotive accommodation: traction: 5 × 2, plus 2 -3 shunting locomotives)

Two or three cranes are currently in place, however, the expansion of all types of freight handling equipment will be required to allow the station to function as a freight center.

⑧ Examination of passenger train storage track at Saigon Station

According to the imagined plan for 2000, the storage of seven passenger trains will be necessary at Saigon Station. There are currently seven sidings, including one freight siding, however, at least two lines for train arrivals and departures and one engine turn-round track need to be secured with at least five lines being necessary. Thus, storage tracks (including passenger train sections) for two or three passenger trains need to be secured. If rolling stock is improved and stored within the passenger train depot, there should be no need to construct additional storage tracks.

All the above-mentioned improvements will vary according to the setting of the train diagram, and it will thus be necessary to set and examine the diagram in the detailed design stage, and so on.

Moreover, in the plan for a interchange station on Hai Van Pass, the thinking concerning protection for over-running by trains is described in Appendix 8.3.7.

7) Staffing plan

In line with the increased train services in 2000, larger numbers of drivers and passenger train conductors, etc. will be necessary.

These personnel will be covered by the staff surpluses created by the suspending of conductor services on freight trains.

Calculation of the required number of additional drivers in 2000 is currently difficult due to the fact that methods of operation and employment setup are still unclear, however, by carrying out an assessment based on careful consideration of train kilometers as of 1993 and planned train kilometers in 2000 and the fact that six drivers will man each locomotive, it is estimated that the surplus staff created through the cutting of freight train conductors will be enough to cover the staff increases caused by additional drivers and passenger train conductors.

- Additional drivers:
  About 300 persons (present persons: about 900) (number of locomotives × 6 drivers)

- Additional passenger train conductors:
  About 700 persons (present persons: about 1,400) (50% increase over current total)

- Reduction in freight train conductors:
  About 1,300

(See Table 8.3.2)

8.4 Track and Stations

8.4.1 Track Standards

(1) General

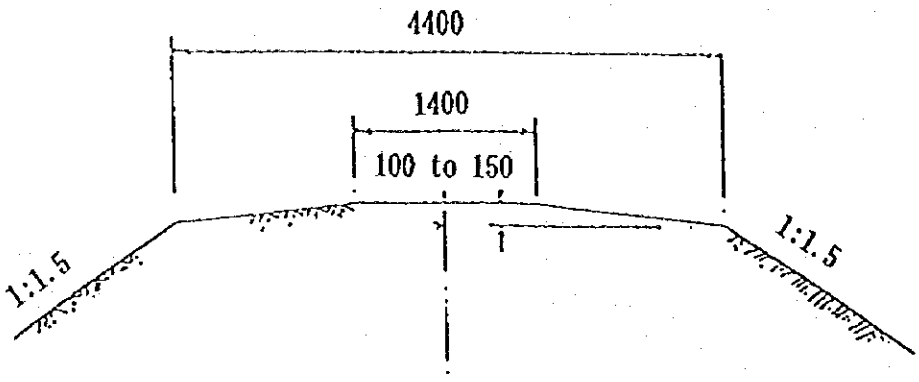
The infrastructure for the Hanoi - Ho Chi Minh Railway was originally constructed in the period between 1899 and 1936 and is now showing a high degree of deterioration due to general aging and damage caused by the war, requiring substantial investment to rehabilitate the entire functions.

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.

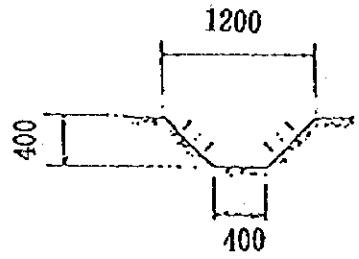
- Maximum Speed : 80km/h
- Gauge : 1,000 mm
- Minimum Radius of Curve : 97 m
- Speed Limit at Curve : $V = 3.5\sqrt{R}$
- Super-Elevation : $h = \frac{6.6 \times V^2_{Max}}{R}$
- Maximum Cant : 95 mm
- Maximum Slack : 25 mm
- Maximum Grade : 17‰
- Vertical Curve Radius : 5,000m or 3,000m inserted at grade change over 4%

(2) Roadway Diagraph

The roadway diagraph for the Hanoi - Ho Chi Minh Railway is shown in Fig. 8.4.1.



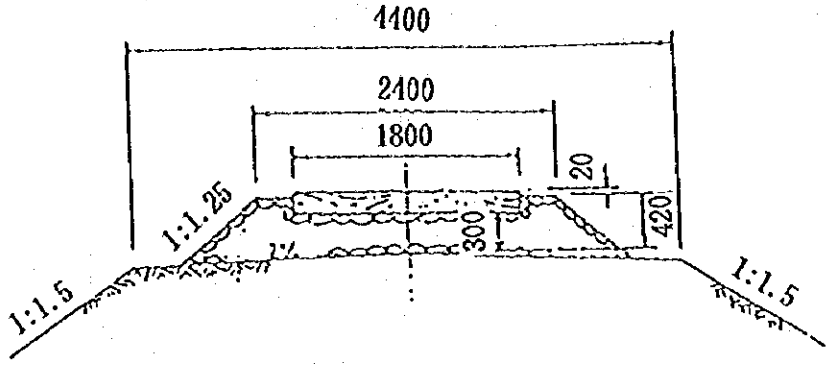
Embankment



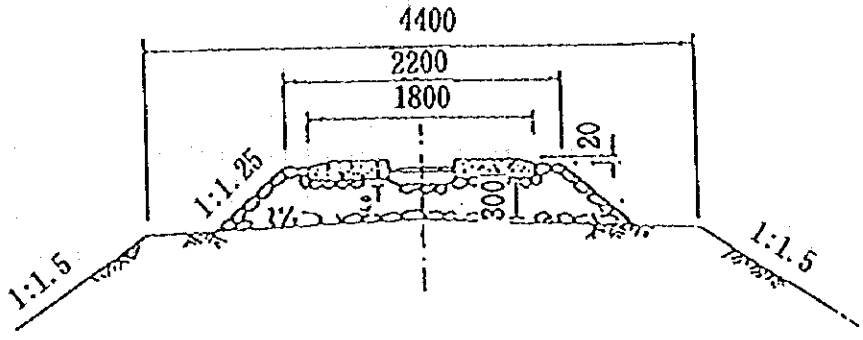
Side Drain in Cutting

All Dimensions are in Millimetres.

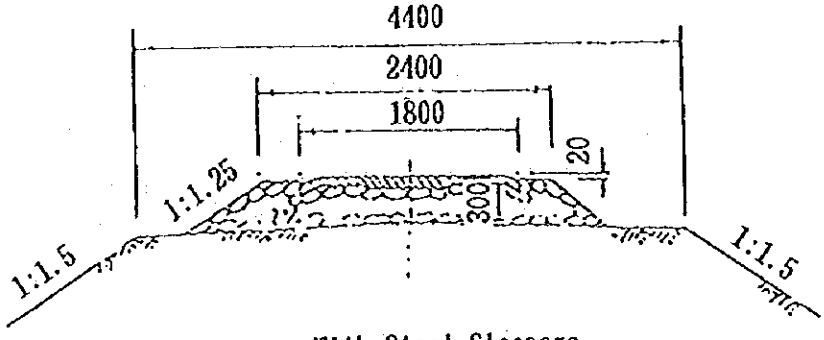
Fig. 8.4.1 Typical Profile of Formation



With Wooden Sleepers



With Tow Block Concrete Sleepers



With Steel Sleepers

Fig. 8.4.1 Typical Profile of Formation (Continued)

8.4.2 Track

(1) Current conditions and problem points

1) Rails

The existing rails on the Hanoi - Ho Chi Minh Line are 30 kg/m and 43 kg/m rails.

The 30 kg/m rails are 12.0 m in length and the 43 kg/m rails are 12.5 m in length and form the weak points on the track. There are many joints where the rate of maintenance work is high.

The 30 kg/m rails are old and have been in use for more than 60 years. They are badly worn and even show cracks due to overuse. Table 8.4.1 shows the combined extension of 30 kg/m rails and indicates the rail replacement plan for 1995.

Table 8.4.1 Combined Extension of 30 kg/m Rails and Replacement Plan for 1995

Union	Combined Length of 30 kg/m Rails (km)	1995 Replacement Plan (km)	Remainder (km)
Union 2	3.6	3.4	0.2
Union 3	311.3	35.0	276.3
Total	314.9	38.4	276.5

2) Turnouts

The speeds of trains passing through the straight sides of turnouts are 70 km/h in the case of back-facing turnouts and 60 km/h in the case of opposite-facing turnouts, and the passing speeds on the turnout sides range from 30 km/h to 35 km/h. Speeds through many of the existing turnouts are limited due to the deterioration of the turnouts that has occurred over time.

Table 8.4.2 shows the areas where train speeds are limited due to turnouts.

Table 8.4.2 Areas of Speed Limitation due to Turnouts

Kilometre	Station	Remarks
688km320	Hue	
1,139km390	Phuoc Lanh	
1,154km370	La Hai	
1,197km520	Tuy Hoa	
1,202km050	Dong Tac	
1,269km500	Hoa Huynh	
1,314km930	Nha Trang	
1,493km690	Chau Hanh	
1,506km100	Song Luy	
1,551km150	Muong Man	
1,710km560	Song Than	

3) Sleepers

Table 8.4.3 indicates the types of sleepers currently being used and the total extension of each type.

Table 8.4.3 Types of Sleepers and Their Total Extension

Sleeper Type	Extension (km)	Remarks
2-Block Concrete	587	
Iron or Wood	1,139	
Total	1,726	

Designs of current 2-block concrete sleepers should be revised as they have the following problems:

2-block concrete sleepers are stronger than concrete sleepers on curves due to the action of the steel bars and the absence of ballast reaction in the centers of such sleepers makes them effective on wider gauge tracks.

However, because the steel bars are only laid approximately 200 mm within the concrete blocks, there are doubts that they can work in unison with the concrete blocks in the face of lateral resistance.

The use of track circuits in line with level crossing and signal automation, etc. in the future will increase, however, problems will arise in the electrical insulation of rail fasteners.

The short length of the concrete blocks will also lead to problems in the introduction of MTT in the future. Moreover, compared to the case of mono-block sleepers, the load and roadbed supporting area and rigidity are small and there is a risk of corrosion to the steel.

The currently used 2-block concrete sleeper is illustrated in Fig. 8.4.2.

The fastening (K3 type) consists of a tie plate placed on the rubber pad, with the actual fastening being performed by a T bolt, stopper, spring washer and nut, however, elasticity is poor and warps are apt to appear.

As for the iron sleepers, corrosion and abrasion can be seen as a result of deterioration over time. Moreover, in terms of electrical insulation, the iron sleepers are more problematic than 2-block concrete sleepers.

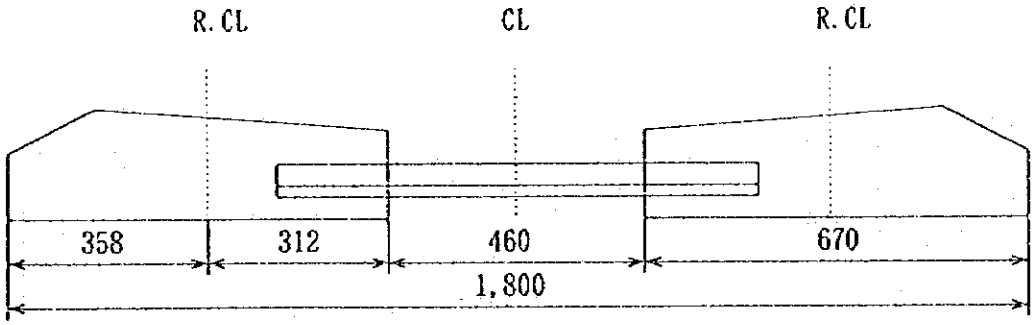


Fig. 8.4.2 2-Block Concrete Sleeper

4) Ballast

A ballast thickness of 30 cm is prescribed as standard, however, there are many sections where this is 20 cm or less, and on sections in the suburban areas of Hanoi and Saigon, etc. where people walk on the lines, there is almost no ballast left at all.

Another problem is the differing grading of ballast caused by the fact that it is manufactured by hand.

If quality control in the area of ballast size distribution is not carried out, the amount of track maintenance will increase in the future in line with the faster train speeds and increased passing tonnage.

5) Level crossings

There are currently some 850 level crossings registered and, although the busy ones are manned by guards who operate the cutout devices, the other ones are unmanned and are not even fitted with alarm systems, and so on.

The level crossings on national roads which are traversed by automobiles are paved, however, all other crossings are unpaved. Due to the entry of the public on tracks from level crossings, there are many locations where the track on either side of level crossings has almost no ballast left. Level crossings (ways of passage) that are not recognized for entry to housing or passage reasons are estimated to outnumber the number of officially recognized crossings. In the urban areas of Hanoi and Saigon, etc., level crossings are occupied by illegal squatters or are used as corridors or work areas. In other areas, too, there are many sections where the lines are used as ways of passage.

6) Maintenance method

The maintenance of lines is performed by 11 management enterprises. Table 8.4.4 lists the enterprises and details the responsible sections of each.

Table 8.4.4 Railway Management Enterprise

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

Track maintenance machines, equipment and tools are very poor, therefore, almost maintenance work is carried out manually. Track inspection and measurement (gauges, levels, lines, surfaces) together with other inspections and measurements is carried out manually.

On the Hai Van Pass, there are continuous curves with a curve radius of 100 mm to 200 mm, and as there are no curve alignment pegs, the control of curves is extremely difficult.

(2) Countermeasures

The problem points in each area are as described below.

The improvement plan units and quantities for each section (each project) are as indicated in Table 8.4.5.

Table 8.4.5 Improvement Plan for Track

Item \ Section	Unit	Total	Ha Noi-Thanh Hoa	Hue-Da Nang	Muong Man-Sai Gon	Other
Rail Renewal (30kg/m→50kg/m)	(Set) km	(2) 276.5			(1) 68.7	(1) 207.8
Rail Welding	(Set) Thousand Share	(5) 53.1	(2) 23.0	(1) 12.6	(2) 17.5	
Long Rail (CWR)	km	291.8	117.9	56.2	117.7	
Turnout Renewal	(Set) Set	(4) 232	(2) 97	(1) 41	(1) 64	30
Monoblock PC Sleeper	(Set) km	(5) 414.0	(2) 149.0	(1) 75.0	(2) 145.0	45.0
Ballast Thickness ≧ 25cm	km	920.0	120.0	100.0	130.0	570.0
Improvement of Level Crossing	Share	258	121	53	84	
Re-alignment of Curve	km	14.2		14.2		
PC Sleepers Making Facilities	Set	8	3	2	3	

( ) : Machinery and tool for improvement

1) Rails

The 30 kg/m rails should be replaced with either 43 kg/m rails or 50 kg/m rails (of 25 m in length each). The machinery and tools required for performing the rail renewal shall be provided. The machinery and equipment to be provided is as indicated in Table 8.4.6.

The length of the 43 kg/m rails shall be doubled from the existing 12.5 m per rail to 25 m per rail by welding two rails together at a time on the track site. The machinery and tools required for welding (gas pressure welding machine, acetylene gas generators) shall be provided.

When carrying out rail replacement, 25 m rails that have been welded together either at the bases or on the track site shall be used. In the case of purchasing new rails, 50 kg/m rails (25 m in length) shall be bought after this in order to reduce maintenance and extending rail life.

Appendix 8.4.1 shows the comparison in terms of the useful service lives and maintenance costs between 40 kg/m rails and 50 kg/m rails.

In line with the faster train speeds and heavier tonnage on the line in the future, the introduction of long rails (Continuous Welded Rail, CWR) shall also be carried out in order to reduce the maintenance work load. Appendix 8.4.2 gives the conditions required for laying long rails.

Table 8.4.6 Machinery and Tool for Rail Renewal

Machine and Tool	Unit	Number	Remarks
Truck	Set	1	
Track Motor Car	Set	1	
Jack Traverser	Set	12	Rail
Rail Carrier	Set	2	
Tie Tamper	Set	2	
Engine Generator	Set	2	
Rail Jack	Set	4	
Rail Saw	Set	1	
Rail Drill	Set	1	
Push Car	Set	2	
Track Irregularity Measurement	Set	1	Gauge measure, Alignment and Level measure, etc.

2) Turnouts

The turnouts through which train speed is limited shall be replaced with the turnouts that were indicated in the plan for speeding up.

The machinery and tools required for carrying out turnout renewal shall be provided. The machinery and tools to be provided are as indicated in Table 8.4.7

Table 8.4.7 Machinery and Tool for Turnout Renewal

Machine and Tool	Unit	Number	Remarks
Truck	Set	1	
Track Motor Car	Set	1	
Jack Traverser	Set	2	Rail
Jack Traverser	Set	1	Turnouts
Rail Carrier	Set	2	
Track Jack	Set	6	
Tie Tamper	Set	2	
Engine Generator	Set	2	
Rail Jack	Set	8	
Rail Saw	Set	1	
Rail Drill	Set	1	
Push Car	Set	2	
Track Irregularity Measurement	Set	1	Gauge measure, Alignment and Level measure, etc.

3) Sleepers

The 2-block concrete sleepers shall be replaced with improved sleepers. Fig. 8.4.3 illustrates the proposed improved 2-block concrete sleeper.

Mono-block pre-stressed concrete (PC) sleepers shall be introduced.

Mold forms and prestress introduction jacks shall be provided for PC sleeper making purposes.

The manufacturing of PC sleepers can be done either through the prestressing of PC steel bars or the post-tensioning of PC steel bars.

The post tensioned method is time consuming in that one sleeper at a time has to be hand made, however, compared to the prestressed method, little space and equipment are required, the use of mold forms is more efficient, and the work can be carried out in the enterprises that are currently manufacturing 2-block concrete sleepers.

The machinery and tools required for sleeper renewal shall be provided. The equipment and tools to be provided are as indicated in Table 8.4.8.

Table 8.4.8 Machinery and Tool for Sleeper Renewal

Machine and Tool	Unit	Number	Remarks
Truck	Set	1	
Track Motor Car	Set	1	
Tie Tamper	Set	2	
Engine Generator	Set	2	
Push Car	Set	2	
Track Irregularity Measurement	Set	1	Gauge measure, Alignment and Level measure, etc.

Fig. 8.4.4 illustrates the proposed improved fastener.

The double elastic fastening is an important part in the composition of double elasticity together with the track pad, the rail spring of which possesses elastic properties.

Dong Anh Railway Material Engineering Factory shall manufacture the plate springs and double elastic fasteners.

Appendix 8.4.3 gives an outline of the plate spring manufacture process and also shows main examples of double elastic fastenings.

As for the sections where track circuits are to be introduced, the existing sleepers shall be replaced with mono-block PC sleepers.

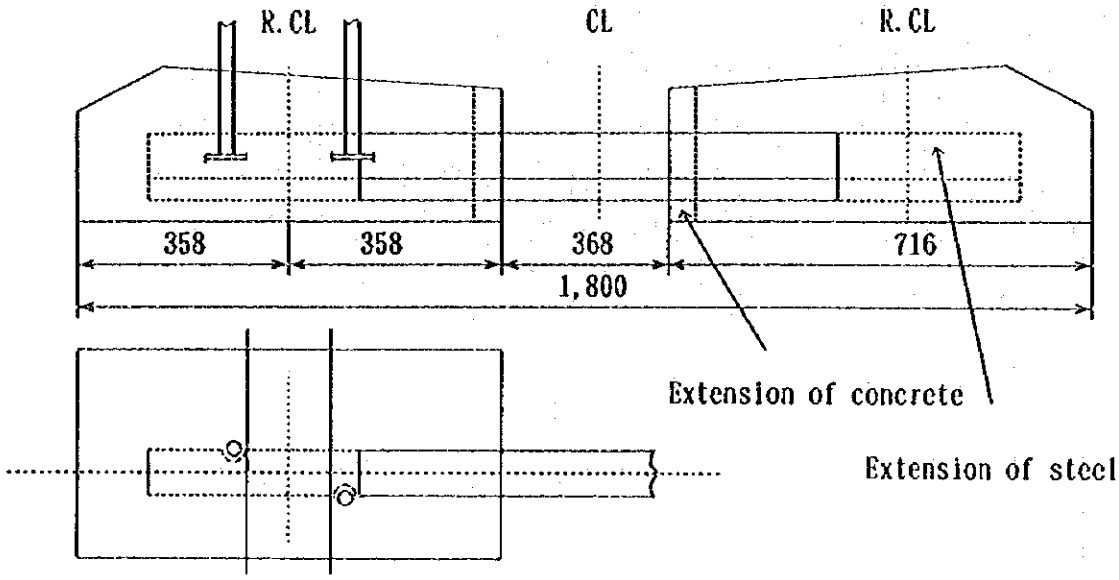


Fig. 8.4.3 Improved RC Sleepers

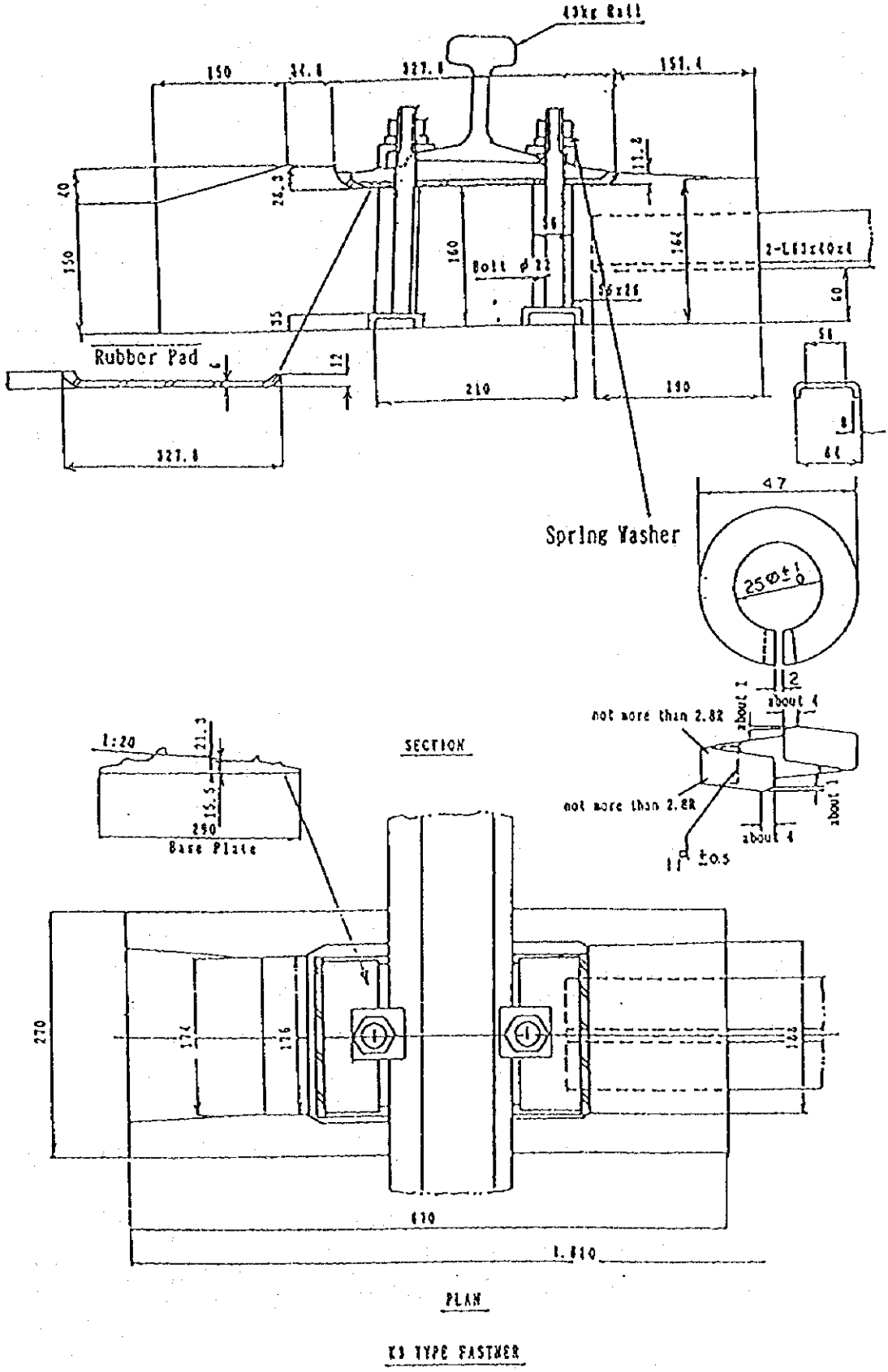


Fig. 8.4.4 Improved Fastenings

4) Ballast

Ballast renewal work and track improvements shall be carried out to secure a minimum ballast thickness of 25 cm.

In each district (Hanoi, Da Nan, Saigon), ballast manufacturing machines and hopper wagons for carrying materials, etc. shall be installed and the quality control of ballast grading should be carried out.

Proposed sites of ballast making facilities are as indicated in Table 8.4.9.

For an outline of the ballast manufacturing facilities, refer to Appendix 8.4.4.

Table 8.4.9 Candidate Areas for the Provision of Ballast Making Facilities

Area	Proposed Sites	Number of Hoppers	Remarks
Ha Noi	Ninh Binh	6	
Da Nang	Nut Thanh	4	
Ho Chi Minh	Dong Nai	6	

5) Level crossings

In addition to the track works, level crossings shall be asphalt paved and safety fencing shall be constructed along the track for 10 m either side of level crossings to prevent the public from entering onto the track.

Regarding unregistered level crossings, related agencies shall be encouraged to construct roads for daily living purposes, and the crossings shall either be officially recognized or abolished upon holding discussions with local residents.

For well ordered areas, level crossings shall either be improved or removed and safety fencing shall be erected.

In the urban areas of Hanoi and Saigon, land shall be bought up to solve the problem of illegal occupancy and to secure side roads, and safety fencing shall be erected.

Safety fencing (H = 2 m) shall be erected 5 m from the center of tracks and side paths of 1 m in width shall be placed beyond the fencing.

Land acquisition and compensation for buildings shall be carried out even in cases where only parts of buildings are causing an obstruction.

Level crossings themselves shall be fitted with cutoff devices and other safety measures shall be taken.

Table 8.4.11 shows the urban area sections and the level crossings where safety measures are to be taken. The integration or abolition of sections and level crossings shall be carried out on an individual basis.

On sections where the rail lines are used as passageways, related agencies shall be encouraged to provide roads for living purposes.

On sections where there already are roads for living purposes, and so on, safety fencing shall be erected to prevent the public from intruding onto the track.

6) Maintenance method

A high speed track inspection car shall be introduced in order to measure dynamic track irregularity (loaded condition) under the same conditions as when a train passes and to aid more appropriate maintenance work. Appendix 8.4.5 gives an outline of the high speed track inspection car. It will be possible to use this on the lines between Hanoi and Lao Cai and Between Hanoi and Dong Dang, too.

Track mechanized maintenance gangs shall be stationed at 30 km intervals and maintenance machinery and tools shall be provided. Table 8.4.10 gives details on the track mechanized maintenance gangs.

One MTT (multiple tie-tamper) each shall be introduced to the sections between Hanoi and Thanh Hoa and between Muong and Saigon, where track improvement is well advanced, and they shall be deployed to separate track mechanized maintenance gang organizations or simply to each gang according to necessity.

Work shall be carried out on the section between Hue and Da Nang up until the point where the second phase track strengthening work in Union 1 and Union 3 has been advanced to some degree.

Table 8.4.11 indicates the other maintenance machinery and tools to be provided.

Machinery and tools shall also be provided to the training centers for use in carrying out education and training in the machinery and tools that will be provided to the track mechanized maintenance gangs and the machinery and tools that will be used in the works. Training and education in theoretical matters and handling methods shall be provided with the aim of raising technical levels.

Table 8.4.12 shows the machinery and tools scheduled to be provided.

Concerning the curves of R $\leqq$ 300 mm on the Hai Van Pass, curve alignment shall be carried out and curve alignment pegs and track center pegs shall be put in place. The curve alignment pegs shall be placed in the following manner:

(a) At 5 m intervals in areas 10 m - 20 m beyond the curve start points,

(b) At a set distance (normally G/2 + 1 m = 1.5 m) outside the outer rail gauges.

The track center pegs shall be placed at intervals of 20 m.

Wooden pegs made from old sleepers, etc. and riveted in the centers for identification shall be used as the curve alignment pegs and the track center pegs.

Table 8.4.10 Track Mechanized Maintenance Gang

Union	Name of Enterprise (Section In Charge)	Mechanized Maintenance Gang	Kilometre	Remarks
Union-1	Ha Noi (12.0 km) (0.0 - 12.0 km)	Giap Bat	5.2	
	Ha Ninh (118.0 km) (12.0 - 130.0 km)	Phu Xuyen	33.3	
		Phu Ly	55.9	
		Nam Dinh	86.8	
		Ninh Binh	114.6	
	Thanh Hoa (110.5 km) (130.0 - 240.5 km)	Bim Son	141.5	
		Thanh Hoa	175.2	
		Thi Long	207.0	
		Truong Lam	237.8	
	Nghe Tinh (166.5 km) (240.5 - 407.0 km)	Cau Giant	261.0	
		My Ly	291.6	
		Vinh	319.0	
		Yen Due	351.5	
		Huong Phu	386.8	
	Quang Binh (119.0 km) (407.0 - 526.0 km)	Tan Ap	408.7	
		Ngoc Lam	449.6	
		Ngan Son	488.8	
		Dong Hoi	521.8	
Union-2	Binh Tri Thien (230.2 km) (526.0 - 756.2 km)	My Duc	550.9	
		Sa Lung	587.7	
		Dong Ha	622.2	
		Pho Trach	659.8	
		Hue	688.3	
		Truoi	715.3	
		Lang co	755.4	
		Kim Lien	776.9	
	Quang Nam-Da Nang (146.8 km) (756.2 - 903.0 km)	Da Nang	791.4	
		Tra Kieu	824.8	
		An My	857.1	
		Nui Thanh	890.4	
	Nghia Binh (193.2 km) (903.0 - 1,096.2 km)	Quang Ngai	927.9	
		Thach Tru	958.7	
		Sa Huynh	990.8	
		Bong Son	1,017.1	
		Phu My	1,049.4	
		Dieu Tri	1,095.5	

Union	Name of Enterprise (Section in charge)	Mechanized Maintenance Gang	Kilometre	Remarks
Union-3	Phu Khanh (282.0 km)	Tan Vinh	1,110.8	
	(1,096.2 - 1,378.2 km)	Phuoc Lanh	1,139.3	
		Chi Thanh	1,170.4	
		Dong Tac	1,202.1	
		Dai Lanh	1,232.2	
		Hoa Huynh	1,269.5	
		Nha Trang	1,314.9	
		Suoi Cat	1,351.4	
	Thuan Hai (167.8 km)	Ka Rom	1,381.3	
	(1,378.2 - 1,546.0 km)	Hoa Trinh	1,419.5	
		Vinh Hoa	1,453.7	
		Song Mao	1,484.5	
		Long Thanh	1,522.7	
	Sai Gon Muong Man (180.2 km)	Muong Man	1,551.2	
	(1,546.2 - 1,726.2 km)	Song Phan	1,582.9	
		Gia Huynh	1,613.5	
		Bao Chanh	1,639.8	
		Bien Hoa	1,697.5	
		Sai Gon	1,726.2	

Table 8.4.11 Machinery and Tool for Maintenance

Machine and Tool	Unit	Number	Remarks
Truck	Set	1	
Track Motor Car	Set	1	
Tie Tamper	Set	2	
Engine Generator	Set	2	
Rail Jack	Set	4	
Rail Saw	Set	1	
Rail Drill	Set	1	
Push Car	Set	1	
Track Irregularity Measurement	Set	1	Gauge measure, Curve Lining Calculator, Alignment and Level measure, etc.

Table 8.4.12 Training Machinery and Tools to be Provided

Machine and Tool	Unit	Number	Remarks
Gas Pressure Welding Machine	Set	1	
Jack Traverser (Rail)	Set	2	
Jack Traverser (Turnout)	Set	1	
Track Jack	Set	6	
Tie Tamper	Set	2	
Engine Generator	Set	2	
Rail Jack	Set	4	
Rail Saw	Set	2	
Rail Drill	Set	2	
Push Car	Set	2	
Track Irregularity Measurement	Set	1	Gauge measure, Lining Calculator, Alignment and Level measure, etc.
Rain-gauge	Set	1	
Wind velocity gauge	Set	1	

8.4.3 Stations

(1) Current conditions and problem points

Appendix 8.4.6 shows station kilometer and wiring outline diagrams.

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.

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.

(2) Countermeasures

Table 8.4.13 indicates the items and stations targeted for improvement in the section improvement plans for the section between Hanoi and Tanh Hoa and the section from Da Nang and Saigon to Muong Man.

With regards to station plazas, they should really be designed to allow the entry of buses and taxis in future and so enable the plazas to act as contact points between the railway and roads. However, until buses and taxis come to be widely used, the station plazas shall be provided with parking spaces, etc. to allow the entry of motorbikes and bicycles, which remain the main forms of transport for most people.

Table 8.4.13 Items and Stations Targeted for Improvement in the Section Improvement Plans

Item	Ha Noi - Tanh Hoa	Hue - Da Nang	Sai Gon - Muong Man
Passenger Station Improvement	Ha Noi, Nam Dinh, Nam Binh, Tanh Hoa	Hue, Lang Co	Muong Man, Bien Hoa, Sai Gon
Freight Station Improvement	Giap Bat, Van Dien Ninh Binh, Cau Yen Dong Giao, Bin Son Tan Hoa, Yen Thai	Hue, Da Nang	Song Than

Table 8.4.14 outlines the equipment and facilities targeted in the station improvement plans.

Table 8.4.15 outlines the equipment and facilities targeted in the freight station improvement plans.

Table 8.4.14 Outline of Station Improvement Equipment and Facilities

Item	Unit	Number	Remarks
Ticket counter improvement	m^2	40.0	
Waiting room improvement	m^2	50.0	Air conditioning
New shop	m^2	30.0	
New cafeteria	m^2	50.0	
Station plaza improvement	m^2	500.0	Parking space

The scale of the improvements is twice the above in the cases of Hanoi and Saigon

Table 8.4.15 Outline of Freight Station Improvement Equipment and Facilities

Item	Unit	Number	Remarks
Loading/unloading machinery	Set	1	Fork lift
Communication equipment	Set	1	

The following improvements shall be carried out in line with the train operation plan described in 8.3.3 (2), 6).

1) New interchange stations

A new interchange station will be constructed in 3 sections shown in Table 8.4.16 where the planned number of trains will exceed the track capacity simply to allow trains to pass each other.

Table 8.4.16 Outline of New Interchange

Kilometre		Length	Outline of Main Equipment and Facilities
From	To		
414km675m	415km225m	550m	Track 500m, Turnout 2 Set, Signal Cabin 50m^2
747km910m	418km460m	550m	Track 500m, Turnout 2 Set, Signal Cabin 50m^2 Bridge 5m
764km930m	465km750m	820m	Track 710m, Turnout (Scissors Crossover) 1 Set Signal Cabin 50m^2, Bridge 29m, Sheeting 5,400m^2 Banking 157,000m^3, Cutting 139,000m^3

2) In-station improvement

Table 8.4.17 gives an outline of in-station improvements.

Table 8.4.17 Outline of In-station Improvements

Station	Kilometre	Main Equipment and Facilities
Van Dien	8km 900m	New short-circuit line 1 Set
Vinh	319km000m	Track 500m, Turnout 2 Set
Dong Hoi	521km800m	Track 450m, Turnout 2 Set
Da Nang	791km400m	Track 450m, Turnout 3 Set
Dieu Tri	1,095km500m	Track 300m, Turnout 1 Set
Muong Man	1,551km200m	Track 250m, Turnout 1 Set
Song Than	1,710km600m	Track 850m, Turnout 5 Set, Refueling equipment 1 Set Land purchase: 104,000 m^2, corridor paving: 500 m^2

8.5 Bridge

(1) Current condition

Hanoi- Ho Chi Minh line was constructed during 1899- 1936 and suffered serious damage and kept without repair or maintenance through the war 1945- 1975. Some structures in southern area were designed with small locomotive load. There are bridges that were collapsed with battles and fallen down into rivers and picked up to reuse. During and after finish of the war, many temporary beams (T66, VN64, VN71, etc.) were constructed. Those bridges are still in use. Moreover all bridges were left without maintenance, especially the lack of painting gave serious damage. There are some bridges that are commonly used with road traffic on the same space. All such bridges are necessary to improve, but there are too many bridges to improve at once.

Many foundations of bridges restrict river water flow. Piers that were constructed for temporary use or heavily restrict water flow, should be removed or improved.
There are 768 bridges at Hanoi - Ho Chi Minh section and its total length is 25,288m. Of all those bridges, the number and total length of bridges that cause to restrict train speed according to VNR's Instruction about train operation speed "Lenh Toc Do Chay Tau,So 01-CD-1995" is shown in Table 8.5.1.

Table 8.5.1 Number of Speed Restricted Bridges

Restricted speed	15km/h	30km/h	40km/h
Number	20	68	9
Total length (m)	5024	5570	543
Percentage (%)	20	22	2

(2) Improvement principles

To the year 2000, bridges will be improved with the following principles. For the priority 3 sections (Hanoi- Thanh Hoa (175km), Hue- Da Nang (103km), Muong Man- Saigon (175km)), some improvements shall be made for speed up trains, increasing traffic capacity and stabilizing transport, to say nothing of retaining safety. For the other sections, some improvement shall be made to remove the dangerous bridges for train operation.

Considering the fact that there are too many bridges which have any defects, the countermeasure to improve bridges are assumed as follows.

(a) At the priority section, bridges which cause impediment for rational train operation, such as the restriction train speed equal or less than 30km/h shall be improved. On Hai Van pas section, new shortcut tunnel study is necessary, so the countermeasure of bridges in the section shall be decided according to the conclusion of that study.

(b) At other sections, bridges which cause barriers for safe train operation, such as the restriction train speed equal or less than 15km/h shall be improved.

(c) In the improvement of bridges, beams that may be utilized with changing or reinforcing some members should be repaired to reuse. But the number of members to improve exceeds more than 30% of whole members, it is cheeper to replace the beam. Abutments and piers should be also reinforced with covering by H-shape pile or sheet pile or concrete to reinforce. If there is not enough space between piers to pass water flow of the river, it causes to dam up the water level and to excavate river bed partially. Piers should be constructed to have proper space.

(d) In flood prone section, when bridges are reconstructed to new one, the formation level should be elevated not to submerge the beam.

(3) Inspection of bridges to be improved

There are so many bridges to be improved. Bridge inspection with using inspection equipment is necessary before to commence improvement work, because to decide improving order and to make improvement design needs detail examination about the condition of beams and foundations. Further more to save improvement expense, detail consideration about the remained bearing strength of bridge members is indispensable. Inspection shall be executed about soundness of whole bridges including continuous checking of cracks and deformation. According to the result of the inspection, priority order of improvement work will be decided.

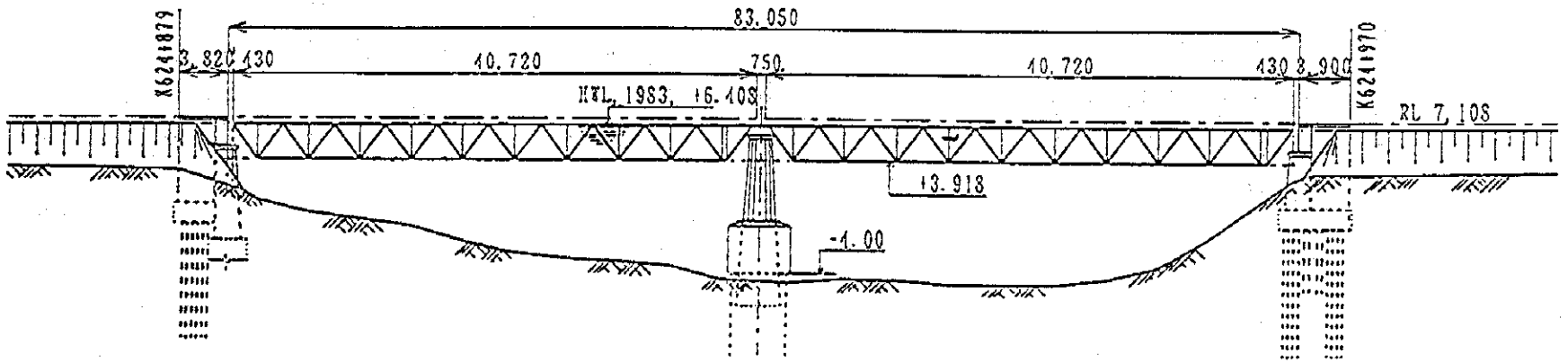
(4) Manufacture of steel beam

Steel beam manufacturing is assumed that the steel material will be imported and beam will be manufactured in Vietnam with introduction foreign technique.

(5) Bridges to be improved up to the year 2000

An example of new bridge construction beside existing one is shown in Fig. 8.5.1.
Bridges to be improved up to 2000 are shown in Table 8.5.2

Current Bridge (T66 beam)



New Bridge (WTT beam, 1.7m raise up)

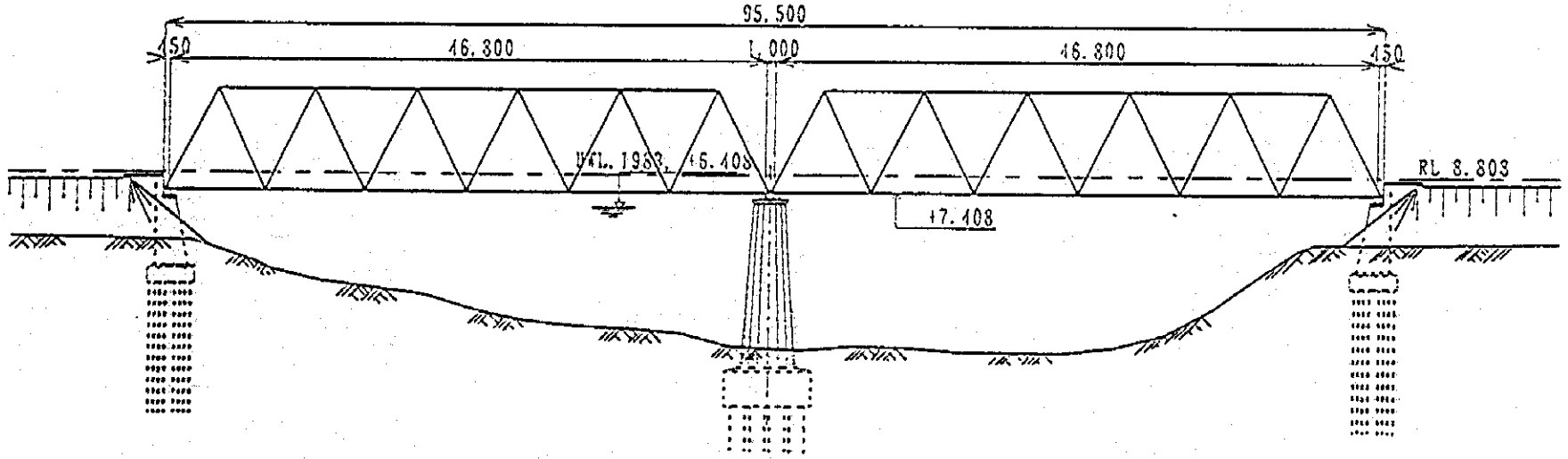


Fig. S.5.1 A Scheme for Bridge Improvement (Lai Phuoc Bridge)

Table 8.5.2 The Bridge List

Priority section 1

No.	Name	km-age	length (m)	Restrict speed	super structure	Countermeasure
7	Ong Tao	103k510	30	30km/h	UNKM	A2;reinforce, beam;replace
8	Ninh Binh	113k480	224	30km/h	T66,K78	Sm1.1 exclusive use , new
9	Cau Yen	119k498	42	30km/h	VN71	beam;repair
12	Tnog Giang	144k290	38	30km/h	VN71	beam;repair
13	Cu	145k450	36	30km/h	VN71	A1;reinforce, beam;repair

Other section

No.	Name	km-age	length (m)	Restrict speed	super structure	Countermeasure
21	Thi Long	208k287	40	30km/h	VN71	A1;reinforce beam;replace
80	Lai Phuoc	624k995	81	30km/h	T66	Sm2.6 elevate new
83	Nham Bieu	632k750	83	30km/h	T66	Sm1.7 ,elevate new
87	My Chanh	651k084	140	30km/h	I,T66	beam;replace

Priority section 2

No.	Name	km-age	length (m)	Restrict speed	super structure	Countermeasure
97	Huong Thuy	697k320	42	30km/h	COMB	beam;replace
98	Phu Bai	706k752	52	30km/h	COMB	A;reinforce, beam;replace
99	Nong	708k743	100	30km/h	VN71	beam3;replace, beam1,2;repair
100	La Son	710k729	22	30km/h	Pegeaud	beam;replace
101	Cho Hom	713k164	42	30km/h	VN71	beam;repair
102	Truoi	715k060	120	30km/h	COMB	beam;repair
103	Chia	716k617	22	40km/h	Pegeaud	beam;replace
105	Ong Loai	719k830	21	30km/h	Pegeaud	A;reinforce, beam;replace
106	Hai	728k934	21	30km/h	Pegeaud	beam;replace
108	Nuoc Ngot	736k450	42	30km/h	COMB	Sm1.1 new
109	Thua Luu	740k936	82	30km/h	COMB	Sm1.1 beam;repair
126	Nam O	778k155	276	15km/h	COMB	replace by new bridge

Other section

No.	Name	km-age	length (m)	Restrict speed	super structure	Countermeasure
128	Phong Le I	800k693	200	30km/h	Krupp	Sm1.4 new
135	Chau Lau	812k400	110	15km/h	Krupp	new
138	Ky Lam	817k037	500	15km/h	Krupp	new
143	Chiem Son	829k802	402	15km/h	Krupp	P1;reinforce, beam1,2,7,8;replace beam3,4,5,6;reinforce
147	Ru Ri	838k191	100	30km/h	Krupp	Sm1.7 new
196	Bong Son	1017k953	415	15km/h	Krupp	P;reinforce, beam;replace
216	Tan An	1086k671	128	15km/h	Krupp, RC	A2,P1,2,3;reinforce, beam1,2,3;reinforce
228	La Hai	1155k772	300	30km/h	Krupp	A,P;reinforce, beam;replace
234	Song Chua	1198k645	164	15km/h	Krupp, RC	A2,P3;reinforce, beam2,3,4;replace
236	Thach Tuan	1212k227	250	30km/h	Krupp	A,P;reinforce beam;replace
285	Long Song Lau	1464k431	160	15km/h	Pegeaud	Sm new route
286	Long Song Nho	1465k053	31	15km/h	COMB	Sm2.9 new route

Priority section 3

No.	Name	km-age	length (m)	Restrict speed	super structure	Countermeasure
300	Dong Nai Nho	1699k245	124	30km/h	COMB	exclusive use new
301	Dong Nai Lon	1699k860	200	15km/h	COMB	exclusive use new

Remark; Rc: Reinforced concrete beam
new: Replace to new bridge
Sm: Submerged bridge, Sm 1.1: Maximum submerged depth is 1.1m
A: Abutment, A1: Hanoi side abutment
P: Pier, P2: The second pier from Hanoi side
beam 3: The third beam from Hanoi side

8.6 Tunnel

(1) Current situation of tunnel

Tunnels on Hanoi - Ho Chi Minh line were constructed from 1925 to 1935. Those lining are deteriorated. Some water leakage is observed, but water leakage itself is not big problem. Leaking water may led down with trough along side wall if necessary. The repair of tunnel lining not to fall rock or concrete is necessary to keep safety train operation. At some tunnels, steel support are built, and safety is ensured at such section, but the steel support cause to invade construction gauge. The construction gauge of VNR is wide enough for car gauge, so to keep the construction gauge of the tunnel seems not urgent matter in current situation.
The procedure of the lining repair is to peel off the weathering surface of lining or rock and to coat with resin or spraying concrete. The tunnel which is deformed by active earth pressure needs to reinforce with rock-bolt and to inject mortal behind the void of the lining.
All such work may pursuit with train operation simultaneously.

According to VNR's Instructions about Train Operation Speed "Leh Toc Do Chay Tau, So 01-CD-1995" , the number of speed restricted tunnel is as follows.

Table 8.6.1 Number of Speed Restricted Tunnel

Restricted speed	15km/h	30km/h
Hai Van pass section	4	
Other section	4	1

(2)Improvement principles

Tunnels with serious lining damages which cause impediment for safe train operation, such as the restriction train speed 15km/h shall be improved. On Hai Van pass section, new shortcut tunnel study is necessary, so the improvement of tunnels in the section shall be decided according to the conclusion of that study.

The improving method is considered as follows.

A-1 : The section on where the linning crushed formerly, it neeeds to inject mortar to the void behind the linning, reinforce with rock bolt, remove the damaged linning surface and fill the missing linning section with spraying concrete .

A-2 : The section on where the earth pressure acts continuosly, it needs to inject mortar to the void behind the linning, reinforce with rock bolt, remove the damaged linning surface and

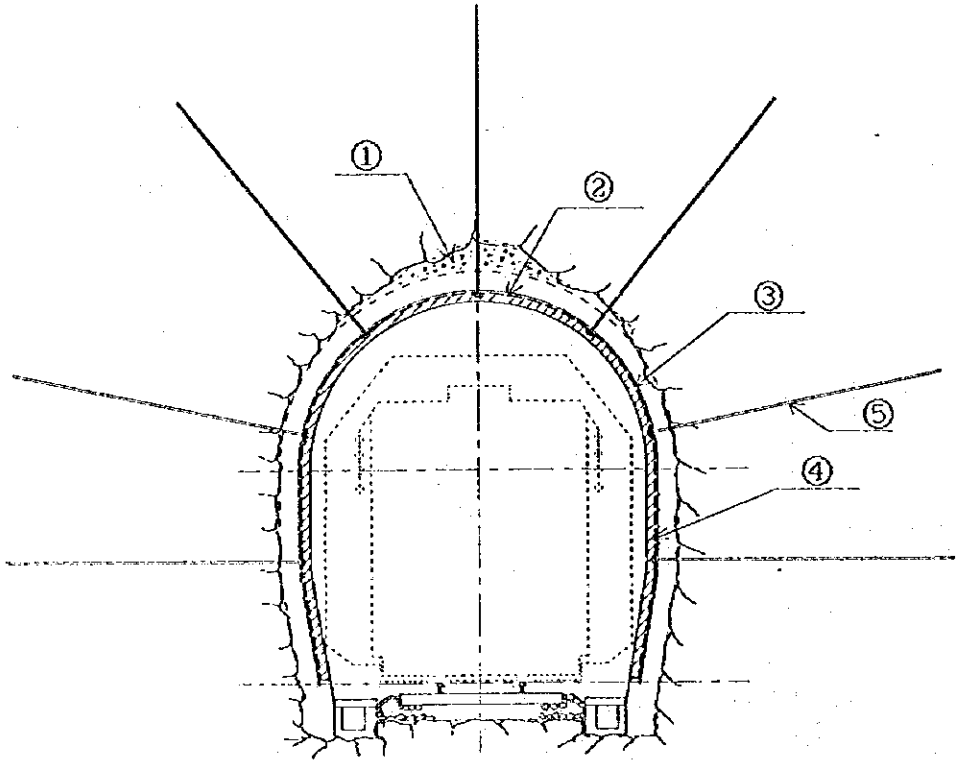
A-1 : The section on where the lining crushed formerly, it needs to inject mortar to the void behind the lining, reinforce with rock bolt, remove the damaged lining surface and fill the missing lining section with spraying concrete .

A-2 : The section on where the earth pressure acts continuously, it needs to inject mortar to the void behind the lining, reinforce with rock bolt, remove the damaged lining surface and spray concrete.

A-3 : The section on where the lining surface is heavily damaged, it needs to remove the damaged lining surface and spray concrete.

A-4 : The section on where the lining surface is damaged, it needs to remove the damaged lining surface and coat with resin.

B : The no-lining section where has the tendency of falling rock, needs to wash the surface and spray concrete.



① Backfilling of crown with aerated mortar
② Chipping of concrete lining (t=10cm)
③ Lining with wire mesh
④ Spraying of concrete (t=10cm)
⑤ Placing of rock bolts (φ 25mm, L=4m, 7bolts/section)

Fig.8.6.1 An Example of Improvement(A-2 Type)

(3) Tunnel inspection

Before commencing improvement work, it is necessary to execute the inspection about the tunnel. Inspection items are as follows,

(a) Soundness of lining
(b) Movement of cracks
(c) Section clearance of tunnel
(d) Behind condition of lining if necessary

(4) Selection of tunnel to be improved

The tunnels that are necessary to improve urgently up to the year 2000 are shown in Table 8.6.2.

Table 8.6.2 Tunnel list to be improved

Non priority section

No.	Name	km - age	length	Rest.speed	Type	Countermeasure
1	Minh Cam So 1	455+417	64m	15km/h	A-3,A-4	lining repair, drainage
4	Le Son So 1	466+091	96m	15km/h	A-3,A-4,B	lining repair

Priority section 2

No.	Name	km - age	length	Rest.speed	Type	Countermeasure
7	Cau Hai	732+816	358m	15km/h	A-1,A-3,A-4	lining repair, drainage
8	Phu Gia	745+690	445m	15km/h	A-1,A-3,A-4	lining repair, drainage

Non priority section

No.	Name	km - age	length	Rest.speed	Type	Countermeasure
16	Phu Cu	1026+749	171m	15km/h	A-2	rock-bolt,lining repair
17	Chi Thanh	1168+537	336m	15km/h	A-2	rock-bolt,lining repair

8.7 Hai Van Pass

8.7.1 Location

Hai Van Pass is located about 8 km to the north of Da Nang city, and about midway line between Hanoi and Ho Chi Minh, from 750.3 km to 777.6 km from Hanoi (this track length is 27.3 km). The Pass has 1,192 meters altitude .

8.7.2 Current Railway Route Alignment

(1) Condition of Topography and Alignment

The track rises and falls about 130 m with the steepest gradient being 17 ‰, the minimum curve radius is 100 m. So in this area of poor track train operations are suffering from slow speed, limited traffic capacity and natural disaster. There are six tunnels totaling a length of 2.3 km.

As the track exists on the side of topographical steep slopes, the line has suffered in the past from several mishaps like falling rocks and slope failures (obstruction of construction gauge). It is impossible to prevent completely these occurring between 759 km and 774 km.

However, safety train operations must be maintained. If the train speed is high, derailments or overturning of a train may occur. If overturning , there are many places where they can roll down to the bottom of the valley or into the sea.

So it is impossible increase the present speed .

(2) Circular Curve Radius and Reverse Curve

Many continuous curves of sharp radius are concentrated in this Section . The total curve lengths of radius 200m or less are 12.6 km, which is 46 % of the section of 27.3 kms. (Table 8.1)

What is worse is that there are many reverse cures of radius 100 m, and there are many reverse curves which have only 5 m of tangent between curves. There are some transition curve lengths of 15 m instead of the stipulated transition curve length of 20 m, as a result to keep a minimum 5 m tangent between curves (tangent length between curves is stipulated as one rolling stock length in Japan). Sharp radius of curves and reverse curves create restricted speeds of 15 km/h.

(3) Steep Gradients and Sharp Curves

The most part of the alignment has the continuous steep gradient of 17‰ and sharp continuous curves (radius 100 m), and as the grades and curves have complementary effect with each other.

In this area there are four sections where the gradient is continuously steeper than 11‰ (the steepest gradient is 16.5‰) and the gradient length is 1 km or more(total steep length is 16.1 km)

On the other hand, the equivalent gradient for a curve of radius 100m is 6‰. So maximum equivalent virtual grade is 22.5‰.

Table 8.1 Sharp Curves on Railway near the Hai Van Pass

Curve Radius	No. of Places	Track Length (m)	Remarks
100 m	99	9,494	
125 or less	15	1,256	
150 ditto	10	1,115	
200 ditto	9	729	
Total	133	12,594	

Note ; minimum curve radius is 160m in Japan.

So helper locomotives are used for freight trains . Recently, D18E locomotives that have Co-Co (3 axle) bogies are operated in a portion of the train in order to increase transport volume. Co-Co type locomotives have accelerated rail wear and the interval between rail replacement is reduced to six months. In this case it is useful to use head-hardened rails.

(4) Traffic Capacity

The section has the lowest traffic capacity between Ha Noi - Sai Gong. Traffic capacity between Ga Hai Van Bac and Ga Hai Van Nam (track length 10.8 km) is 22 trains in both directions per day. Therefore, the addition of trains, freight trains or local passenger trains, through Hai Van Pass are restricted. For the time being, the required traffic capacity can be met by double locomotives traction and by installing signal stations.

8.7.3 Countermeasures for the Problems of Hai Van Pass

Hai Van Pass has been a bottleneck to increased traffic flow between the North and the South of Viet Nam because of its continuous steep gradients and sharp curves. A fundamental countermeasure is the construction of new Hai Van tunnel, by which transport capacity and travel time will be significantly improved.

In the Master Plan, it is recommended that the construction of a new Hai Van tunnel should be after the year 2010.

This is because traffic volume estimated at 2010 will be dealt with by constructing a new interchange station at the Pass, and train operation safety will be secured by keeping the train speed at 25km/h or less.

Further economical analysis was carried out for the following two cases.

Case 1: constructing a new Hai Van Pass tunnel

Case 2: instead of constructing a new Hai Van Pass tunnel, the equivalent amount of cost will be used for repairing the old or deteriorated bridges where the train speed is limited from safety operation.

Case 2 was judged more economical than Case 1. Accordingly it was recommended in the Master Plan that construction of new Hai Van Pass tunnel should be after 2010.

However, in the Feasibility Study of Hanoi-Chi Minh railway line targeted at 2000, a new policy was adopted to select the section of Hue Da Nang as a priority section and not only to secure safety and reliability of train operation but also to improve the train service by increasing the train frequency more than in other sections. Accordingly the necessity of increasing the transport capacity at Hai Van Pass was picked up in tempo in Feasibility Study compared with while in drawing up the Master Plan.

The examination of necessity of a new Hai Van Pass tunnel should be made not only from shortening train travel time but also from increasing transport capacity as already explained in Vol. I : Master Plan.

As the policy was adopted to quickening the tempo of increasing the transport capacity, economical feasibility of constructing a new Hai Van Pass might be improved.

Further it could be mentioned that cost estimation of construction of new Hai Van Pass tunnel in the Master Plan was a rough one of Master Plan level. If the cost is estimated more accurately based on site survey including geological survey to be made in a new feasibility study, the estimated cost has the possibility to become cheaper than the one estimated in the Master Plan, thus increasing the economic feasibility of construction of new Hai Van Pass tunnel.

For all the reasons above, it is recommended that a feasibility study on constructing a new Hai Van Pass tunnel including geological survey (namely elastic wave test), optimal route selection, cost estimation, cost benefit analysis and optimal timing of construction, should be implemented before 2000. Further it should be mentioned that, if the feasibility study above identifies the optimal timing of new Hai Van Pass tunnel construction, the more appropriate repair plan of existing Hai Van Pass tunnel could be established. This fact also supports the early implementation of a feasibility study on construction of a New Hai Van Pass tunnel.

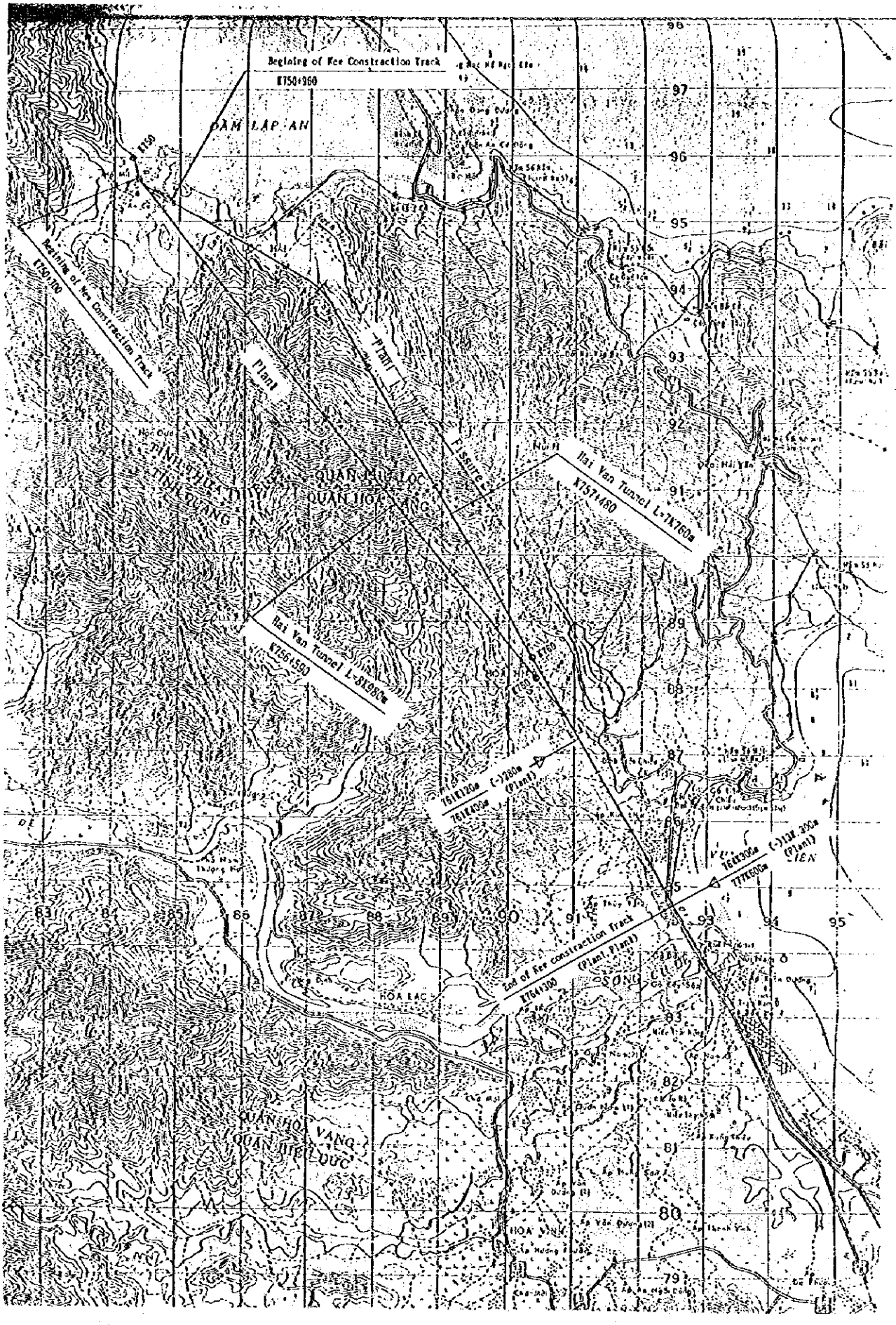

Beginning of Ree Construction Track
K750+960
DAM LAP AN
Beginning of Ree Construction Track
K750+100
Plant
Plant
T.Tsuine
QUAN HOA LOC
QUAN HOA VANG
Hai Van Tunnel L=8K980m
K756+590
Hai Van Tunnel L=7K760m
K757+480
K761+120m
761+400m
(-)280m
(Plant)
K766+300m
777+600m
(-)132.300m
(Plant)
VIEN
End of Ree construction Track
(Plant Plant)
K764+300
HOA LAC
QUAN HOA VANG
QUAN HOA DUC
OSONG

Fig. 8.7.1

8.8 Submerged Railway Sections

8.8.1 Location

Of the total length of 1726.2 km of the Hanoi - Saigon Line, some 180 km consists of railway sections subject to flooding, and service cancellations continue for between one and two weeks on these sections almost every year. (In extreme cases, train services can be suspended for as long as a month or more).

Every section is liable to flooding, however, the worst section is that between Vin and Than Loc (319.0 km + 498.7 km = 179.7 km length). This section crosses low lying land and flood prone areas concentrate along the Ngan San River side (351 km - 420 km) and the Rao Nay River (425 km - 470 km) upstream of Gianh River.

8.8.2 Selection of Submerged Sections

The flood prone railway sections were described in Section 8.15 (Natural Conditions). In this Section, these sections shall be limited to those where flooding exceeds rail level, and a description shall be given of the current conditions, the problem points and countermeasures concerning these sections.

The selected sections are indicated below, and that between Vin and Than Loc will be limited to one of these.

(1) Yen Xuan - Minh Le (330.0 km - 481.8 km, 151.8 km long)

(2) Nong Son - Tra Kien (813.6 km - 824.8 km, 11.2 km long)

(3) Vinh Hoa - Muong Man (1,453.7 km - 1551.2 km, 97.5 km long)

(4) Song Than - Binh Trien (1,710.6 km - 1,718.3 km, 7.7 km long)

Concerning all other sections not included above, it is desirable that surveys and countermeasures be carried out immediately.

8.8.3 Current Conditions and Problem Points

(1) Yen Xuan - Minh Le (330.0 km - 481.8 km)

On this section of 151.8 km, there are many flood prone sections covering a total of 67.3 km or 44% of the total. However, as the causes, problem points and countermeasures differ according to section, each major section shall be discussed separately.

1) Section Between 331.0 km and 338.4 km (7.4 kms)

a) Current Conditions and Problem Points

This section is between Yen Xuan Bridge (l = 436.8 m) on the Ca River and the Cho Thuong Bridge (l = 259.0 m) on the Giang River, and is situated upstream of the convergence point of these two great rivers. Ga Tho Thung is also located on this section.

As the embankments on this section act like levees blocking off the waters of the two rivers, flood waters reach the formation level almost every year, and flows over the formation level and washes away the embankment and ballast edges on the downstream side. In order to prevent this from happening, an earth wall has been built on the downstream side. The depth of the water during heavy flooding has been known to reach as high as 1.9 m in stations, and work is currently underway to raise the height of the embankments by approximately 2 m.

Moreover, because the Ca River bed has moved some 1.0 km to the terminal side, water control works are currently being carried out, however, the construction of a new bridge of around 150 m in length is desired to match with the new center of flow.

(b) Countermeasures

The dam plans, flow volumes, flow sections and levee heights along the upstream of each river shall be surveyed and the river plans clarified.

As for the line itself, the bridges, roadbed and stations, etc. all need to be raised by about 2 m and heavy works are forecast. Moreover, there is a minor curve of R = 100 m at the entrance to Cho Trong Bridge, and a new alignment is required to allow curve improvements to be carried out.

In conclusion, regarding this section, survey of the rivers shall be carried out at the same time as research into an alternative route for the line. The taking of countermeasures to counter water damage is important on this section.

2) On the section between Yen Xuan and Minh Le, where it is considered track raising will be necessary, there have been numerous past cases of water exceeding the rail level by between 1 - 2 m and stations being totally inundated by one meter of water. The causes and the problem points all differ and should be arranged according to the necessary countermeasures. Track raising is considered to be possible on the following sections:

(a) 349.0 km - 355.9 km: (6.9 kms)

(b) 357.7 km - 364.5 km: (6.8 kms)

(c) 391.1 km - 397.5 km: (6.4 kms)

(d) 424.0 km - 428.0 km: (4.0 kms)

(e) 429.5 km - 436.8 km: (7.3 kms)

Each of these sections has seen the railway line affected by overflowing of the Ngan San River or other main rivers. The problem of water drainage will, therefore, not go away until river improvements are taken, and raising of the track is also necessary. Delays will occur unless the river plans are clarified before the countermeasures are taken.

When forming the work plans, curve improvements are also necessary where the sections contain minor curves. Such sections shall be arranged separately, while sections without minor curves can be treated as projects for track raising only. The question of whether or not bridges are to be raised should be considered as they are a separate issue.

3) The sections where it is thought that the countermeasures will consist of increasing number and size of flood openings are as follows:

(a) 364.5 km - 371.0 km: (6.5 kms)

(b) 375.8 km - 385.1 km: (9.3 km s)

(c) 385.7 km - 389.3 km: (3.6 kms)

(d) 448.9 km - 454.0 km: (5.1 kms)

(e) 463.0 km - 464.5 km: (1.5 kms)

(f) 473.0 km - 478.0 km: (5.0 kms)

These are sections where insufficient flood openings are available and it means that the railway acts as a levee and flooding is thought to occur due to inundation of the line running over flat land. The required flood opening cross-section will be obtained from consideration of rainfall, runoff coefficient, flow area and flow volume, etc.

(2) Nong Son - Tra Kien (813.6 km - 824.8 km, 11.2 km)

The flood prone section is between 815.0 km and 816.5 km. The water damage on this section is thought to be caused by flooding at Ky Long Bridge. This shall be investigated and the countermeasures will probably consist of track raising.

(3) Vinh Hoa - Muong Man (1,453.7 km - 1551.2 km, 97.5 km)

1) Section between 1,463.2 km and 1,465.3 km

The water damage on this section is thought to be caused by flooding at Long Song River, and an investigation will be carried out.

2) Section between 1,490.3 km and 1,495.1 km

The bridge span on this section was extended from 5 m to 24 m, however, it still suffers from water damage. Because repeating the span enlargement would require unnecessary cost, the remedial works should be carried out after first conducting investigations.

3) Section between 1,527.2 km and 1,533.8 km

The water damage on this section is thought to be due to a low formation and the fact that the length of the side drains is not sufficient. When investigating the drainage method, it will also be necessary to examine countermeasures involving the raising of the formation level.

(4) Song Than - Binh Trien (1,710.6 km - 1,718.3 km, Extension 7.7 km)

As this section is in a cutting, groundwater seeps up and covers the line due to inadequate nature of the drainage channels. Ga Thu Duc is also subject to flooding.

It is thought that the water damage on this section can be countered through strengthening of the side drains, however, investigation of the possibility of line raising is also considered to be necessary.

(5) Classification of Submerged Railway Sections by Countermeasure

Table 8.8.1 summarizes the countermeasures to be taken on the above flood prone railway sections.

Table 8.8.1 Summary of Countermeasure for Submerged Railway Section

in [ ]; Side Drain

No	Rerouting		Track Raising		Crossing Waterway		Bridge Included		Note
	Number of Section (Section)	Track Length (km)	Number of Section (Section)	Track Length (km)	Number of Section (Section)	Track Length (km)	Number of Bridge (Bridge)	Bridge Length (m)	
1	Vinh-Dong Hai (319.0 km -521.8 km)								
	5	32.4	1	6.4	6	31.0	18	1,637.7	Related to Bridge Improve
2	Da Nang - Dieu Tri (791.4km - 1,095.5 km)								
			1	1.5			1	72.6	
3-1	Dieu Tri - Muong Man (1,095.5 km - 1,551.2 km)								
			1	2.1	1 [1]	0.8 [6.6]	3	253.3	Related to Bridge Improve
3-2	Muong Man - Sai Gon (1,551.2 km - 1,726.2 km)								
					[1]	[3.2]			
Total	5	32.4	3	10.0	7 [2]	31.8 [9.8]	22	1,963.6	

8.9 Other Civil Engineering Structure

(1) Earth Structures

1) Current Conditions and Problem Points

If approximately 2% of all railway line consists of bridges and tunnels, the remaining 98% is dominated by earth structures such as cuttings and embankments, etc.

Of these cutting or embankment sections, one or the other is subject to damage caused by heavy rains and flooding in the rainy season every year. In addition, other problems such as roadbed mud-pumping and embankment subsidence, etc. also occur.

Protection facilities are gradually being put into place, however, they are still limited to only a few areas and there are many structures where subsidence and deformation, etc. are occurring due to disasters or changes over time, and so on.

Regular inspections of civil engineering and drainage equipment, etc. are carried out twice per month and before and after the typhoon and rainy seasons, and the results are recorded in track inspection records. Depending on the findings of the regular inspections, emergency

inspections are also carried out. Moreover, during the typhoon and rainy seasons, efforts are made to prevent disasters from occurring in advance through fixed precautions and patrols.

2) Countermeasures

The repair of earth structures through improvements or disaster recovery, etc. is easy. However, in future it will be necessary to maintain the state of tracks at high levels to match the higher speeds and greater density of trains. For this reason, the emphasis in the accident prevention setup needs to be changed from the implementation of emergency and recovery measures to the control of weak areas and prevention in advance.

However, the sheer length of the Hanoi - Ho Chi Minh Line would mean that huge investment costs and much time would be required in order to ensure advance prevention in hardware terms. For this reason, in addition to the disaster warning and temporary reinforcing work currently carried out, a system of train regulation according to rainfall and wind velocity shall be introduced in order to forecast potential disaster situations and prevent train accidents from happening in advance.

Regarding the train regulation method, the JR train operation regulations, which were established based on the long-term study of disasters and natural phenomena, shall be used as reference and a similar system for VNR shall be established based on consideration of the actual conditions on the Hanoi - Ho Chi Minh Line. Appendix 8.3.3 gives the JR train operation regulations.

From now on, records on disasters, rainfall and wind velocities shall be collected and analyzed for use in developing future train operation regulations that are more closely matched with the local conditions.

Furthermore, a long-term disaster prevention plan shall be compiled in consideration of structures where the confirmation of safety is extremely difficult, districts where it is not easy to establish appropriate warning systems during rainy periods, and cases where the securing of train safety through disaster warning and operation regulation is difficult.

In line with the introduction of operation regulations, rainfall meters and wind velocity gages shall be installed. Table 8.9.1 shows the sites where the rainfall meters and wind velocity gages are to be installed.

Slope face improvement shall be carried out in areas where there are repeated mud and sand outflows and scouring, etc., even when recovery works are carried out after disasters. Table 8.9.2 shows the areas where slope face improvement is to be carried out.

Table 8.9.1 Insallation Place of Rain-gauge and Wind Velocity Gauge

Section	Number	Insallation Place
Ha nOi - Thanh Hoa	3	H Noi (0.0km), Ninh Binh (114.6km), Thanh Hoa (175.2km)
Thanh Hoa - Hue	3	Vinh (319.0), Tan Ap (408.7), Dong Hoi (521.8)
Hue - Da Nang	3	Hue (688.3), Lang Co. (755.4), Da Nang (791.4)
Da Nang - Muong Man	6	Quang Ngai (927.9), Dieu Tri (1,095.5), Dong Tac (1,202.1), Nha Trang (1,314.9), Ka Rom (1,381.3) Song Mao (1,484.5)
Muong Man - Sai Gon	2	Muong Man (1,551.2), Sai Gon (1,726.2)
Total	17	

Table 8.9.2 Areas Planned for Slope Face Improvement

Kilometre		Extension	Remarks
From	To		
811km000m	821km000m	10km000m	
848km000m	849km000m	1km000m	
1,046km000m	1,047km000m	1km000m	
1,712km000m	1,713km000m	1km000m	
Total		13km000m	

(2) Sections at Risk From Falling Rocks

1) Current Conditions and Problem Points

In the hilly and mountainous part of the line south of the central point, there are some sections where large rocks and boulders are exposed. There are also areas where there is evidence of fallen rocks, however, despite this, only a very small part of the line has been provided with protective measures.

Although there have, so far, been no accidents involving trains being hit by falling rocks or trains riding onto falling rocks, vision is poor on the line and there are many sections where there is a strong possibility of major accidents occurring due to falling rocks. Continuing rock erosion and the fact that the lines are in warm areas of heavy rainfall are both factors that further contribute to the chances of such accidents occurring.

2) Countermeasures

(a) As it is difficult to directly determine the level of risk of falling rocks, it is necessary to make estimations based on continuous changes. It is thus necessary to observe slopes and high risk boulders and loose rocks and to maintain falling rock control drawings and maintenance ledgers.

(b) The arrangement and removal of boulders and loose rocks on slopes is the most effective and extremely important means of preventing rock falls from occurring.

(c) Lines need to be protected to ensure that train operations are not affected even if rocks do fall.

A rock falling protection system shall be installed between Phu Hiep (1,209 km, 600 m) and Hoa Son (1,220 m, 100 m).

The signaling system is described in Section 9.6 (Signaling).

Falling rock detection fencing (H = 2.1 m) fitted with cables at intervals of 25 cm shall be erected on the section from 1,217 km, 300 m to 1,219 km, 800 m, and the cables shall be connected to the signaling system.

(3) Soft track bed

There are some sections where the track bed is not stiff enough and track ballast sinks into track bed. At those section, continuous routine maintenance is necessary and furthermore to construct drainage or to drive piles into road bed should be considered.

(4) Curve radius and section gradient

There are some sections where curve radius is smaller than 300m or section gradient is larger than 17 ‰. To improve curve radius or section gradient is too expensive to execute only its improvement to compare with other investment efficiency. Then such improvement should be executed accompany with other improvement like disaster prevention work or producing shortcut route.

(5) platform

Platform is necessary for easy ride on-down to trains. Current platform are short in some stations and not high enough. High platform is convenient for passengers to ride on-off trains. But to elevate platform needs to change construction gauge in some part. To treat cargo with manpower, high platform is convenient also.

(6) Establishment of facilities maintenance system

1) Establishment of structure inspection center
We would like to recommend to establish a structure inspection center that takes charge of the inspection and plan of improvement about bridges, tunnels, slopes and drains with providing inspection devices.

2) System for precaution against disaster
To prevent a train accident from natural disaster caused by heavy rain, it is necessary to measure the amount of rainfall every one hour during heavy rain. If the amount of rainfall exceeds the set up amount , the precaution against disaster should be taken to prevent the accident of train .

In the precaution against disaster, a watch patrol on foot goes around the appointed place every one hour. Trains are restricted their speed or stopped according to the amount of rainfall.

8.10 Signaling

8.10.1 Current signaling system

(1) Block system

VNR has been replacing from token to tokenless block system* at section by section on the line between Ha Noi-Saigon.

VNR will replace all block system by tokenless by 2000 with VNR's budget and schedule.

*This tokenless block system is called as semi-automatic block system in VNR.

(2) Signals

VNR has replaced semaphore signals with color light signals at 72 stations, but semaphore signals at 90 stations are used yet.

Visual distance of semaphore signals is less than 400m in night, sometimes it is less than 100m in bad weather. Therefore, semaphore signals are not adequate for high speed train operation, especially in night.

VNR has planned to eliminate semaphore signals replacing with color light signals as fast as possible.

(3) Signal aspect

3-positions/2 aspects system is applied for tokenless block sections. The details of aspect pattern are as follows:

Type of Train	Entrance Route	Home Signal	Starting Signal
Stopping Train	Home Track	Y	R
	Side Track	YY	R
Passing Train	Home Track	G	G

Note: Y, R and G stand for yellow, red and green light respectively.

(4) Electric power source

Power source is supplied at 77 stations but other stations have no power. Stations that have no electric power utilize batteries. Batteries need to be replaced periodically, but existing batteries are superannuated and need to be replaced with new one as soon as possible.

8.10.2 Plan for rehabilitation and improvement

(1) Block system

VNR has already a program to replace from token to tokenless block system, therefore, replacement of block system will be implemented by VNR by 2000.

(2) Replacement of semaphore signals with color light
Installation of color light signals for 72 stations will be implemented by 1996. Remained 90 stations have no program to replace at present. Therefore, they are included in the program 2000.

(3) Installation of approaching signals
Approaching signals are newly installed at all stations. Speeding down at the entrance of a station to confirm home signal will be improved by installing approaching signals.

(4) Replacement of relay interlocking device
Mechanical interlocking devices are replaced with electric relay interlocking devices, when signals are electrified.

(5) Renewal of power source and measures for power cut
Renewals of electric power and increase its capacity will be carried out at the time of electrification of signals or replacement of block systems.
Electric power is supplied at a station that has track and sidings over 5 from high voltage power source and equipped with an emergency engine generator(EG) and batteries. The capacity of batteries equipped is supply of power for 5 hours during power failure from the EG.
Electric power at a station that has track and sidings under 4 is supplied from low voltage power source and equipped with batteries. The capacity of batteries is supply of power for about 10 hours during power cut.

(6) Level crossing signal systems will be newly installed at main level crossings in urban areas and national roads that have heavy traffic. Objectives are 60 manned and 143 unmanned crossings between Hanoi and Saigon. The number installed with emergent solution to level crossings in Hanoi and Ho Chi Minh cities projects is excluded from the above-mentioned number.
A train approaching signal system and closing gates will be installed at a manned level crossing. Bell and flasher signals will be installed at a unmanned level crossing.

It is desirable to install action indicators besides railway crossing device. They work so as to inform for a train driver of gate-closing.

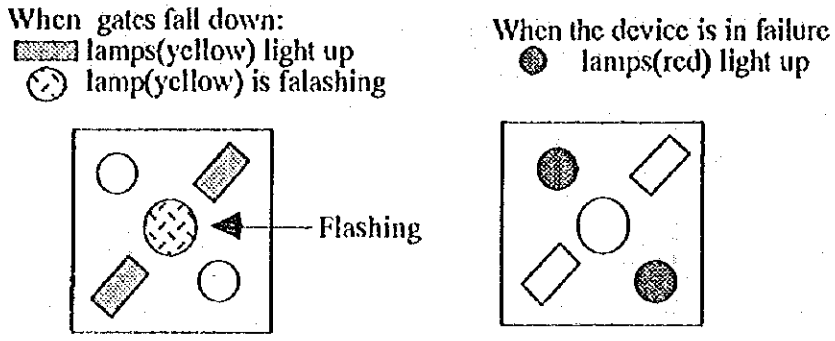


Fig. 8.10.1 Action Indicator

(7) Signaling facilities for new interchange stations

According to the train operation plan in 2000, 3 interchange stations will be constructed between;

Tan Ap(408.7km)-Kim Lu(426.0km)

Thau Luu(741.6km)-Lang Co(755.4km)

Hai Van Bac(760.7km)-Hai Van Nam(771.6km)

Signaling facilities for them will be planned.

(8) Warning signal system for rock falling detector

A warning signal system will be installed at a vulnerable section by rock falling. It is between Phu Hiep-Hoa Son section.

A warning system is consist of light signals and buzzers to inform accident occurring to people concerned. Signal will be transmitted to both side stations through lines.

The layout of the system is shown in Fig. 8.10.2.

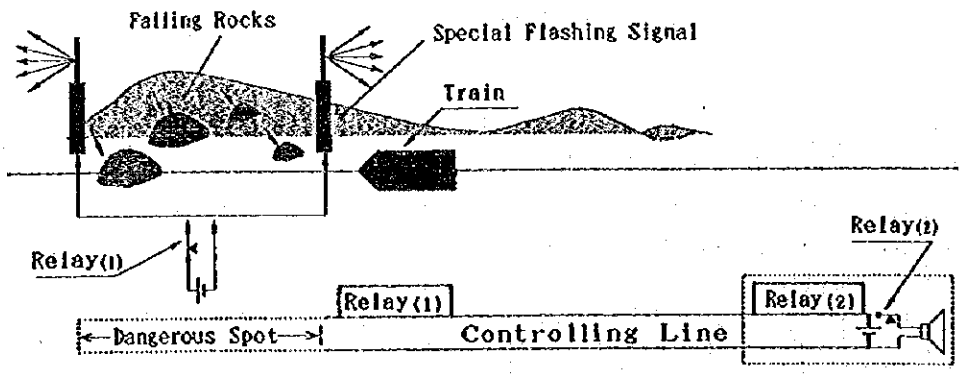


Fig. 8-10-2 Layout of Warning System

(9) Countermeasures for flood or submergence

A signal device box should be installed on high floor racks at vulnerable spots from flood. Insulation joints need to be washed by water just after the flood. If electric devices are submerged, such devices need to be replaced.

(10) Investment by Program 2000

Investment costs for signal improvement are divided into 3 priority section and station improvement projects. Signal improvement outside priority sections is formulated in the Signal Rehabilitation and Improvement project as follows:

Improvement Item/Project	Unit	Priority U1	Priority U2	Priority U3	Signal Project	Total
Tokenless Block Sytm	VNR will implement them					
Color light signals	Station mil.$	13 1.09	5 0.91	7 0.59	65 6.42	90 9.01
Power source	Station mil.$	13 0.52	2 0.08	7 0.28	63 2.52	85 3.40
Engine Generator	Station mil.$	3 0.24	1 0.08	3 0.24	4 0.30	11 0.86
Manned Crossing	Spot mil.$	15 0.99	4 0.48	9 1.05	32 3.82	60 6.34
Total	mil.$	2.84	1.55	2.16	13.06	19.61

Other investment:

-Signaling facilities for 2 new interchange stations 0.15 million US$

-Warning signal system for rock falling detector 0.23 million US$

Total investment cost for Hanoi Saigon Line by program 2000 is 19.73 million US$.

8.11 Telecommunication

(1) Current conditions

(a) Telecommunication line

Almost telecommunication lines are installed with bare wire lines. As the bare wire is made of steel, they quickly rust and have been replaced frequently. It is difficult to introduce modern communications, such as data transmission, seat reservation system in the near future.

The current communication lines and carrier communication network is shown in Fig. 8.11.1 Communication line & Carrier communication network.

(b) Transmission facilities

Since transmission devices are out of date and production of spare parts was stopped, supplying of parts is difficult. There are many breakdowns due to poor contact in the contact, which can be said to be terminal problems. The replacement of all connection areas is required to alleviate this weak points. As a result, available components and second-hand components are born from old facilities purchased from the national telephone company.

(c) Exchange facilities

Exchanges are installed at 21 site between Hanoi and Saigon, and of these, 4 sites(Hanoi, Da Nang, Nha Trang and Saigon) are installed with digital exchange. The remaining 17 sites use manual exchanges. As an exchange is connected with only 1-4 transit trunks, an exchange already is fully used. Switching of telephones are executed by manual. An exchange is connected to the public telephone company's line, it is possible for railway telephones to link with the public telephones.

(d) Terminal facilities

Terminal facilities are telephones for train blocking, dispatching telephones, railway, a central telephone at a station, telephones to manned level crossings. Though these telephones are very important for train operation and safety, the reliability and communication quality are low due to deterioration of them.

(e) Power source facilities:

The transmission uses an AC 220V electricity and the exchange uses DC 24V and DC 48V. The DC power is supplied through rectifiers and batteries. Some of the main stations have manually operated emergency generators.

(f) Maintenance system;
There are 4 companies located in Hanoi, Vinh, Da Nang and Saigon, and there are 16 branches covering the maintenance work for around 10 stations. There are night shifts for emergency repair in 24-hour maintenance.

Overall deterioration can currently be seen throughout the telecommunication facilities. Some facilities are in terminal state of disrepair and there are a lack of repair parts and measuring instrument. The current superannuated telecommunication system and facilities are maintained with the efforts of qualified engineers and skilled technicians. The present technical levels of maintenance staff are sufficient for handling the existing facilities, however, renewed training and education will be required in line with the introduction of a new system.

(2) Countermeasures

The large part of the telecommunication facilities will need to be renewed by 2010. The target for investment into equipment and facilities for up to 2000 is planned according to the following principles:

- Equipment investment that satisfies the demand for telecommunications in term of both quality and quantity shall be carried out.
- The equipment investment shall match with the objectives of securing more safety, more income and improved services by 2000.
- Consideration shall be given to 2010 by investing in equipment that does not eventually prove to be wasteful or surplus to requirement by that time.

The new telecommunication network plans in Union 1, 2 and 3 are shown in Fig 8.11.2, 3, and 4 Communication network plan.

There are 2 kinds of systems for long-distance transmission to be newly installed:

-Optical fiber cable system:
The optical fiber cable does not receive external influence. The quality of the system is very good and would be optimal for such communications as high speed data transmission and other communications that are expected to be used by modern railway systems in the future. As the cable is laid underground, the maintenance of cable will be easy.
However, the cable line would be affected by natural disasters of the railway track.

-Digital microwave radio system

The wireless system would not be affected by any accident or disasters on the railway lines because there are no facilities between antennas. However, the system is vulnerable to phasing and other environmental effects, so that it is not really suited to high speed transmission in particular.

Combination of the above-mentioned two systems are the most fundamental system because the communication lines are simultaneously or supplementary used the wire and wireless networks.

However, in the present situation, the replacement of the existing facilities must take priority up to 2000. The replacement of bare wire by underground-cable will be selected as an earlier project.

The construction of combining system with cable and wireless should be implemented as a long term project.

(a) Communication line

The communication line between Hanoi-Thanh Hoa-Vinh and Muong Man-Saigon will be converted from bare wire line to a compound communication cable of 8 optical fiber and 30 pair of metal conductors. This cable shall be laid underground.

(b) Transmission equipment

The optical fiber transmission equipment capacity will initially be 240 lines (8Mbit/secx2) with expansion up to a maximum of 480 lines(8 Mbit/secx4) possible. (Refer: Appendix 8.11.1)

Existing equipment shall be replaced with new models. It will be necessary to use the old equipment as maintenance components. For this reason, the installation of new equipment should be implemented as soon as possible.

(c) Exchange facilities

Current manual exchanges on the section between Hanoi-Tanh Hoa, Hue-Da Nang and Muong Man-Saigon will be replaced with new digital exchanges. When optical fiber cables are laid simultaneously, direct distance dialing will be realized, in stead of current manual switching.(Refer: Appendix 8.11.2)

(d) Terminal facilities

- The renewal schedule of a station central telephone for up to 2000 is shown in Fig 8.11.2,3 and 4 Communication network plan.

- Seat reservation system

Since the existing transmission equipment would not be able to cope with on-line terminals throughout the country, seat reservation systems for closed individual station area will be installed at the stations indicated in Fig. 8.11.2,3 and 4 Communication network plan.

A seat reservation system will improve current manual ticket sailing at stations to a computer system with printing out attractive ticket. An advanced ticket sale will be expanded to handle more increased seat reservations and terms in advance.

- Portable radios

Since the communication line is not renewed on the section between Hue-Da Nang priority section, portable radio system facilities will be installed for the communications at stations and working sites.

Refer; Fig 8.11.3 Communication network plan U2.

(e)Power source facilities

It will not be possible to use the existing power facilities for the renewed exchanges and transmission facilities.

New rectifiers, batteries and generators will be installed on the priority sections.

Generators installed will be the type that detects power cut and automatically operates and supplies power.

(f) Surveillance system

The effects of accidents or breakdowns will be greater than previously experienced. In order to detect such situation as soon as possible, central surveillance systems will be installed at Hanoi and Saigon to observe respective areas.

(g) Auxiliary facilities

As the facilities installed newly require strict temperature and humidity control, air conditionings should also be installed.

(h) Train radio

Train radios are very effective communication means for train operation safety and stability. However there are higher priority project in the telecommunication field than the train radio, so that it is not included in the investment project up to 2000.

(3) Maintenance system

There are 2 kinds of maintenance methods that preventive maintenance and posterior maintenance. Preventive maintenance is preventing the occurrence of breakdowns according to the forecasting and posterior maintenance is repair after breakdown occurred. It is recommended to introduce above-mentioned maintenance methods based on the study of reliability.

Training on general electrical and railway communication curriculums should be provided for beginners at the railway training center.
The basic theory of digital differs from that for analog technology. It is necessary to provide training in basic digital technology for all technicians.
The project to install new digital facilities should include a development of training for engineers and technicians, installation of training facilities and preparation of user's manuals in Vietnamese version.

The following facilities are necessary to be installed at the training center:

- Optical fiber telecommunication,
-Switching devices,
-Auxiliary facilities,
-measuring devices

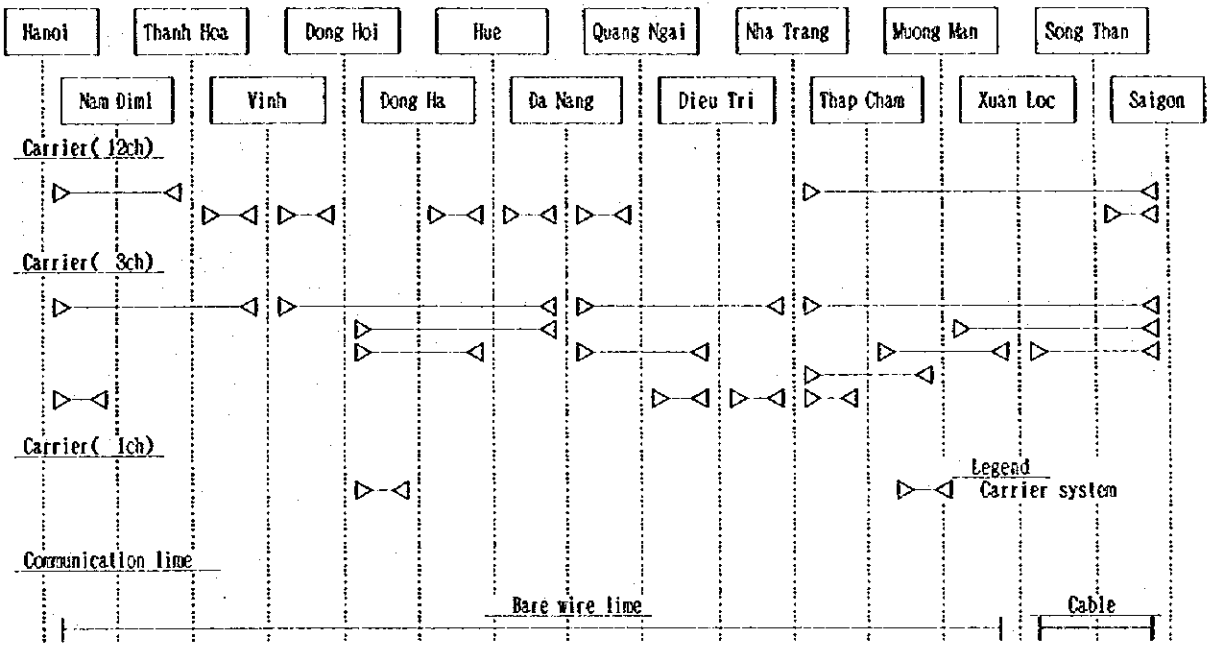


Fig. 8.11.1 Communication Lime & Carrier Communication Network

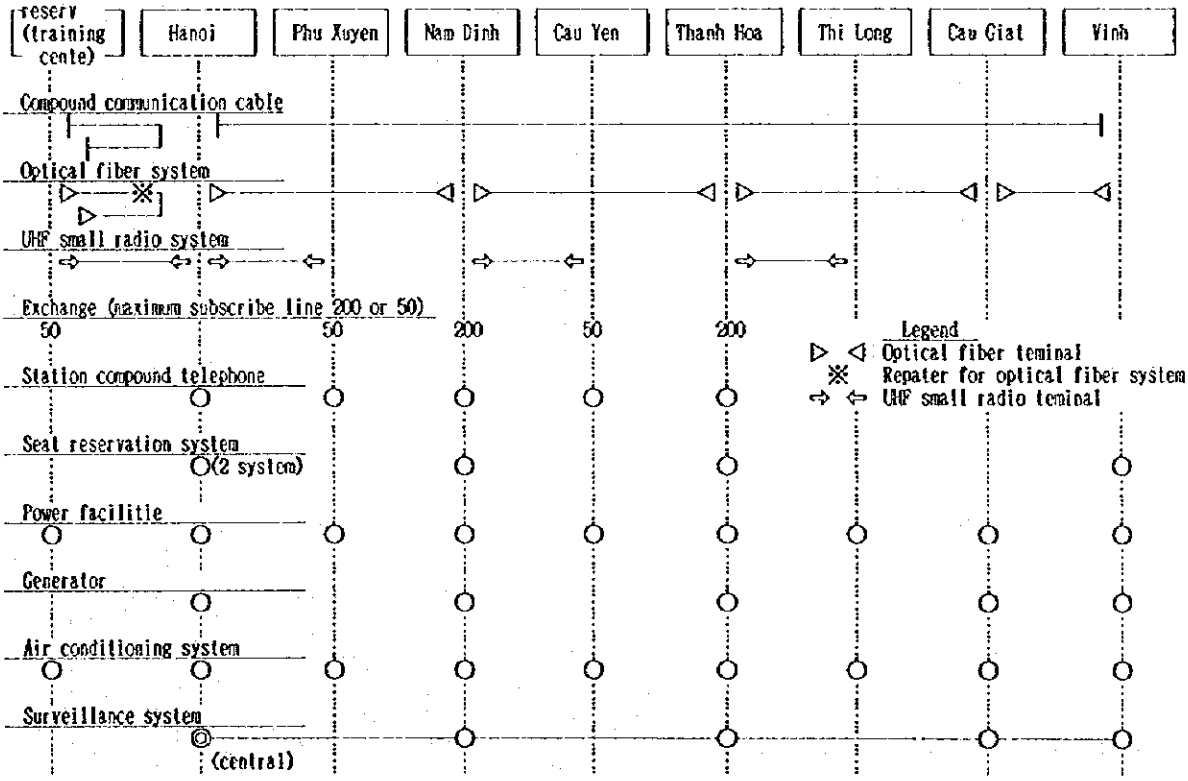


Fig. 8.11.2 Communication Network Plan U1

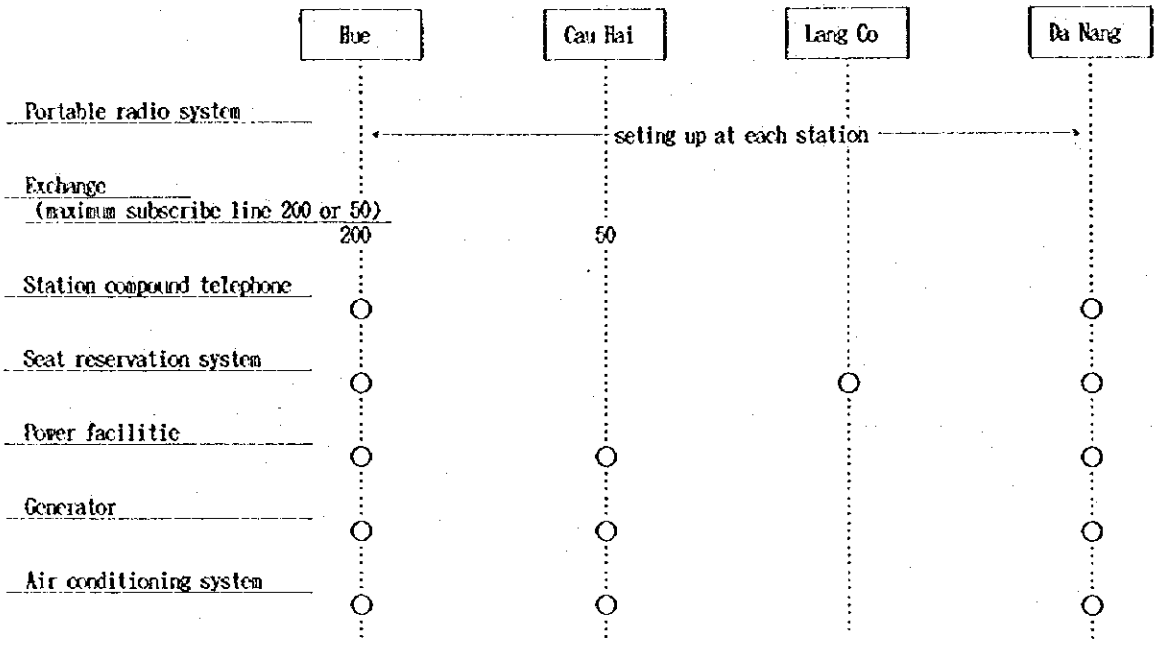


Figure 8.11.3 Communication network plan U2

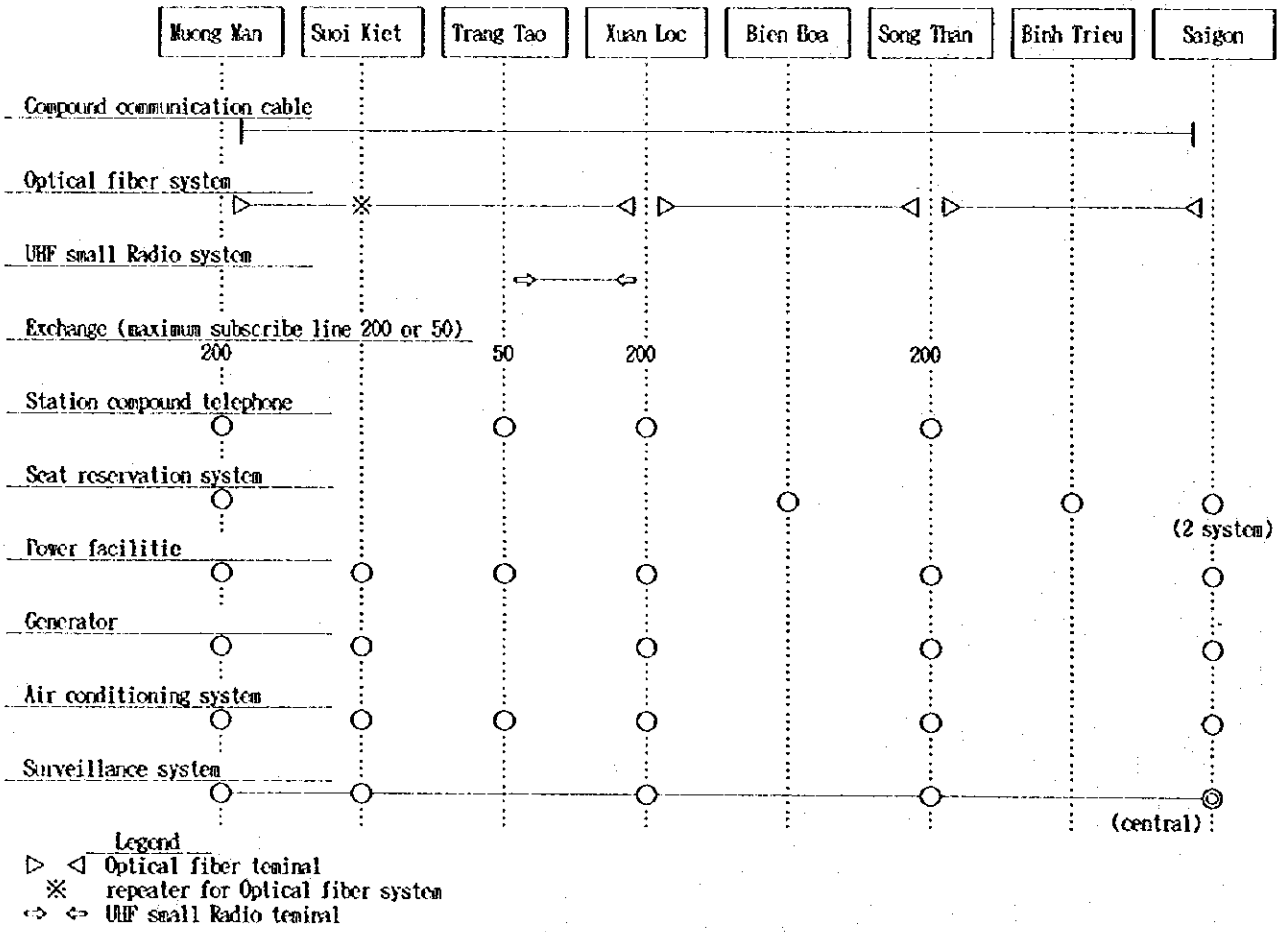


Figure 8.11.4 Communication network plan U3

8.12 Rolling Stock

8.12.1 General

Rolling stock concerned is mainly stated in this chapter, including a part of rolling stock for Lao Cai - Cai Lan Line, because rolling stock concerned should be nationwidely examined.

8.12.2 Collected Data and Information on Current Conditions

Collected data and information are rearranged as follows.

Fig. 8.12.1	Organization Chart of Rolling Stock Concerned
Table 8.12.1	Locomotive (1993)
Table 8.12.2	Number of Locomotives by Situation in Dec. 1993 and Dec. 1994
Table 8.12.3	Number on Book of PC and FC (1000mm) (Dec. 31, 1993)
Table 8.12.4	PC by Manufacturing Year (1000mm)
Table 8.12.5	FC by Manufacturing Year (1000mm)
Table 8.12.6	Classification of PC and FC of Union 1 for Hanoi - Ho Chi Minh Line and Northern Other Lines (1000mm) (Dec. 31, 1993)
Table 8.12.7	Cause-wise Ineffectivity of DHLs
Table 8.12.8	Cause-wise Ineffectivity of DELs
Table 8.12.9	Declining Tendency of D4H
Table 8.12.10	Declining Tendency of D9E
Table 8.12.11	Number of New Production Capability of PC and FC with and without Execution of Regular Overhaul in Workshops

8.12.3 Some Findings

(1) Life of rolling stock

- Locomotive

SL	condemned by 2010
D4H	15
D5H	10
D8H (1435)	15
D11H	10 (After rehabilitation)

D9E	30 (At present, more than 30, but still usable)
D12E	20
D13E	20
D18E	25
• PC and FC	30

(2) Passenger coaches and wagons

Passenger coaches equipped with plane bearing is being modified to roller bearing type, but wagons equipped with plane bearing will be used until their life without modification to roller bearing type.

(3) D9E s are still usable from view points of their soundness of carbody frame and bogie, and procurable spare equipment such as engine.

(4) D18Es are able to run only section between Hanoi and Da Nang.

(5) One rescue car with capacity of 100 to 120 tons is needed for each Union as soon as possible.

8.12.4 Problems and Countermeasures

(1) Cause-wise ineffectivity of DHLs and DELs (Tables 8.12.7 and 8.12.8)

1) D4H

Failure of principal equipment seems to be included in column of "waiting spare parts." Accumulation of statistical breakdown figures of principal equipment is the most important to take the most suitable countermeasures and to avoid repetition of same breakdown or trouble.

Anyway, D4H could be kept for rather long period by cannibalization, because the number of D4H is very large. The Table 8.12.7 may prove such fact, because availability of D4H is rather good. However, it takes averagely 48 days per locomotive for regular maintenance. It must be reduced. D4H is planned to be gradually replaced by larger output power locomotive or condemned by 2010, due to the small output power and the large fuel consumption. It is recommended, however, that D4H should be kept by cannibalization as long as possible for local passenger train on Hanoi - Ho Chi Minh Line, for passenger train on northern lines, and for shunting locomotive of all the VNR. It is not recommendable, however, that D4H is used for freight train, because output power of D4H is too small.

2) D11H

Number on book of D11H is 10, but the available number is only 2. Further, necessary days for regular maintenance are so long. It is averagely 155 days per locomotive and it makes worse their availability. D11H should be rehabilitated as soon as possible.

3) D9E

Table 8.12.8 shows that D9E is aged, because the availability is low due to large breakdown figures of principal equipment and such long necessary days for regular maintenance as 105 days per locomotive. It is said that 10 to 15 D9Es will be rehabilitated in near future. However, it is recommended that D9E should be kept only by cannibalization for family D9Es after 2000, because the age of D9E is too old and the number of D12Es will become surplus in 2005 and 2010 as mentioned in the clause 7.5.1 of the revised Master Plan.

4) D12E

The availability is comparatively good. However, it should be more improved by reducing mean necessary days of 46.5 per locomotive for regular maintenance and by preparing spare equipment in advance, establishing inventory control system.

5) D13E

The availability is so bad despite the young age. Why it takes so many days as about 180 per locomotive for regular maintenance? The reason should be analyzed so as to find the most suitable rehabilitation way.

6) D18E

The availability is worse than that of D12E. Mean necessary days for regular maintenance is almost double of D12E, although there are differences in number of wheels, etc. The measures to reduce the necessary days for regular maintenance should be found. For example, the neck points which cause long cycle time from in-coming to out-going should be step by step improved by using critical pass analyzing method.

(2) Declining Tendency of D4H and D9E (Tables 8.12.9 and 8.12.10)

Excluding newly introduced D5H and locomotives such as D11H, D12E, D13E and D18E which were recommended to be rehabilitated in the Interim Report (1), declining tendency of D4H and D9E was examined. The remarkable declining tendency of the both locomotives cannot be found. As for D9E, it is said that the available number of D9E will be 28 in 2000, but, after 2000, will gradually decrease because of the age, spare parts shortage, material shortage, etc., and 10 to 15

D9Es may be rehabilitated. As for D4H, the available number may gradually decrease by cannibalization.

(3) Establishment of daily cleaning system for passenger coach

Passenger coach should be more clean to offer comfortable travel for passengers. Seat, sleeping bed, window side, table, ceil, corridor and toilet should be kept more clean. What passenger coach seems to be aged or poor may be caused by the dirtiness. Cleanliness and good arrangement are fundamental matter. More developed daily cleaning system should be established.

8.12.5 Estimation of Existing Number of Rolling Stock in 2000

(1) Locomotive (Tables 8.12.2, 8.12,9 and 8.12.10)

1) D4H

Although remarkable declining tendency of D4H cannot be found, 80% of present available number 190 will remain in 2000 under the condition that the condemnation by cannibalizing 20% of present available number is optimistically assumed. Namely, 150 D4Hs will remain in 2000.

2) D5H

Number on book of D5H was increased to 13 in 1995 from 3 in 1994 and there are no problems for spare parts. Therefore, 13 D5Hs will be available in 2000. D5H will be used only for passenger train on Hanoi - Lao Cai Line.

3) D11H

It is said that 4 D11Hs will be rehabilitated in 1996. The remained 6 D11Hs are recommended to successively rehabilitated before 2000. Therefore, 10 D11Hs will be available in 2000. It is preferable to concentrate 10 D11Hs to Da Nang Loco. Depot.

4) D9E

It is said that actual 28 D9Es will be available in 2000 without cannibalization.

5) D12E

Actual 40 D12Es will be available in 2000.

6) D13E

Excluding one D13E waiting condemnation and including 5 D13Es planned to be procured in

1996, 19 D13Es will be available in 2000.

7) D18E

Actual 16 D18Es will be available only on Hanoi - Da Nang Section upto 2000.

(2) Passenger coach (PC) (Tables 8.12.3, 8.12.4, 8.12.6, 8.12.12, 8.12.13 and 8.12.14)

1) Calculation is made, assuming that PCs manufactured before 1970 will be condemned in 2000.

2) Table 8.12.12 shows the list of PC to calculate existing number in 2000 for Hanoi -Ho Chi Minh Line and for northern other lines resulted from Tables 8.12.3, 8.12,4 and 8.12.6.

3) Because it is not clear how many condemned PCs before 2000 belong to Hanoi -Ho Chi Minh Line, number of condemned PCs is proportionally allotted for Hanoi -Ho Chi Minh Line use and for northern other lines use as shown in Table 8.12.13. Anyway, PCs of Union 2 and Union 3 belong to Hanoi -Ho Chi Minh Line use.

4) As conclusion, existing PCs (1000mm) of all VNR in 2000 are shown in Table 8.12.14.

(3) Wagon (FC) (Tables 8.12.3, 8.12.5, 8.12.6, 8.12.15, 8.12.16 and 8.12.17)

1) Calculation is made assuming that FCs manufactured before 1970 will be condemned in 2000.

2) Table 8.12.15 shows the list of FC to calculate existing number in 2000 for Hanoi - Ho Chi Minh Line and for northern other lines resulted from Tables 8.12.3, 8.12.5 and 8.12.6.

3) Because it is not clear how many condemned FCs before 2000 belong to Hanoi - Ho Chi Minh Line, number of condemned FCs is proportionally allotted for Hanoi - Ho Chi Minh Line use and for northern other lines use as shown in Table 8.12.16. Anyway, FCs of Union 2 and Union 3 belong to Hanoi - Ho Chi Minh Line use.

4) As conclusion, existing FCs (1000mm) of all VNR in 2000 are shown in Table 8.12.17.

8.12.6 Rolling Stock Plan upto 2000

(1) Preconditions

1) Existing SLs are condemned before 2000

2) New locomotives will be D12E and D18E types in view of locomotive standardization. As for standard locomotive of 1500CV class, DEL for new high speed train with output of 1450CV is recommended as mentioned later.

3) Existing D11H (10 locomotives), D12E (40 locomotives), D13E (14 locomotives) and D18E (16 locomotives) will be rehabilitated when their age reaches 15 to 20 years old. Namely, D11H should be rehabilitated before 2000.

4) 28 D9Es will be used for local passenger trains substituting for D12Es.

5) D11H and D13E will be utilized as equivalent to D12E class.

6) D4H will be used for light weight local passenger trains substituting for D12Es.

7) PCs for Hanoi - Ho Chi Minh Line and Hanoi - Lao Cai Line are together examined. As for short PCs, first class and second class sleeping cars with air-conditioner for Hanoi - Ho Chi Minh Line take priority of new manufacturing.

8) Dining car (HC), baggage car (HL) and post car (BV) are treated as service car (S), and one service car is connected to each train.

9) Passenger train configuration is assumed as follows.

Limited Express (New high speed train):	DEL+2×A_N+3×B_N+2×A+2×B+1×S+DEL
Limited Express:	DL+1×A_N+3×B_N+2×A+2×B+1×S
Express (Middle distance):	DL+1×A_N+3×B_N+1×A+3×B+1×S
Express (Short distance):	DL+1×A+4×B+1×S
Local:	DL+(2 to 4)×(B and/or C)+1×S

10) Rescue car

It is said that VNR has to purchase as soon as possible 2 or 3 rescue cars. However, it is clarified that the price of rescue car hauled by locomotive, with capacity of 100 to 120 tons, is too high

(may be, more than US8×10^6 per car). Therefore, the investment cost of rescue car is not included in the Draft Final Report. Only the above comment is stated as reference.

(2) Rolling Stock Plan up to 2000

The detail is described in the Clause 9.19 of this Volume. In conclusion, the following table shows rolling stock plan upto 2000 along with investment cost.

(Million US$)

		Unit Price		Number	Price		Total
		F	D		F	D	
New high speed train (5 trains)	DEL	1.5		10	15		15.0
	PC	0.08	0.12	50	4.0	6.0	10.0
D18E (New)		1.5		33	49.5		49.5
D12E (New)		0.98		16	15.7		15.7
PC (New) (Air-conditioned)		0.08	0.12	32	2.6	3.8	6.4
FC (New)			0.032	661		21.2	21.2
D11H (Rehabilitation)		0.44	0.24	10	4.4	2.4	6.8
PC (Remodelling)		0.33	0.08	20	6.6	1.6	8.2
Total					97.8	35.0	132.8

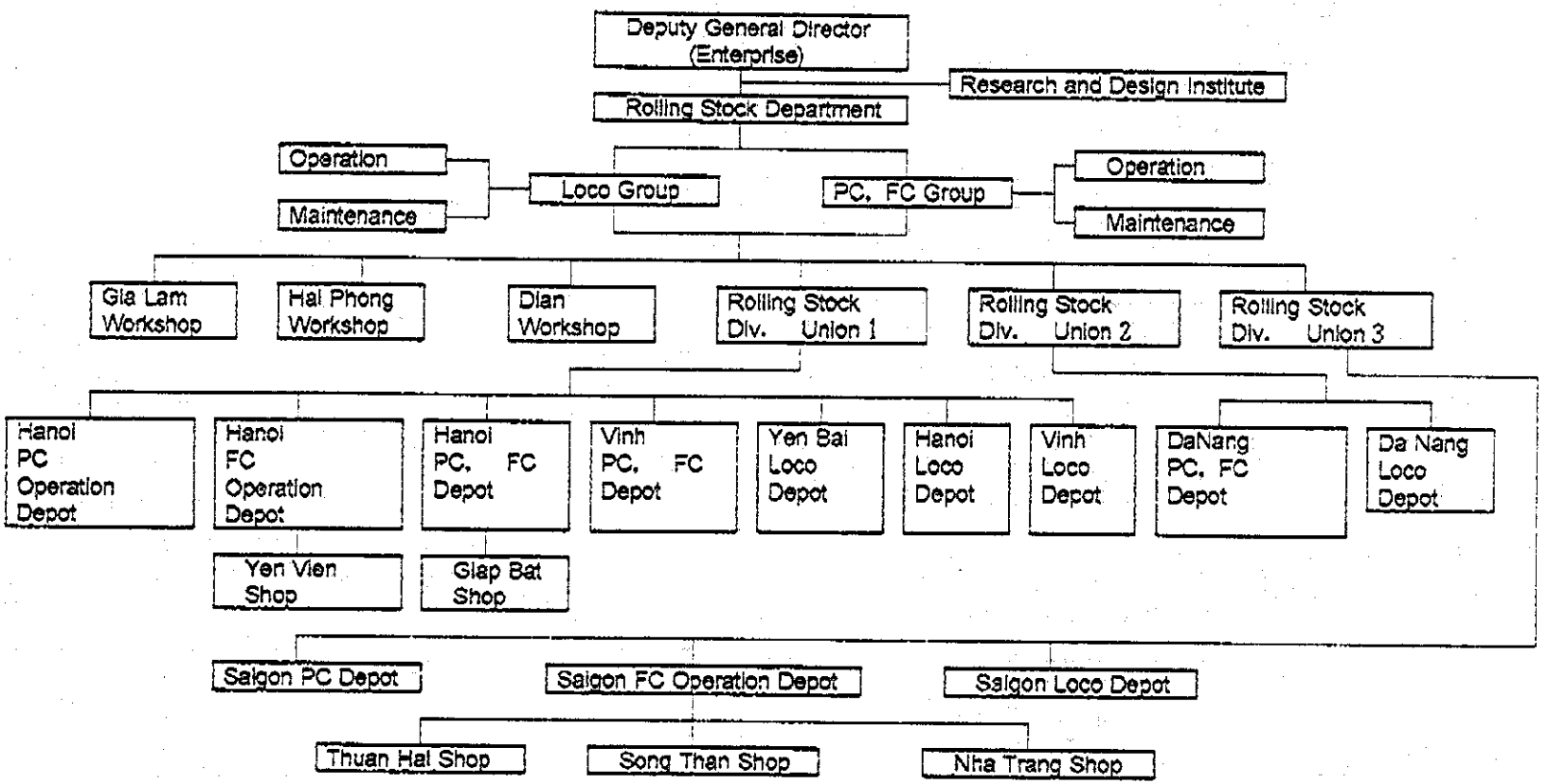


Fig. 8.12.1 Organization Chart of Rolling Stock Concerned (Revised: Aug. 1995)

Table 8.12.1 **Locomotive (1993)**

(Revised : Aug.1995)

Loco	Wheel Arrangemen	Total Weight (t)	Axle Weight (t)	Output (CV)	Max. Speed (km/h)	Max. Tractive Effort(kg)	Yen Bai					Hanoi					Vinh					Union 1 Total				
							1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
SL (1000)	131, 141 231	50.05~63	10.5	750~1100	67~79	8000~14000	33	11	0	4	18	58	32	13	18	8						91	43	13	22	26
SL (1435)	141	79.3	13.2	1780	80	19,400						17	7	2	6	4						17	7	2	6	4
D4H	Bo—Bo	24	6	400	50/70	7.200	68	65	36	3	0	55	42	22	13	0	46	31	17	15	0	169	138	75	31	0
D5H	B—B	40.64	10.16	500	65	9,964	3	3	2	0	0											3	3	2	0	0
D11H	Bo—Bo	56	14	1100	100	16.200																				
D8H(1435)	Bo—Bo	78	19.5	800	90	21.000						5	3	3	2	0						5	3	3	2	0
D9E	Bo—Bo	52	13	900	114	15,600																				
D12E	Bo—Bo	56	14	1200	80	14,600						15	15	9	0	0						15	15	9	0	0
D13E	Co—Co	72	12	1350	96	21,600																				
D18E	Co—Co	84	14	1800	105	25.500											16	16	9	0	0	16	16	9	0	0

Loco	Usability 2 / 1	Operativity 3 / 1		Manufact. Country	Year of Manufacture	Age (Dec.1993)	Da Nang					Saigon					Enterprise					Grand Total				
							1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
SL (1000)	0.47	0.14		JPN.FRC, VIETNAM																		91	43	13	22	26
SL (1435)	0.41	0.12		CHINA																		17	7	2	6	4
D4H	0.73	0.36		RUSSIA	1985-1989 1981	4~8 (161) 12 (87)	57	32	14	23	2	4	4	1	0	0	18	7		11	0	248	181	90	65	2
D5H	1.00	0.67		AUSTRALIA	1966-1970	23~27																3	3	2	0	0
D11H	0.20	0.10		RUMANIA	1978	15	9	2	1	7	0	1	0	0	1	0						10	2	1	8	0
D8H(1435)	0.60	0.60		RUSSIA	1986	7																5	3	3	2	0
D9E	0.74	0.49		USA	1983	30						39	29	19	0	10						39	29	19	0	10
D12E	1.00	0.68		CZEKO	1985	8	25	25	18	0	0											40	40	27	0	0
D13E	0.80	0.33		INDIA	1985	8						15	12	5	2	1						15	12	5	2	1
D18E	1.00	0.56		BELGIE	1983	10																16	16	9	0	0

REMARKS : 1 on Book, 2 Usable, 3 Normal Use, 4 Waiting Repair, 5 Waiting Condemnation

Table 8.12.2 Number of Locomotives by Situation in Dec. 1993 and Dec. 1994

Locomotive	Depot	Yen Bai				Hanoi				Vinh				Da Nang				Saigon				Enterprise				Total			
	Year	1	2	4	5	1	2	4	5	1	2	4	5	1	2	4	5	1	2	4	5	1	2	4	5	1	2	4	5
SL (1,000)	1993	33	11	4	18	58	32	18	8																	91	43	22	26
	1994	10	10	0	0	43	16	3	24																	53	26	3	24
SL (1,435)	1993					17	7	6	4																	17	7	6	4
	1994					13	7	3	3																	13	7	3	3
D4H	1993	68	65	3	0	55	42	13	0	46	31	15	0	57	32	23	2	4	4	0	0	18	7	11	0	248	181	65	2
	1994	80	78	0	2	54	44	0	10	31	31	0	0	57	33	0	24	4	4	0	0	-	-	-	-	226	190	0	36
D5H	1993	3	3	0	0																					3	3	0	0
	1994	3	3	0	0																					3	3	0	0
D11H	1993													9	2	7	0	1	0	1	0					10	2	8	0
	1994													9	2	7	0	1	0	1	0					10	2	8	0
D8H (1,435)	1993					5	3	2	0																	5	3	2	0
	1994					5	3	2	0																	5	3	2	0
D9E	1993																	39	29	0	10					39	29	0	10
	1994																	39	28	1	10					39	28	1	10
D12E	1993					15	15	0	0					25	25	0	0									40	40	0	0
	1994					15	15	0	0					25	25	0	0									40	40	0	0
D13E	1993																	15	12	2	1					15	12	2	1
	1994																	15	12	2	1					15	12	2	1
D18E	1993									16	16	0	0													16	16	0	0
	1994									16	16	0	0													16	16	0	0

1. On Book 2. Usable 4. Waiting Repair 5. Waiting Condemnation

Table 8.12.3 No. on Book of PC and FC(1000mm) Dec. 31, 93)

Revised : Aug. 1995

	TOTAL	UNION 1						UNION 2						UNION 3						Total	Assumption	
	Dec.31, 92	R	P	TOTAL	D	I	Dec.93	R	P	TOTAL	D	I	Dec.93	R	P	TOTAL	D	I	Dec.93	Dec.31, 93	R	P
PC (1000) TOTAL	748	242	205	447	58	17	406	52	64	116	3	12	125	179	42	221	22	23	222	753	504	249
Sleeping (1st)	48	23		23	2	1	22	4		4			4	21		21			21	47	47	0
Sleeping (2nd)	66	34		34		5	39	2	1	3			3	29		29		3	32	74	73	1
Coach (1st)	68	33		33		8	41	6		6			6	29		29		11	40	87	87	0
Coach (2nd)	287	109	64	173	24		149	29	2	31	1	5	35	69	14	83	16		67	251	210	41
Coach (3rd)	251	11	138	149	26		123	9	58	67	1	1	67	6	29	35	1		34	224	27	197
Dining	25	13		13	2	2	13	2		2	1	6	7	10		10	4	2	8	28	28	0
Baggage	12	3		3	2	1	2	2	1	3			3	3	3	6		7	13	18	14	4
Post	27	11	8	19	2		17							8		8	1		7	24	18	6
Wagon (1000) TOTAL	4,466	1546	1617	3163	238	2	2927	297	409	706	13	1	694	322	275	597	18		579	4,200	2168	2032
Covered	1,505	517	260	777	9		768	220	142	362	3		359	228	138	366	5		361	1,488	965	523
Open (High Side)	1,680	869	585	1475	147		1307	47	77	124	2		122	57	45	102	5		97	1,526	973	553
Open (Low Side)	389	47	249	296	6		290	13	57	70	3		67	2	21	23			23	380	62	318
Open (Flat)	526	67	275	342	64		278	14	117	131	1		130	7	46	53	4		49	457	88	369
Open (High Capacity)	27		25	25	1		24								2	2			2	26	0	26
Tank	213	30	144	174	5		169	3	7	10			10	17	12	29	2		27	206	50	156
Conductor	126	16	79	95	6	2	91		9	9	4	1	6	11	11	22	2		20	117	30	87

[Remarks]

R : Roller Bearing
P : Plane Bearing
D : Decrease (Condemnation or to Another Union)
I : Increase (from Another Union or New Manufacturing)
Assumption : Number of cars of R and P is assumed in decrease of P and increase of R.

Table 8.12.4 PC by Manufacturing Year (1000㎜) (Dec.31, 1993) (Revised : Aug.1995)

Kind / Year / Mfg. Country	R	P	R	P	R										Total	
	Before1970		1971		1978	1979	1980	1984	1986	1987	1988	1991	1992	1993 1994		
A※ (First class sleeping car)																
TQ (China)																
Ru (Rumania)					11										11	
AN (India)																
VN (VietNam)									10		2	7	4	4	27	
FAP(France)	9														9	
S. Total	9				11				10		2	7	4	4	47	47R+0P
B※ (Second class sleeping car)																
TQ																
Ru					31		4								35	
AN																
VN					3	3	3	2		7	13	5			36	
FAP	2	1													3	
S. Total	2	1			34	3	7	2		7	13	5			74	73R+1P
A (First class coach)																
TQ																
Ru						54									54	
AN							21								21	
VN											12				12	
FAP																
S. Total						54	21				12				87	87R+0P
B (Second class coach)																
TQ			60	31											91	
Ru					52										52	
AN							25								25	
VN		3		7	18						30				58	
FAP	25														25	
S. Total	25	3	60	38	70		25				30				251	210R+41P
C (Third class Coach)																
TQ			6	90											96	
Ru																
AN															65	
VN	15	50														
FAP	6	57													63	
S. Total	21	107	6	90											224	27R+197P
HC (Dining car)																
TQ																
Ru						8									8	
AN							4								4	
VN										10				1	11	
FAP	2					3									5	
S. Total	2					11	4			10				1	28	28R+0P
BL (Baggage car)																
TQ			5												5	
VN				4					9						13	
S. Total			5	4					9						18	14R+4P
BV (Mail car)																
VN		6			18										24	
S. Total		6			18										24	18R+6P
Total	59	117	71	132	133	68	57	2	19	17	57	12	4	5	753	504R+249P

Table 8.12.5 FC by Manufacturing Year (1000㎜)

(Dec.31,1993)
(Revised : Aug.1995)

Kind \ Year	R	P	P	P	P	R											
Kind	Before 1970		1971	1972 ~74	1975	1978	1979	1980	1984	1986	1987	1988	1991	1992	1993		
G Covered	190	100		300	123	175	210	300				15		75		1488	965R+523
H Open (High Sid)	107	100	103	250	100	235	100	380	151							1526	973R+553
V Open (Low Side)	62	318														380	62R+318P
M Open (Flat)	88	254			115											457	88R+369P
MVT Open (Hi-Capacity		26														26	0R+26P
P Tank	35	141		15					15							206	50R+156P
XT Conductor		20	10	42				3		21	6	15* (Plain Bearing)				117	30R+87P
TOTAL	482	959	113	607	338	410	310	683	166	21	6	30		75		4200	2168R +2032P

[Remarks] (1) Manufacturing countries
Most of all : China, Rumania, India
Few : Viet Nam, USA, France, Japan, Belgium, Russia

(2) R : Roller bearing
P : Plain bearing

Table 8.12.6 Classification of PC and FC of Union 1
for Hanoi-Ho Chi Minh Line and Northern Other Lines (1000mm)

(Dec. 31, 1993)

	Grand Total	Total		HN-HCM Line		Northern Other Lines		Remarks	
		R	P	R	P	R	P		
PC(1000) Sub. Total	406	248	158	180	40	68	118		
AN :1st Sleeping	22	22		16		6			
BN: 2nd Sleeping	39	39		30		9			
A : 1st Coach	41	41		33		8			
B : 2nd Coach	149	108	41	69	10	39	31		
C: 3rd Coach	123	11	112	5	30	6	82		
HC: Dining	13	13		13					
HL: Baggage	2	2		2					
BV : Post	17	11	6	11			6		
FC(1000) Sub. Total	2927	1548	1379	840	415	708	964		
G : Covered	768	517	251	330	100	187	151		
H : High Side	1307	869	438	430	120	439	318		
N : Low Side	290	47	243	15	80	32	163		
M : Flat	278	67	211	17	60	50	151		
MVT: Open High Capasity	24		24		5		19		
P: Tank	169	30	139	30	27		112		
XT: Conductor	91	18	73	18	23		50		

R: Roller Bearing

P: Plane Bearing

Table 8.12.7 Cause-wise Ineffectivity of DHLs

	1993			1994		
	D4H	D11H	D8H	D4H	D11	D8H
Depot	Yen Bai	Da Nang	Hanoi	Yen Bai	Da Nang	Hanoi
No. on Book	65	2		65	2	
Regular maintenance	3131	332		3133	286	
Damaged by accident						
Rehabilitation						
Waiting space parts	71			80		
Engine						
Torque converter						
Compressor set						
Radiator fan set						
Another important cause, if any						
Others						
Ineffectivity (%)	13.5	45.5		13.5	39.2	

(1) Example of ineffectivity (D12E)

Number on book : 40

Cause-wise ineffective days per year of each D12E : α

Cause-wise ineffectivity of D12E : $\sum_{1}^{40} \alpha / (40 \times 365)$

(2) No. on Book of D4H

1993 : Exclude " Waiting condemnation"

1994 : Exclude "Waiting condemnation" and D4H transfered from Vinh Loco. Dept.

(3) No. on Book of D11H is the number of available locos.

Table 8.12. 8 Cause-wise Ineffectivity of DELs

	1993				1994			
	D9E	D12E	D13E	D18E	D9E	D12E	D13E	D18E
Depot	Saigon	Da Nang	Saigon	Vinh	Saigon	Da Nang	Saigon	Vinh
No. on Book	29	25	14	16	29	25	14	16
Regular maintenance	3568	1150	2440	1321	2518	1175	2511	1290
Damaged by accident	66		30	2			35	1
Rehabilitation								
Waiting space parts								
Engine-Generator set								
Engine	393	100	26	2	310	75	15	4
Generator								1
Traction motor	35			10	22	150	10	12
Compressor set	70		20	5	48		10	6
Radiator fan set	22		10	3	15		25	5
Another important cause, if any	350		36	4	316		90	5
Others		275				400		
Ineffectivity (%)	42.6	16.7	50.1	23.1	30.5	19.7	52.8	22.7

(1) Example of ineffectivity (D12E)

Number on book : 40

Cause-wise ineffective days per year of each D12E : α

Cause-wise ineffectivity of D12E : $\sum_{1}^{40} \alpha / (40 \times 365)$

(2) No. on Book of D9E and D13E:

Exclude " Waiting condemnation"

Table 8.12.9 Declining Tendency of D4H

Year	Yen Bai				Vinh				Da Nang				Total			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
1981																
82									2	2			2	2		
83									24	20	4		24	20	4	
84									27	23	4		27	23	4	
85					44	35	5	4	32	28	4		76	63	9	4
86					48	38	6	4	36	32	4		84	70	10	4
87	20	20			48	34	8	6	51	44	7		119	98	15	6
88	46	45		1	44	37	5	2	56	44	12		146	126	17	3
89	57	56		1	42	36	5	1	57	40	3	14	156	132	8	16
90	67	66		1	42	36	5	1	57	35	8	14	166	137	13	16
91	67	66		1	46	38	7	1	57	33	10	14	170	137	17	16
92	67	66		1	46	38	7	1	57	33	10	14	170	137	17	16
93	67	65		2	45	37	8	0	57	33	10	14	169	135	18	16
94	80	78		2	31	26	5	0	57	33	0	24	168	137	5	26

Remarks : 1. Number on Book

2. Available Number

3. Number of Waiting Repair

4. Number of Waiting Condemnation

Table 8.12.10 Declining Tendency D9E (Saigon Loco. Depot)

Year	No. on Book	Available Number	Waiting Repair	Waiting Codemnaiton	Remarks
1985	46	38		8	
1990	39	29		10	
1993	39	29		10	
1994	39	28		11	

Table 8.12.11 Number of New Production Capability of PC and FC with and without Execution of Regular Overhaul in Workshops

		With	Without
Gia Lam*1	PC	15(OH 80)	30
	FC	50(OH 255)	80
Hai Phong	PC	10	15
	FC	60	80
Dian* 2	PC	50(OH 300)	250～300
	FC		300

* 1 Gia Lam Workshop was constructed in the plan capable to newly manufacuture 100 PCs and 1000FCs per year along with execution of 600PCs and FCs overhaul by 5500 personnel. Actual number of personnel is only 640.

* 2 As for Dian Workshop, if new manufacturing line of PC and FC is installed, 400 ～ 500 PCs and 1000FCs could be manufactured per year without execution of their overhaul.

Table 8.12.12 List of PC to Calculate Existing Number in 2000 (1000mm) (Dec. 31, 1993)

	Union 1						Union 2 and Union 3		Total		Condemnation before 2000		
	HN-HCM Line		Northen Other Lines		Subtotal								
	R	P	R	P	R	P	R	P	R	P	R	P	Total
An : 1st Sleeping	16	0	6	0	22	0	25	0	47	0	9	0	9
Bn : 2nd Sleeping	30	0	9	0	39	0	34	1	73	1	2	1	3
A : 1st Coach	33	0	8	0	41	0	46	0	87	0	0	0	0
B : 2nd Coach	69	10	39	31	108	41	102	0	210	41	25	3	28
C : 3rd Coach	5	30	6	82	11	112	15	86	26	198	21	107	128
HC : Dining	13	0	0	0	13	0	15	0	28	0	2	0	2
HL : Baggage	2	0	0	0	2	0	12	4	14	4	0	0	0
BV: Post	11	0	0	6	11	6	7	0	18	6	0	6	6

R : Roller bearing

P : Plane bearing

Table 8. 12. 13 Number of PCs to be Condemned in or before 2000 (1000mm)

	HN-HCM Line	Northern Other Lines	Remarks
AN	9× (16+25) /47 ··· · 8	9×6/47 · · · · · 1	Roller
BN	2× (30+34) /73 ···· 2	2×9/73 · · · · · 0	Roller
	1	0	Plane
A	0	0	R and P
B	25× (69+102) /210··· 20	25×39/210 · · · 5	Roller
	3×10/41 · · · · · 1	3×31/41 · · · · 2	Plane
C	21×(5+15) /26 · · · · 16	21× 6/26 · · · 5	Roller
	107× (30+86) /198 · · 63	107×82/198 · · · 44	Plane
HC	2	0	Roller
HL	0	0	R and P
BV	0	6	Plane

Table 8.12.14 Existing PCs in 2000 (1000mm)

	HN-HCM Line			Northern Other Lines			Grand Total
	R	P	Total	R	P	Total	
AN	33	0	33	5	0	5	38
BN	62	0	62	9	0	9	71
A	79	0	79	8	0	8	87
B	151	9	160	34	29	63	223
C	4	53	57	1	38	39	96
HC	26	0	26	0	0	0	26
HL	14	4	18	0	0	0	18
BV	18	0	18	0	0	0	18
Total	387	66	453	57	67	124	577

Table 8.12.15 List of FC to Calculate Existing Number in 2000(1000mm) (Dec. 31, 1993)

	Union 1						Union 2 and Union 3		Total		Condemnation before 2000		
	HN-HCM Line		Northern Other Lines		Sub total								
	R	P	R	P	R	P	R	P	R	P	R	P	Total
G : Covered	330	100	187	151	517	251	448	272	965	523	190	100	290
H: High Side	430	120	439	318	869	438	104	115	973	553	107	100	207
V: Low Side	15	80	32	163	47	243	15	75	62	318	62	318	380
M: Flat	17	60	50	151	67	211	21	158	88	369	88	254	342
MVT: High Capacity	0	5	0	19	0	24	0	2	0	26	0	26	26
P: Tank	30	27	0	112	30	139	20	17	50	156	35	141	176
XT: Conductor	18	23	0	50	18	73	12	14	30	87	0	20	20

R : Roller bearing

P : Plane bearing

Table 8.12.16 Number of FCs to be Condemned in or before 2000

	HN-HCM Line	Northern Other Lines	Remarks
G	190×(330+448)/965·····153	190×187/965·····37	Roller
	100×(100+272)/523·····71	100×151/523·····29	Plane
H	107×(430+104)/973·····59	107×439/973·····48	Roller
	100×(120+115)/553·····42	100×318/553·····58	Plane
V	30	32	Roller
	155	163	Plane
M	38	50	Roller
	254×(60+158)/369·····150	254×151/369·····104	Plane
MUT	0	0	Roller
	7	19	Plane
P	35×(30+20)/50·····35	35×0/50·····0	Roller
	141×(27+17)/156·····40	141×112/156·····101	Plane
XT	0	0	Roller
	20×(23+14)/87·····9	20×50/87·····11	Plane

Table 8. 12. 17 Existing FCs in 2000 (1000mm)

	HN - HCM Line			Northern Other Lines			Grand Total
	R	P	Total	R	P	Total	
G	625	301	926	150	122	272	1198
H	475	193	668	391	260	651	1319
V	0	0	0	0	0	0	0
M	0	68	68	0	47	47	115
MVT	0	0	0	0	0	0	0
P	15	4	19	0	11	11	30
XT	30	28	58	0	39	39	97
Total	1145	594	1739	541	479	1020	2759