THE REPUBLIC OF VIETNAM

REPORT ON STUDY
FOR
RAILWAY RECONSTRUCTION

JULY 1974

OVERSEAS TECHNICAL COOPERATION AGENCY
JAPAN

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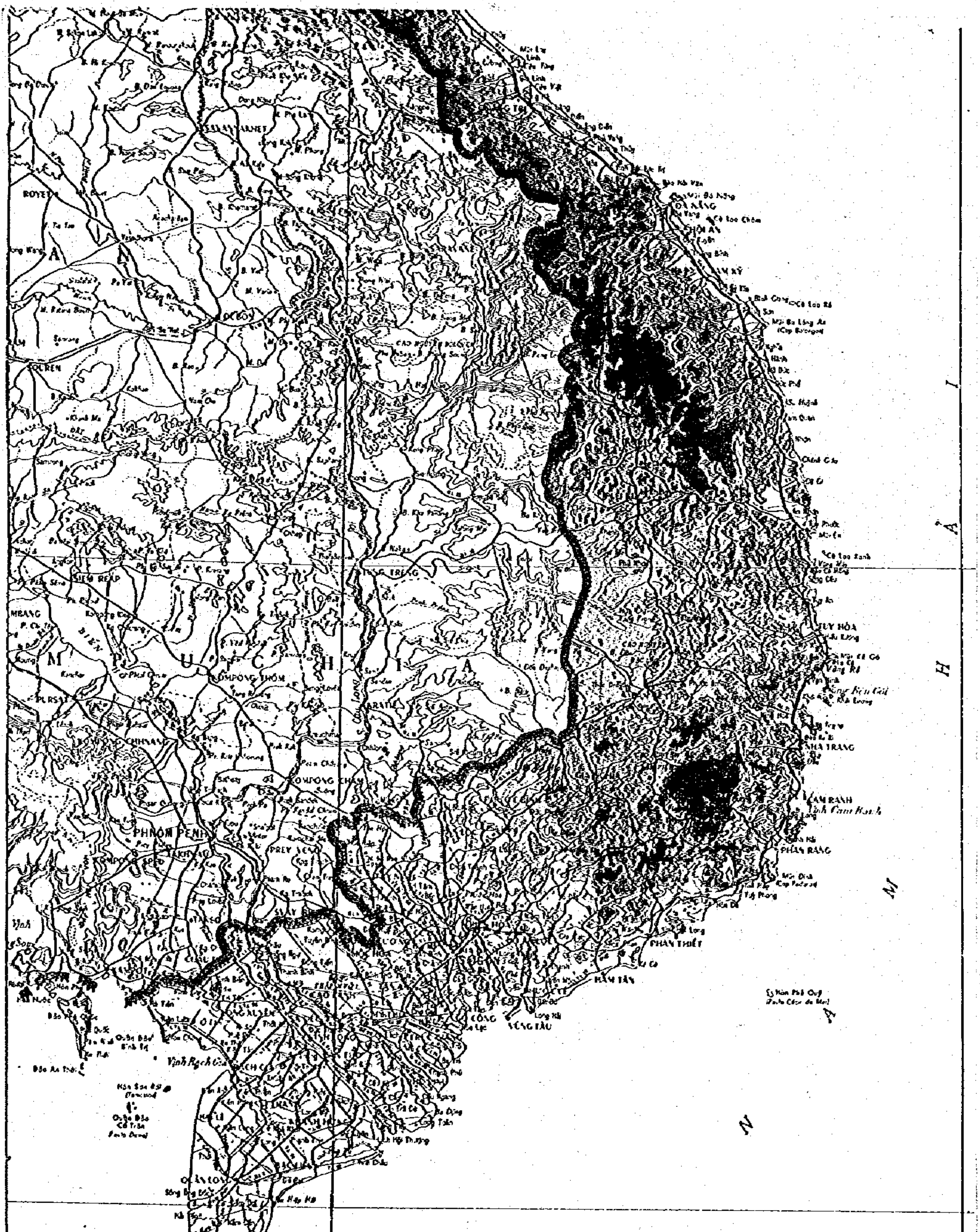

PHNOM PENH
KOMPONG THOM
KOMPONG CHAM
SIEM REAP
PURSAT
M P U C H I A
HỘI AN
TUY HÒA
NHA TRANG
CAM RANH
Vịnh Cam Ranh
PHAN RANG
PHAN THIẾT
HÀM TÂN
VŨNG TÀU
Vịnh Rạch Giá
Đảo Côn Sơn
Mũi Cà Mau
N A M H A I

PREFACE

The Government of Japan, in response to the request of the Republic of Viet-Nam Government, decided to cooperate in conducting a survey on the Viet-Nam Railway reconstruction plan, and entrusted the execution of the survey to the Overseas Technical Cooperation Agency.

In view of the importance of this plan, the Agency organized and despatched a survey team of eight members, headed by Mr. Tetuji Akaiwa, Director of the Rolling-stock Industry Division, Railways Supervision Bureau of the Ministry of Transport. The field research required for the reconstruction plan was carried out by the team during a 35-day period beginning from October 4, 1973.

This report is a compilation of the survey results. We would be most delighted if this report could contribute to the Public welfare, stability and economic development of Viet-Nam, as well as to the friendly relations between Japan and Viet-Nam.

We gratefully acknowledge the valuable assistance and cooperation of the Viet-Nam governmental organizations concerned, and of the Viet-Nam Railway System. We also wish to express our appreciation to the staff of the Japanese Embassy in Viet-Nam for their cooperation in the execution of the field research, and to the Ministry of Foreign Affairs, Ministry of Transport, and Japanese National Railways for assistance in providing delegates for the survey team.

July, 1974

Keiichi Tazuke
Director-General
Overseas Technical Cooperation Agency

Transport.

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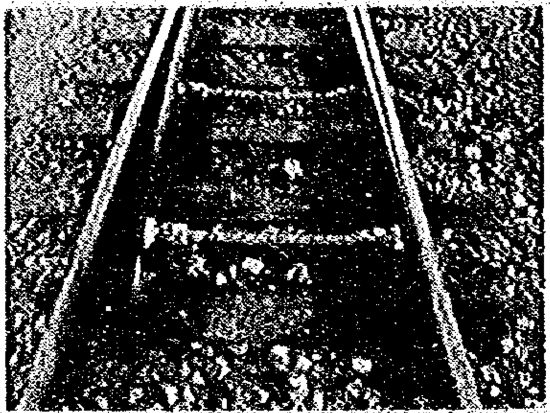
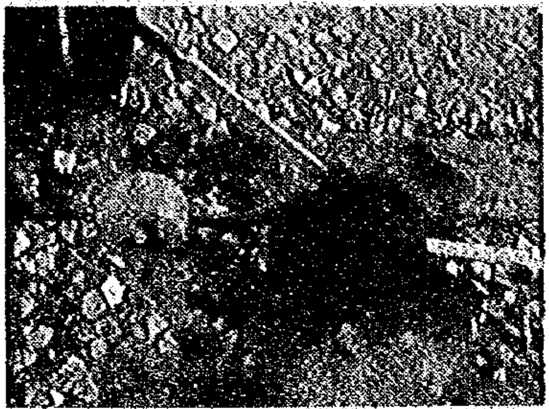


Switch in the small station between Da-Nang and Hue

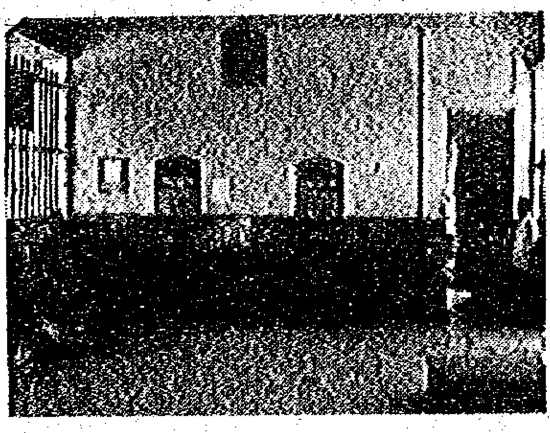


Switching system at the left picture. It is no use for high speed operating and a big locomotive

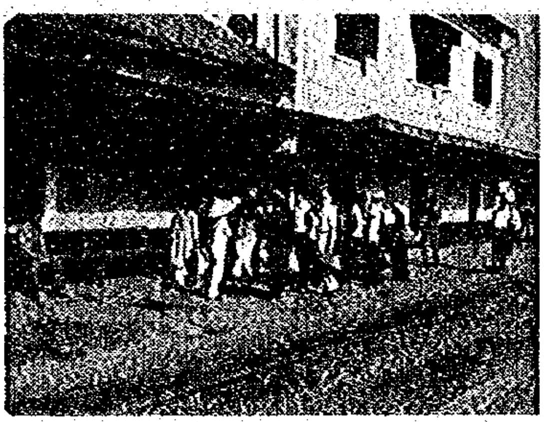
Bridge for road and railway near Thap-Cham station

Brocken bridge between Da-Nang and Baren

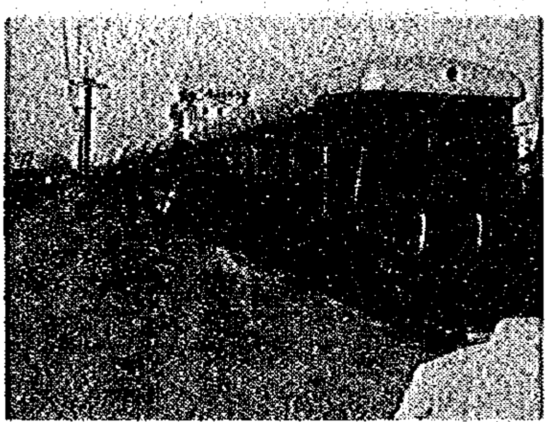
Railroad in the Saigon



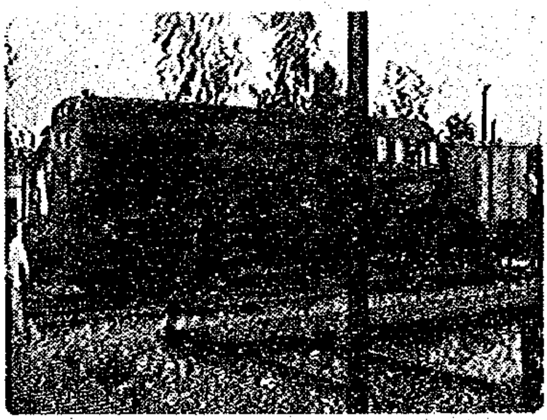
The room in the Tap-Cham station



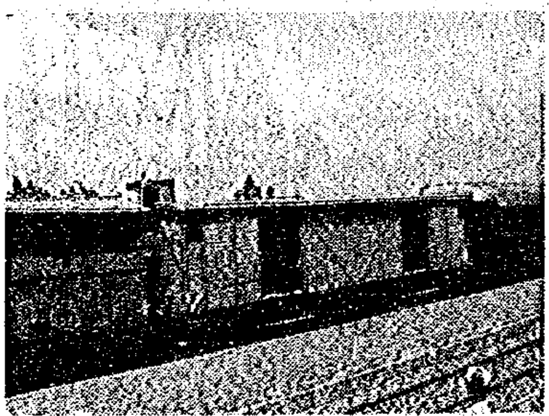
Passenger going to the exit at the Bien-Hoa station



The train at the Saigon station



The BB-900 DL at the Qui-Nhon station



The rolling stocks at the Thap-Cham station

SUMMARY

SUMMARY

The railway between Saigon and Hanoi, on which the present Viet-Nam railway is based, was completed in 1936 after more than thirty years of effort by France. However, since that time this railway has been extensively devastated or unused due to World War II (which broke out shortly after its completion) and frequent postwar strife. Several sections have no trace of track at all, particularly between Phu-Cat and Da-Nang.

Viet-Nam Railway System authorities announced a reconstruction and modernization plan immediately after the cease-fire agreement with North Viet-Nam in February, 1973. Under this plan, temporary reconstruction is to be completed during 1974 except in extremely damaged sections, while reconstruction of the entire line is to be executed during a five-year period beginning in 1975, the objective being attainment of maximum operating speeds of 70 km per hour. Moreover, after 1980 modernization is to be carried out to achieve maximum operating speeds of 120 km per hour.

As of 1973, temporary reconstruction had already been completed on the 1,041 km of trunk line between Saigon and Hue, except for 279 km between Phu-Cat and Da-Nang and about 100 km between Gia-Ray and Malam. (However, due to threats from the Viet Cong not all of the repaired sections are in use.) By June, 1974, all temporary work is to be completed except for the Phu-Cat/Da-Nang section.

The present domestic transportation, this being the means least treatened by guerillas. 95% of the passenger transport depends on buses, and 85% of the freight transport on trucks. The present Viet-Nam railway cannot compete with bus and truck transportation in terms of speed and safety. However, when the political stability of the Viet-Nam Government is realized, the threats from the Viet Cong removed, and high speed railway transportation secured, it is presumed that a considerable volume of bus as well as truck transportation will be replaced by railway transportation, particularly in view of the recent worsening oil situation.

One of the significant factors behind the reconstruction and modernization of the Viet-Nam railway is the national desire that this long-devastated railway should be improved to the same degree as those of such neighboring countries as Thailand and Malaysia. Another important factor is to make this railway a part of the Trans Asian railway network envisioned in a proposal by ECAFE. Moreover, it is expected that when economic exchange with the present North Viet-Nam is initiated, link-up with the railways of that area will make this railway an artery of commodity traffic between South and North Viet-Nam, thus increasing the significance of reconstruction and modernization.

In the Viet-Nam Railway System's reconstruction and modernization plan, no target year has been set by which the maximum operating speed of 120 km per hour is to be achieved. A ten-year construction period is projected for the 1,041 km of track between Saigon and Hue. To attain a maximum operating speed of 95 km per hour (as prevails in neighboring countries), the required cost is estimated to be approximately US$328 million (1 dollar = 280 yen = 560 piasters).

For the extremely damaged section between Phu-Cat and Da-Nang, bridges and road beds should be reconstructed under a ten-year plan designed from the beginning for eventual use at the maximum operating speed of 120 km per hour. For the other track sections in which temporary work has been completed, bridge and road bed reconstruction plans should be designed for use at the maximum

operating speed of 95 km per hour. While the ten-year construction period is underway, the temporary strengthening of track and the use of passenger cars now maintained by the Viet-Nam Railway System will make possible a maximum operating speed of 65 km per hour in local sections.

To advance this reconstruction and modernization plan, it is indispensably necessary to improve technical standards by training technical experts and personnel, and to enhance the administrative and management capabilities of the Viet-Nam Railway System.

1. OUTLINE OF SURVEY

1. OUTLINE OF SURVEY

1-1. Purpose of Survey

In February, 1972, when the cease-fire agreement with North Viet-Nam was brought about, the Viet-Nam Railway System Authorities worked out a reconstruction and modernization plan costing US$120 million and covering the whole of Viet-Nam's railways that have been devastated by prolonged war. While the System has carried out emergency reconstruction work by itself during constant skirmishes with the Viet-Cong, the Authorities asked Japan (which enjoys a worldwide reputation for its high railway engineering standards) to survey the technical and economic propriety of the plan, which is expected to start in 1975.

1-2. Scope of the Survey

The scope of survey was confined to the 1,041 km of trunk line between Saigon and Hue. This scope was determined on the grounds that in a period of a month or so, detailed survey is usually limited to about 200 km, necessitating the utmost possible reduction of the range, and that it was difficult to survey north of Hue and branch lines where threats by the Viet Cong still remained.

1-3. Survey Content

Based on the results of the survey between Saigon and Hue, technical advice was given in such fields as raod beds, bridges, rolling-stock, and signals and telecommunication facilities, along with estimation of cost required.

1-4. Member List of Survey Mission and Schedule

Head	Teruji Akaiwa	Director, Rolling-stock Industry Division, Railways Supervision Bureau, Ministry of Transport
Transportation Economics	Isao Sato	International Cooperation Office, Policy Division, Minister's Secretariat to the Minister, Ministry of Transport
Signal and Telecommunication	Itsuo Matsuda	Deputy Director, Engineering and Electricity Division, Private Railway Department, Railways Supervision Bureau, Ministry of Transport
Civil Engineering (Construction)	Koji Nozaki	Struction Division, Track and Struction Department, Japanese National Railways
Civil Engineering (Track)	Yoshio Kobori	Administration, Division, Track and Construction Department, Japanese National Railways
Operation	Yukio Yoda	Safety Division, Train Operation Department, Japanese National Railways
Rolling stock, Work Shop	Toshio Fujimaki	Rolling-stock Planning Division, Mechanical Engineering Department, Japanese National Railways.
Coordinator	Kiyotaka Nakano	Osaka International Training Center, Overseas Technical Cooperation Agency

Survey Schedule

The survey mission left Tokyo in the morning of October 4, 1973, and arrived in Saigon in the afternoon via Hong Kong. The mission stayed in the Republic of Viet-Nam for about five weeks for talks with the persons concerned and for collection of data. This period included six days for the surveys around Da-Nang and Hue and five days around Nha-Trang, Qui-Nhon and Da-Lat. After the survey there, the mission left Saigon on November 6 and returend to Tokyo on November 7, via Hong Kong.

Major visits and surveys performed by the mission are outlined below:

Date		Items
October 4	(Thurs.)	Arrival in Saigon
5	(Fri.)	Visit to Embassy of Japan Courtesy Visit to Minister of Transportation and Telecommunications; Schedule arrangement
6	(Sat.)	Courtesy Visit to Minister of Plans and Development Collection of data at VNRS
7	(Sun.)	Review of data
8	(Mon.)	Collection of data at VNRS Dinner party by invitation of the Japanese Ambassador
9	(Tues.)	Courtesy Visit to Minister of Pbulic Works Review of data Collection of data at VNRS Cocktail party held by the director of VNRS
10	(Wed.)	Collection of data at VNRS Review of data
11	(Thurs.)	Trip to Da-Nang Visit to the commander of the First Army Division Detailed schedule arrangements at Da-Nang and Hue
12	(Fri.)	Survey around Da-Nang – Quang-Ngai – Sahuynh Survey at workshop in Da-Nang
13	(Sat.)	Survey around Da-Nang – Thualuu – Hue Survey between Hue and Quangtri
14	(Sun.)	Survey at Hue station Review of data
15	(Mon.)	Trip from Hue to Da-Nang
16	(Tues.)	Survey at Da-Nang station Survey at the Port of Da-Nang Trip from Da-Nang to Saigon
17	(Wed.)	Review of data Meeting and mutual discussion among mission members Collections of data at VNRS
18	(Thur.)	Trip to Nha-Trang Detailed schedule arrangements for Nha-Trang, Qui-Nhon Trap-Cham and Da-Lat Districts. Survey at the Nha-Trang workshop and Nha-Trang Station
19	(Fri.)	Trip from Nha-Trang to Qui-Nhon Survey around Nha-Trang – Vangia – Vanmy – Sahuynh.

Date			Items
			Survey at the Vanmy Workshop Survey at Qui-Nhon Station
October	20	(Sat.)	Trip from Qui-Nhon to Nha-Trang. Survey at Tuy-Hoa Station Survey at the Da-Nang railway bridge
	21	(Sun.)	Trip from Nha-Trang to Da-Lat Survey at the Port of Cam-Ranh, the industrial development area Thap-Cham Workshop and Ninh Thuan railway bridge
	22	(Mon.)	Trip from Da-Lat to Saigon
	23	(Tues.)	Collection of data at VNRS Survey at the Chihcoa workshop Survey on the construction site of the Cho Ray Hospital Review of data
	24	(Wed.)	Survey between Saigon and Bien-Hoa Survey at the Dian workshop Survey at the Port of Saigon Collection of data at VNRS
	25	(Thur.)	Collection of data at VNRS Arrangement of data
	26	(Fri.)	Survey at Tuy-Hoa work shop Survey at Dian work shop Survey of the level-crossing in Saigon Courtesy to Ex-minister for Communication and Post, (because of changing the Minister) Arrangement of data
	27	(Sat.)	Collection of data at VNRS Arrangement of data Discussion about the interim report among the members of the survey team
	28	(Sun.)	Arrangement of data
	29	(Mon.)	Collection of data at VNRS Arrangement of data
	30	(Tues.)	Visit Embassy of Japan Collection of data at VNRS Arrangement of data
	31	(Wed.)	Collection of data at VNRS Arrangement of data
November	1	(Thur.)	Survey between Saigon and Thap-Cham Arrangement of data
	2	(Fri.)	Presentation of the interim report to the Director of VNRS, and discussion Reception by the chief of the survey team
	3	(Sat.)	Courtesy to the Minister for Planning and Development Arrangement of data
	4	(Sun.)	Arrangement of data
	5	(Mon.)	Greeting of returning to Japan
	6	(Tues.)	Leave Saigon

2. PRESENT CONDITIONS OF THE REPUBLIC OF VIETNAM AND THE RECONSTRUCTION PLAN

2. PRESENT CONDITIONS OF THE REPUBLIC OF VIET-NAM AND THE RECONSTRUCTION PLAN

2-1. Present Conditions of the Economy

1) The Gross National Product

The Gross National Product of Viet-Nam amounted to VN$1,639.6 billion, with the per capital GNP being VN$58,793 in 1972. Of this agriculture comprises 30%, industry 11%, services 59%. The service sector comprises more than half of the whole, which is characteristic of a war economy. It is also notable that the industrial sector comprises a lower share than in the economies of other developing countries.

Table 2-1-1 Growth of the G.N.P. of Viet-Nam

(Unit: VN$ 1 billion)

Year	1965	1966	1967	1968	1069	1970	1971	1972
GNP	146.0	237.6	356.7	385.3	557.6	804.4	1,024.0	1,139.0

Table 2-1-2 Composition of the G.N.P. of Viet-Nam (1971)

Item	Shares
Total	100.0 %
Agriculture	30.0
Industry	11.0
Service	59.0

In the past 10 years, general private consumption has been about 80% of the G. N. P. and government consumption 21%. The total of the two has exceeded the G.N.P. in almost all years. This indicates the great excess of imports every year. At present more than half of the important excess is handled through reliance on foreign assistance.

Table 2-1-3 G.N.P. at Value for the Current Year

(Unit: VN$ 1 million)

Item	1962	1963	1964	1965	1966	1967	1968	1969	1970
Total G.N.P.	93,951	100,917	115,337	146,021	237,589	356,660	385,260	557,600	763,800
Private consumption	77,929	85,420	93,246	110,364	178,390	284,421	318,645	448,800	626,000
Percentage against G.N.P. %	82.0	83.9	80.2	75.6	75.1	79.7	82.7	82.2	82.2
Goternment consumption	19,713	20,975	25,032	32,359	52,885	73,466	86,529	130,400	154,000
Percentage against G.N.P. %	20.7	20.6	21.5	22.3	22.3	20.6	22.5	23.4	20.2
Export	5,347	8,356	7,768	12,023	30,471	42,458	28,248	34,100	35,700
Import	-17,888	-21,031	-22,951	-28,621	-76,008	-110,680	-105,812	-135,100	-133,800

2) Trade

Trade results for 1972 for the Republic of Viet-Nam showed that import amounted to VN$ 233,225 million (US$690,512,000), while export amounted to VN$5,467 million (US$15,618,000). Thus import exceeded export by VN$227,758 million (S$674,894,000).

Table 2-1-4 Balance of Trade of Viet-Nam

Year	Import		Export		Balance
	1,000,000 piastres	1,000 dollars	1,000,000 piastres	1,000 dollars	1,000,000 piastres
1963	10,016	286,171	2,684	76,671	△ 7,332
64	10,422	297,771	1,696	48,460	△ 8,726
65	12,507	357,342	1,242	35,490	△ 11,265
66	28,385	495,600	1,495	27,581	△ 26,890
		(57.3)	(54.2)		
67	43,044	538,050	1,313	16,410	△ 49,731
68	37,293	475,286	935	11,694	△ 36,358
		(78.5)		(80.0)	
69	53,427	667,839	954	11,931	△ 52,473
70	44,030	550,394	916	11,468	△ 43,114
71	70,104	874,164	994	12,395	△ 69,110
72	233,225	690,512	5,467	15,618	△ 227,758
		(338.0)		(350.0)	

The imported articles cover a broad field, ranging from provisions down to petroleum, petro-chemicals and machinery. However, exported articles are confined to rubber, fishes, lobster and crabs. The rapid increase in the export of iron in 1972 was due primarily to an increase in scrap iron shipments.

Table 2-1-5 Articles Imported by Viet-Nam (Unit: VN$ 1,000,000)

Article	1970		1971		1972	
	Quantity 1,000 tons	Amount VN$1,000,000	Quantity 1,000 tons	Amount VN$1,000,000	Quantity 1,000 tons	Amount VN$1,000,000
Live animals	-	64	-	13	-	82
Meat	-	-	-	45	-	4
Crustacea molluscs	-	-	-	13	-	21
Dairy products	35	1,841	29	3,044	25	5,651
Other crude animals	-	1	-	4	-	13
Live plant cut flowers	-	-	-	-	-	2
Vegetables	-	7	-	77	-	257
Edible fruits	5	84	1	62	3	345
Coffee, tea	-	1	-	5	-	16
Corn and rice	198	1,688	191	2,097	340	10,729
Flour, etc.	154	1,720	75	2,159	60	2,620
Seeds, beans, etc.	-	79	-	125	-	357
Vegetable oil, etc.	18	612	13	525	26	2,711
Preparations of meat and fish, etc.	6	497	4	295	13	2,367

Article	1970		1971		1972	
	Quantity 1,000 tons	Amount VN$1,000,000	Quantity 1,000 tons	Amount VN$1,000,000	Quantity 1,000 tons	Amount VN$1,000,000
Sugar	103	952	229	3,690	166	14,216
Cocoa	-	2	-	12	1	109
Preparations of citrus fruits	8	182	21	75	6	781
Preparations of vegetables and fruits	1	28	1	130	5	1,004
Other food preparations	1	169	1	143	2	540
Soft drinks, beer	1	35	2	244	8	4,142
Food wastes	29	367	39	840	28	1,552
Tobacco	3	281	5	828	17	722
Salt, sulphur, stone, cement	700	1,272	943	3,027	781	6,802
Metalliferous ores	-	5	1	8	-	34
Coal and petroleum products	1,222	7,918	794	2,366	1,860	20,865
Inorganic chemicals	75	1,044	81	1,432	41	2,217
Organic Chemicals	6	687	9	1,387	10	5,664
Pharmaceutical products	2	1,499	3	5,933	3	9,700
Cosmetics, etc.	-	79	-	216	1	1,314
Soap, etc.	2	90	1	69	1	200
Other chemical products	9	337	9	369	11	1,551
Plastic materials, etc.	34	1,131	35	1,717	53	6,594
Rubber and manufactures	5	561	5	922	6	3,104
Manufactures of leather	-	11	-	25	-	78
Wood and manufactures	7	25	-	54	1	74
Cork and manufactures	-	21	-	20	-	53
Pulp, etc.	34	617	52	989	34	1,716
Paper, and manufactures	25	450	49	785	29	2,281
Printed matter	1	270	1	142	80	519
Synthetic fibers	8	1,656	7	2,949	10	14,810
Cotton	29	1,958	17	3,116	25	6,825
Ceramics	7	141	9	293	7	1,118
Glass and glassware	9	783	13	425	11	1,430
Iron, steel	221	3,714	195	4,998	212	16,042
Copper and manufactures	1	85	1	108	1	233
Aluminium and manufactures	5	370	2	382	3	1,211
Zinc and manufactures	5	164	6	225	2	473
Machinery and appliances, other than electric	30	5,772	29	9,365	21	20,874
Electrical machinery	8	1,567	10	4,148	13	14,057
Road motor vehicles	28	2,614	22	2,682	21	7,051
Ships and boats	3	160	1	131	-	465
Precision machines	1	263	1	562	1	1,836
Watches and clocks	-	11	-	40	-	632
Musical instruments	-	12	-	58	-	1,221
Sporting goods and toys	-	28	-	41	-	286
Pens, pipes, type-writers, etc.	-	39	-	169	-	962

Table 2-1-6 Main Articles Exported by Viet-Nam

(Unit: 1,000 ton · VN$1,000,000)

Articles	1970		1971		1972	
	Quantity 1,000 tons	Amount VN$1,000,000	Quantity 1,000 tons	Amount VN$1,000,000	Quantity 1,000 tons	Amount VN$1,000,000
Crustacea, molluscs	-	4	-	94	2	16,03
Other live animals	-	23	-	44	1	205
Coffee, tea	-	17	-	21	1	288
Cereal preparations	-	14	-	13	-	43
Rubber, etc.	24	708	33	760	45	1,565
Leather	-	-	-	-	-	34
Wood, and manufactures	-	3	-	2	67	404
Glass	-	-	-	-	-	25
Iron, steel	-	2	2	2	18	383
Copper	4	79	1	27	4	275
Aluminium	1	29	-	-	1	66
Works of art	-	2	-	1	-	44

Table 2-1-7 Rice Exports and Imports

(Unit: Ton · VN$ 1,000,000)

Year	Imports		Exports	
	Quantity tons	Amount VN$1,000,000	Quantity tons	Amount VN$1,000,000
1958			112,702	472
1959			245,689	819
1960			340,043	954
1961			154,451	511
1962			83,951	307
1963			322,570	1,251
1964			48,650	187
1965	129,593	1,476		
1966	434,194	6,927		
1967	750,318	15,807		
1968	677,900	15,746		
1969	341,000	5,403		
1970	567,675	7,629		
1971	137,200	8,319		
1972	271,000	16,707		

3) National Budget

Since the major portion of Viet-Nam's annual revenue is assigned to national defense expenditures, and in spite of compensation through foreign assistance, the Viet-Nam national budget continues to have a deficit every year.

Table 2-1-8 The Viet-Nam National Budget

Article	1969	1970	1971	1972
1. Annual revenue	73.07	150.0	165.6	201.7
(Items)				
Customs	27.52	75.4	72.6	56.1
Direct tax	4.75	7.8	10.0	16.2
Indirect tax	9.26	13.4	16.1	20.7
Others	31.54	53.4	66.9	108.7
2. Annual expenditure	138.05	192.24	261.2	338.2
(Items)				
National defense	91.59	124.00	153.2	198.8
Others	46.46	68.24	108.0	139.4
3. Foreign aid	14.75	21.05	33.6	65.4
Balance	△ 50.23	△ 21.19	△ 62.0	△ 71.1

4) Population

Looking at the regional distribution of the population, more than 60% of the whole is concentrated in the southern region, especially around Saigon. In Central Viet-Nam, 30% of the population is concentrated in the cities along the coastline such as Nha-Trang, Qui-Nhon, Duang-Ngai, Da-Nang and Hue.

Table 2-1-9 Growth of the Total Population of Viet-Nam

Year	Total Population 1,000 persons	Southern Viet-Nam 1,000 persons	Central Viet-Nam 1,000 persons
1956	12,366	7,642	4,724
57	13,052	8,372	4,860
58	12,935	8,152	4,783
59	13,789	8,908	4,881
60	14,072	9,111	4,961
61	14,494		
62	14,275	9,335	4,940
63	14,133	9,156	4,977
64	14,359	9,405	4,954
65	15,124	9,785	5,239
66	15,112	9,857	5,255
67	16,256	10,414	5,842
68	16,259	10,283	5,976
69	16,543	10,494	6,049
70	17,333	11,211	6,122
71	18,708	12,193	6,516
72	19,213	12,670	6,543

Table 2-1-10 Population in the Main Cities of Viet-Nam (1972)

City	Population (1972) 1,000 persons	Percentage of the general population %	Remarks
Saigon	1,845	9.6	
Bien-Hoa	521	2.7	
Long-Khanh	186	1.0	
Cam-Ranh	115	0.6	
Nha-Trang	206	1.1	
Tuy-Hoa	136	0.7	
Qui-Nhon	219	1.1	
Phu-Cat	65	0.3	
Quang-Ngai	735	3.8	
Da-Nang	458	2.4	
Hue	198	1.0	
Da-Lat	93	0.5	
Total population	19,213		

Table 2-1-11 Growth of the Population of the Main Cities in Viet-Nam

(Unit: 1,000 persons)

City	1969	1970	1971	1972
Saigon	1,707	1,761	1,805	1,845
Bien-Hoa	435	469	497	521
Long-Khanh	140	156	161	186
Cam-Ranh	84	102	105	115
Nha-Trang	-	-	195	206
Tuy-Hoa	-	120	125	136
Qui-Nhon	-	-	189	219
Phu-Cat	-	60	94	65
Quang-Ngai	589	553	731	735
Da-Nang	363	428	438	458
Hue	171	209	200	198
Da-Lat	84	90	87	93
Total population	16,543	17,333	18,708	19,213

5) Agriculture

Of the agricultural products, rice is produced in the largest quantity, and nearly 80% of all rice produced comes from the southern region. Rice had been exported until 1964, but the disturbances of war brought a decrease in production in 1965, and since then internal demand has exceeded production. The insufficiency has been covered through reliance on importation. Also, agricultural products such as sweet potatoes, corn, manioc, peanuts, fruits and others, are being used in place of rice.

The cultivation of rubber, which is one of the few exports of Viet-Nam, is done in a certain part of the southern region and in the central highland. However, production is decreasing. This appears to be caused by the fact that poor maintenance of the rubber plantations has reduced the production per unit area; and by the fact that fighting in the highland containing the producing area has become violent.

Table 2-1-12 Agricultural Production

(Unit: Ton)

Article	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972
Rice	5,326,670	5,185,030	4,821,660	4,336,390	4,688,400	4,366,150	5,115,000	5,715,500	6,324,200	6,348,200
Sweet potatoes	300,170	301,000	277,930	246,150	254,010	234,685	225,500	219,750	230,300	240,500
Manioc	389,460	288,600	236,020	290,280	261,855	260,190	233,495	215,710	270,000	247,300
Corn	36,840	46,000	43,820	35,390	32,820	31,760	30,350	31,435	33,750	41,700
Soybeans	4,570	4,000	4,330	7,580	5,660	7,465	5,965	7,455	8,400	7,100
Mango beans	10,700	12,000	11,875	14,410	19,980	13,360	11,690	11,095	13,000	13,800
Cowagos	13,300	8,000	10,430	6,215	9,140	5,680	6,110	6,220	9,080	3,850
Pineapples	62,355	56,985	48,095	38,790	37,020	34,110	33,255	33,325	34,000	32,900
Fruits	263,540	231,730	233,260	201,900	191,165	221,880	222,885	235,705	245,000	230,500
Cotton	25	25	28	40	40	40	40	40	-	-
Kapok	785	710	910	720	975	720	730	810	720	610
Jute	1,338	890	865	790	770	525	250	250	135	130
Mulberries	10,810	14,210	11,730	7,340	4,245	2,945	2,560	1,575	600	850
Coconuts	146,405	140,875	147,330	129,460	130,600	110,705	98,545	118,450	125,000	116,300
Peanuts	32,260	36,500	32,595	34,420	33,730	32,055	34,410	32,185	37,000	38,900
Sesame	985	400	250	225	280	235	210	235	215	170
Tea	4,730	5,380	5,905	5,210	4,195	4,770	4,900	5,545	5,800	5,100
Coffee	3,580	3,420	3,530	3,070	3,345	3,300	3,550	3,925	4,400	3,900
Tobacco	6,820	7,275	7,575	6,900	7,890	7,620	7,790	8,420	8,600	8,800
Black pepper	542	600	605	440	470	410	435	410	475	500
Sugar cane	964,165	1,055,190	1,092,850	935,670	769,960	426,070	321,445	335,720	340,500	331,000
Rubber	76,180	74,200	64,770	49,455	42,510	34,000	27,650	33,000	37,500	20,000

6) Livestock

At present, livestock production is a secondary business for Viet-Namese farmers. It is not conducted as a full-scale operation.

Table 2-1-13 Number of Livestock in Viet-Nam (1972)

		Total	Southern Viet-Nam	Central Viet-Nam Lowland	Central Viet-Nam Highland
Buffalos	(100 head)	5,008	3,386	1,368	254
Cattle	(100 head)	5,525	3,345	4,657	523
Pigs	(100 head)	42,750	30,057	11,520	1,173
Chickens	(1,000 head)	23,250	19,117	3,310	823
Ducks	(1,000 head)	18,170	16,307	1,838	25
Horses		8,070	3,670	1,550	2,850
Goats	:	38,200	5,190	18,670	14,350
Sheep		18,530	2,440	15,420	670

7) Fishery

The Viet-Namese have engaged in fishing from olden times and fish are an important source of protein. However, in the last few years fishing production has not increased very much due to a labour shortage, and due to the closing of fishing grounds.

Table 2-1-14 Fisheries Situation in Viet-Nam

Item	1968	1969	1970	1971	1972
Number of fishermen (persons)	272,304	277,118	317,352	335,690	342,797
Number of fishing boats (ship)	77,959	81,956	88,209	91,424	95,062
Amount of fish caught (tons)	410,000	463,844	577,450	587,490	677,718
Marine fishes	321,645	355,488	441,765	435,545	501,278
Fresh-water fishes	51,045	63,673	74,140	71,066	81,772
Shrimps	24,600	27,504	33,268	45,779	54,248
Crabs, etc.	9,414	13,370	18,832	19,782	29,725
Cuttle fishes	3,296	3,809	9,445	15,318	10,695

8) Industry

Industry in this country is characterized by the fact that food, drinks and fiber comprise almost all production. Cement, glass and light machines, though they are produced, are on a very small scale. Especially in respect to heavy industry, this sector remains quite underdeveloped.

Table 2-1-15 Industrial Production in Viet-Nam

Item	Unit	1968	1969	1970	1971	1972
Sauce	1,000 lit.	59,967	62,368	65,609	71,126	69,830
Canned foods	1,000 cans	1,418	2,344	4,400	1,192	193
Condensed milk	1,000 cans	32,752	30,555	66,030	95,340	-
Sugar	1 ton	103,813	112,435	127,417	239,254	225,379
Beer	1,000 lit.	119,406	134,221	148,669	146,891	143,179
Soft drinks	1,000 lit.	92,341	120,446	125,689	118,533	115,617
Ice	1 ton	470	667	816	813	-
Tobacco	1 ton	12,579	11,312	9,675	12,168	11,769
Yarn	1 ton	6,304	9,260	13,264	14,767	10,459
Cloth	1,000 m.	79,579	105,158	129,491	119,314	79,690
Fish net	1 ton	143	-	545	381	-
Cotton underwear	1 ton	1,098	3,948	3,599	3,120	17,136
Towels	1,000 m	2,308	2,820	1,068	1,728	-
Elastic braids	1,000 m	16,259	27,265	20,571	11,868	13,780
Paper	1 ton	19,584	33,199	42,823	48,537	46,376
Tyres, tubes	1,000 feet	3,605	4,536	3,757	2,978	3,965
Mattresses	1 ton	5,259	1,770	363	149	3,191
Caustic soda	1 ton	13,907	18,823	30,004	25,901	23,908
Soap	1 ton	10,826	11,384	13,366	13,167	12,757
Tooth paste	1,000 tubes	8,920	11,373	12,018	7,188	10,355
Matches	1,000,000 sticks	4,610	3,923	4,991	6,626	6,718
Medicines	VN$1,000,000	-	5,675	17,469	9,390	7,700
Cement	1 ton	144,708	247,185	285,751	263,313	243,172
Glass	1 ton	10,054	16,465	18,793	20,979	24,458
Wire	1 ton	3,161	5,177	4,854	4,663	1,050
Nails	1 ton	3,185	3,863	2,970	2,034	-
Sewing machines	1 price	16,871	48,005	7,529	6,000	49,225
Dry batteries	1,000 pieces	14,897	15,305	49,376	38,367	52,888
Storage batteries	1 piece	21,293	25,127	15,773	15,687	37,853
Electric bulb	1,000 pieces	262	397	1,316	2,499	1,409
Watches and clocks	1 piece	43,152	48,617	12,370	1,300	-
Plastic articles	1 ton	13,250	35,162	38,808	25,371	28,523
Pencils	1,000 units	8,541	10,732	8,130	6,980	3,844
Ball-point pens	1,000 units	5,213	4,538	6,281	4,593	3,620

2-2 Four-year National Economic Development Plan

According to the Four-year National Economic Development Plan, the G.N.P. is expected to increase from VN$921 billion in 1971 (not specifying actual amounts of goods produced) to VN$ 1,775 billion in 1975 (at 1971 values), increasing at the rate of 5 or 6% in the first two years and 7% in the second two years. By particular fields, agricultural production would go from VN$277 billion in 1971 to VN$402 billion in 1975, increasing at the rate of 9.7% per year. Industrial production would go from VN$101 billion in 1971 to VN$157 billion in 1975, increasing at the rate of 11.7% per year. On the other side, services, increasing at the average rate of 3.3% per year, would go from VN$543 billion in 1971 to VN$616 billion in 1975. The highest rate of increase in the four years is the 55.4% in industry, with the 45% in agriculture following it. As for the relative shares of each field, agriculture will comprise 34% (30% in 1971), industry 13% (11% in 1971) and services 52%. Thus, though the industrial structure will be improved somewhat, great changes in it cannot be expected. Looking at consumption, the program will try to keep the increases in government consumption and in private consumption to under 2% and 7% respectively, the percentage of the G.N.P. for each to 17.7% and 72.1% respectively, and to control the total of these two to under 89.8% of the G.N.P. (according to the figures for 1971, government consumption was 22.1%, in private consumption 78.6%, and the total of the two amounted to 100.7%).

With aid to improve the balance of trade, and with consideration for enlarging total exports, this program states that exports would increase from US$14 million in 1971 to US$175 million.

There are planned enlargements in exports of woods, duck feathers, spices and so on, which are exported in small amounts at present, and initiation of the exports of bananas and other items. This is in addition to sharp increases in the exports of rubber and fish, which are the main exports today.

Moreover, there is an expected improvement in the balance of trade from US$125 million in 1971 to US$230 million in 1975 through an increase in foreign tourists, through the transportation of export-import goods on national-flag ships, through the institution of domestic insurance companies concerned with export-import goods, and so on.

Regarding imports, on the other hand, while it is planned to keep the increase in imported raw materials down to 21%, and to decrease imported consumer goods by 11%, imported capital goods are to almost double over the amount in 1971.

As a whole, imports, with a rate of increase considered as 11.4% during the four years, would go from US$895 million in 1971 to US$919 million in 1975.

The population program is aimed at controlling the population increase at under 3% each year. The occupational structure will not be much different from that of 1971, though there will be a small change from the service sector into industry and commerce.

For agriculture, forestry and fishing, the rates of production increase are considered to be 49.3% in agriculture, 1.5% in forestry, 20.1% in fishery and 29.1% in livestock.

The total production of agriculture, forestry and fishing is expected to increase from VN$23.5 billion in 1971 to VN$84 billion in 1975. More specifically between 1971 and 1975 each product is expected to increase as follows: rice, from 6.7 million tons to 7.6 million tons; corn, from 37,000 tons to 300,000 tons; pigs, from 3.36 billion head to 5.1 billion head; fish products, from 498,000 tons to 798,000 tons.

Industrial production, during the same period, is expected to increase from VN$15.5 billion to VN$21.9 billion. The food industry would occupy 20.0% of the total (1971, 14.5%), the textile industry 14% (1971, 11.5%) and other industries such as rubber, mechanical and electrical implements, paper, chemical products and so on, 8% (1971, 13%). There would be power output of 883,000 KW in 1975.

3. PRESENT STATE OF VIET-NAM RAILWAY

3. PRESENT STATE OF VIET-NAM RAILWAY

3-1. General Conditions

3-1-1. History

The first railway in Viet-Nam, opened in 1885 between Saigon and Mytho, extended for approximately 70 km. (This railway is not presently used because of expansion of the road network.)

The railway between Saigon and Hanoi, the 'Indo China Line', required 33 years for construction, and was opened in 1936.

Due to the outbreak of World War II in 1939 and the following querrilla warfare rolling stock and ground facilities such as tracks and bridges have been intentionally destroyed. In addition, many typhoons and floods further damaged the equipment.

After the Geneva Conventions were concluded in 1954 dividing Viet-Nam into north and south, in order to improve transportation facilities the Government of South Viet-Nam promoted large-scale reconstruction projects on the railway. These were carried out in two periods, from 1955 to 1959, and from 1968 to 1969.

In spite of such projects, the expansion of the Viet-Nam war destroyed railway facilities on a large scale, especially from 1972 to January 1973. The transportation capacities of South Viet-Nam Railways were reduced rapidly to an almost complete traffic stoppage; that is, the South Viet-Nam Railway network of 1,414 km was rendered inoperative, except for only 74 km near Saigon.

3-1-2. Outline of reconstruction and modernization plan of VNRS

After the Viet-Nam war ended in January 27, 1973, VNRS authorities planned an independent reconstruction plan with an estimated cost of US$120 million and submitted this to the Government.

This project has three stages:

The intention of the first and the second stages, requiring 18 months in total, is to complete emergency work covering approximately 800 km between Saigon and Quang-Ngai in order to obtain a stable traffic flow at approximately 30 km/h; and the intention of the third stage, requiring 5 years, is to systematically reconstruct VNRS, involving not only the reopening of the whole network but also comprehensive modernization of the entire transportation system for an increase in transportation capacity, speed-up, and so on.

The details of this project are as follows:

oo First stage of project:

To perform emergency reconstruction work on the following sections totalling 883 km on which traffic services were stopped in 1972:

This will require 6 months of emergency repairs.

Saigon - Nha-Trang - Qui-Nhon - Phu-Cat	659 km
Da-Nang - Mychanh	140 km
Thap-Cham - Da-Lat	84 km
Total	883 km

Type of construction:

Emergency repair of track	883 km
Reconstruction of steel bridges	1,988 m
Reconstruction of concrete bridges	378 m

Signal and communication systems, etc.

For the above a budget of US$6,316,000 is appropriated.

oo Second stage of project:

To reconstruct in 12 months the following heavily damaged sections, 186 km in total, on which operations were suspended 10 years ago.

Phu-Cat - Quang-Ngai	143 km
Mychanh - Dongna	31 km
Muongman - Phathiet	12 km
Total	186 km

Type of construction:

Temporary repair of track	186 km
Reconstruction of steel bridges	2,735 m
Reconstruction of concrete bridges	1,123 m

For the above a budget of US$9,474,000 is appropriated.

oo Third stage of project:

Reconstruction the section of 136 km between Quang-Ngai and Da-Nang, which is the most heavily damaged portion, and the systematic reconstruction of the whole route (1,414 km in total) are to be performed in 5 years. The Details are as follows:

Reconstruction and improvement of track	1,414 km
Reconstruction of steel bridges	14,849 m
Reconstruction of concrete bridges	9,867 m
Repair of tunnels	9,047 m
Construction of stations	163
Other	

US$104,210,000 has been appropriated.

Items of required financing for reconstruction (in thousands of US$)

	First Stage	Second Stage	Third Stage	Sub Total
Imported goods	3,490	6,235	66,379	76,104
Domestically-produced goods, and labor	2,826	3,239	36,771	42,836
Total	6,316	9,474	103,150	118,940

Full total is US$120 million, including other expenses of US$1,060,000.

Although the above project allows a maximum running speed of 40 km/h, such speeds are too slow when compared with other transportation facilities; therefore, systematic modernization is required for the postwar national economy.

The future objective is to achieve a maximum speed of 120 km/h and an average speed of 70 km/h; to carry out improvement and maintenance of ground facilities; and to introduce modern rolling stock with due regard to links with an Asian trunk network.

3-1-3 Progress Made in Reconstruction

After approval of a US$6 million budget for the first stage of this project, emergency work is being performed at present using the internal resources of the VNRS. Except for the section of approximately 100 km between Malam (1,532.8 km from Saigon) and Gia-Ray (1,630.9 km from Saigon), where instability of the local situation still prevents emergency repair work, the reconstruction has been completed.

The sections on which traffic services have been resumed are as follows: approximately 103.1 km between Hue and Da-Nang, 244.1 km between Phu-Cut, Qui-Nhon and Nha-Trang, and 32.0 km between Bien-Hoa and Saigon, and others (520 km in total).

As regards the previously mentioned section between Malam and Gia-Ray, it could be said that emergency work would be completed within 6 months when considering interval resources and past execution results. When this construction is completed, traffic services in the section of 414.6 km between Nha-Trang and Saigon, and 84.1 km between Thapcham and Da-Lat will be possible (498.7 km in total); therefore the total length of sections where operations could be performed is estimated to be 877.9 km. As a result, the trunk railway of 1,041.2 km between Hue and Saigon would contain only one inoperable section of 279.5 km (26.8% of the total) between Da-Nang and Phu-Cat.

Fig. 3-1-1 (a) Reconstruction Within 6 Months

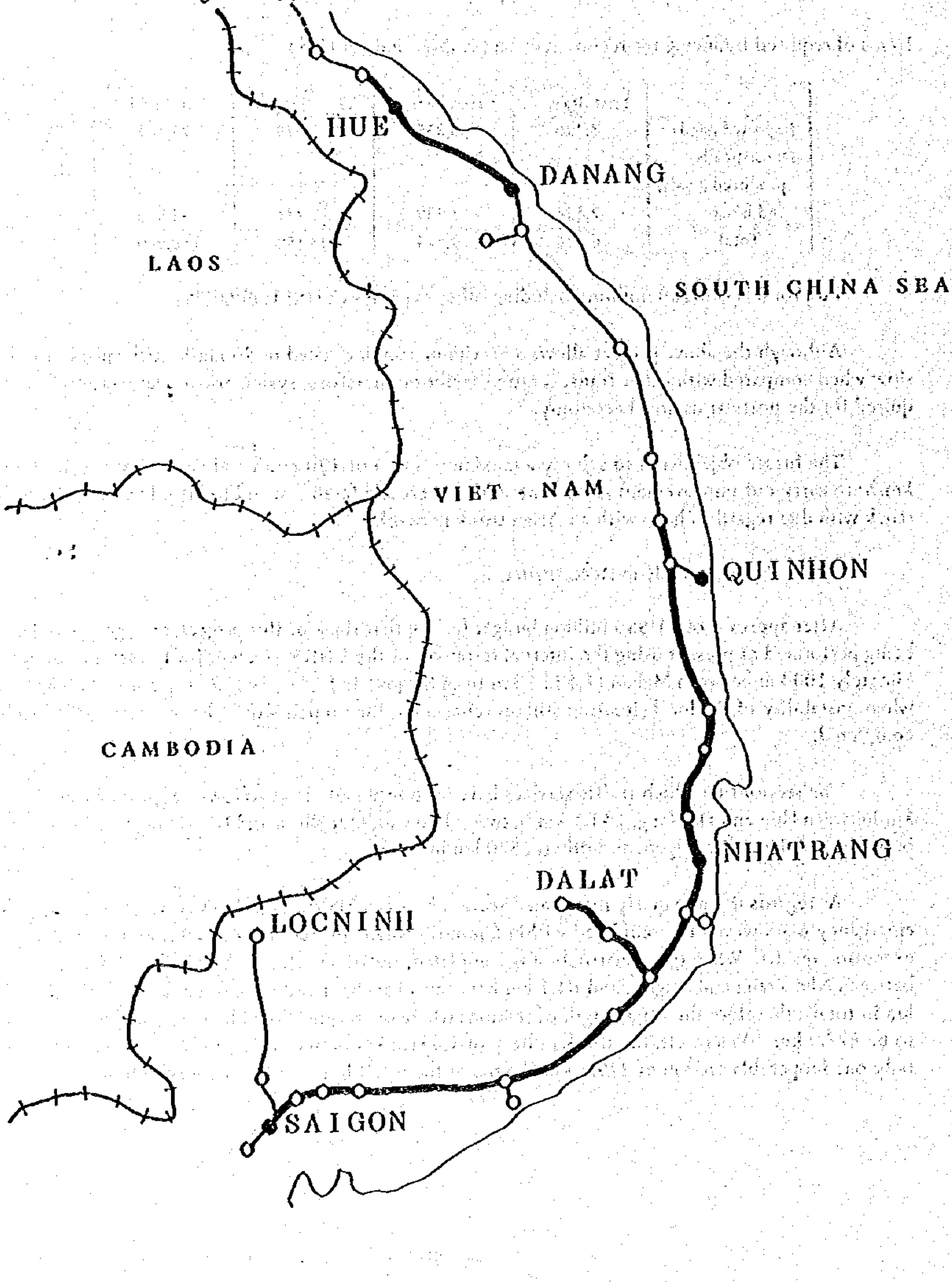
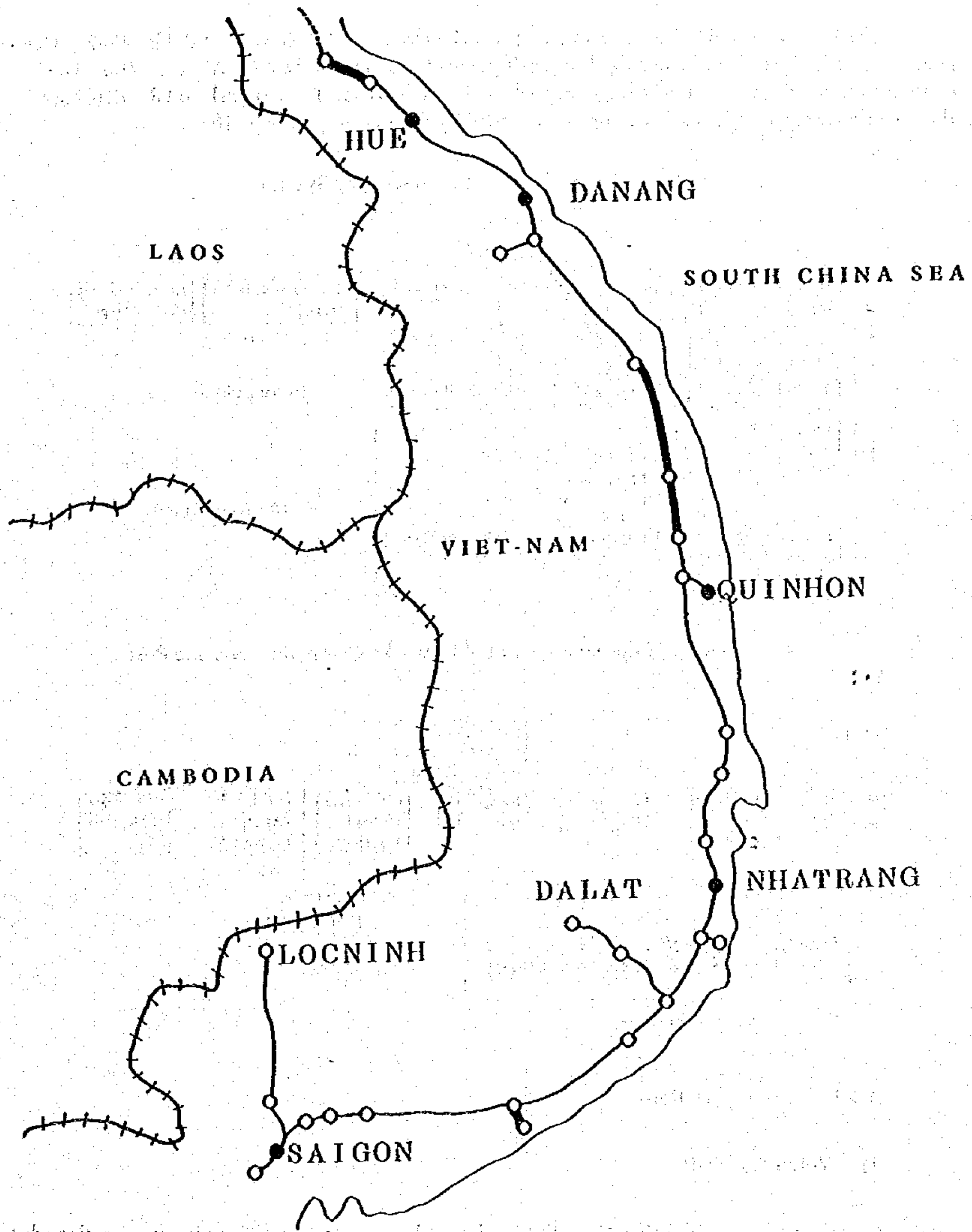


Fig. 3-1-2 (b) Reconstruction After 6 Months but Within 12 Months

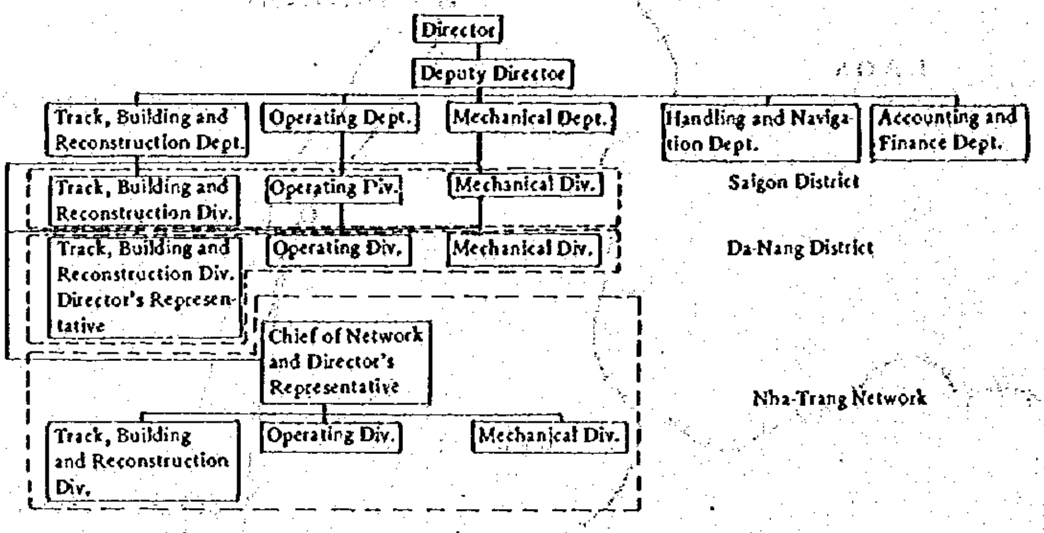


3-2 Present State and Controversial Points

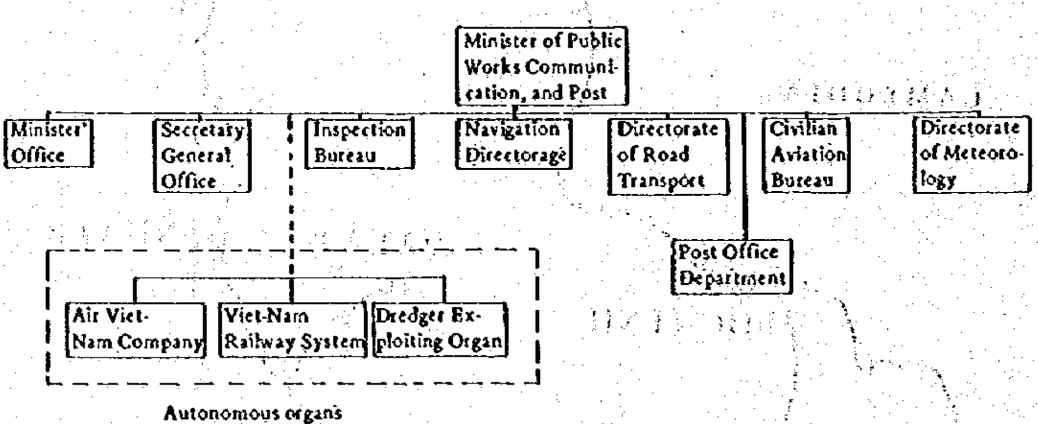
3-2-1 Organization

The Viet-Nam Railway System (VNRS), which belongs to the Ministry of Public Works, Communication and Post, is to be managed on a self-paying basis as is the case for Air Viet-Nam. The constitution describes a head office, an network, and two districts. The network and districts have three sections respectively; each section is controlled by their corresponding offices.

Organization of the Viet-Nam Railway System



Organization of the Ministry of Public Works, Communication and Post



3-2-2 Transportation

1) Volume of Traffic

On many occasions the Viet-Nam Railway has had to suspend operations in many sections due to the disturbances of war, since the completion of the 1,729.7 km between Hanoi and Saigon in 1936.

The conclusion of the Geneva Conventions in 1954 allowed complete reconstruction to start, this being completed in 1959.

But, not only because of the intensification of guerrilla warfare in various places at about 1961, but also because of the reduction in the length of operating sections, the volume of traffic has greatly declined.

Table 3-2-2-1

	Passengers		Freight		Length of Sections in Service (km)
	Volume of traffic (1000 person-km)	Index	Volume of traffic (1000 person-km)	Index	
1958	426,817	126	84,085	55	1,323
59	514,583	152	107,584	71	1,345
60	541,736	160	143,848	95	1,345
61	583,120	173	166,844	110	1,345
62	338,015	100	151,798	100	1,250
63	229,992	68	183,510	121	1,250
64	124,635	37	134,069	88	940
65	14,045	4	31,714	21	468
66	3,838	1	14,171	9	529
67	12,814	4	28,578	18	368
68	12,926	4	18,369	12	641
69	71,481	21	41,196	27	619
70	88,256	26	52,850	35	625
71	85,657	25	38,273	25	640
72	65,672	19	6,626	4	685

* The length of operating sections includes branch lines.
* From data by VNRS

Note: As regards the index in Table 1, the figure in 1962 is set as 100, with a time schedule drawn up in 1962 used as the base.

The withdrawal of the U.S. Army reduced volume of freight traffic to the extent that the operation of freight trains was not required.

2) Train Operations

As shown in Table 1, the operating sections of the VNRS reached a maximum during 1959 to 1961, and decreased thereafter. At present, train operations are carried out only in a short section of 520 km out of the total distance (1,109.3 km) of the railway running through Viet-Nam. Table 2 gives a comparison between the time schedules of 1962 and 1973.

Table 3-2-2-2

Section	Section distance	Number of trains 1962 Passengers	Number of trains 1962 Freight	Number of trains 1962 Passengers & Freight	Number of trains 1963 Passengers	Time required and average speed 1962 Passengers	Time required and average speed 1962 Freight	Time required and average speed 1962 Passengers & Freight	Time required and average speed 1973 Passengers
Don-Ha · Hue	67.9	1	1	1	-	139min	142min	142min	
		(1)	(2)	(1)		29.3km/h			
Hue · Lang-Co	67.1	2	1	0	2	129min	139min		139min
	(67.1)	(0)	(6)	(0)	(1)	31.2km/h			29.0km/h
Lang-Co · Da-Nang	36.0	1	2	0	2	85min	93min		81min
	(36.0)	(0)	(4)	(1)	(2)	25.4km/h			26.7km/h
Da-Nang · Tam-Ky	73.2	1	2	0		121min	148min	141min	
		(0)	(4)	(1)		36.3km/h			
Tam-Ky · Quang-Ngai	63.3	1	1	0		103min	142min	108min	
		(0)	(3)	(1)		36.9km/h			
Quang-Ngai · Tam-Quan	76.5	1	1	0		149min	187min	152min	
		(0)	(3)	(1)		308km/h			
Tam-Quan · Dieu-Tri (Phu-Cat · Dien-Tri)	91.1	1	2	0	3	143min	200min	153min	(62min)
	(24.7)	(0)	(3)	(1)		38.9km/h			23.9km/h
Dieu-Tri · Tuy-Hoa	101.9	1	1	0	1	202min	256min	204min	266min
	(101.9)	(1)	(3)	(1)	(1)	30.3km/h			23.0km/h
Tuy-Hoa · Nink-Hoa	83.1	2	1	9	2	171min	202min	171min	
	(83.1)	(1)	(3)	(1)	(0)	29.2km/h			308min
Nink-Hoa · Nha-Trang	34.2	3	1	0	2	58min	82min	55min	22.9km/h
	(34.2)	(1)	(3)	(1)	(0)	35.4km/h			
Nha-Trang · Thap-Cham	92.9	1	1	0	1	141min	180min	176min	207min
	(92.9)	(1)	(3)	(1)	(1)	39.5km/h			26.9km/h
Thap-Cham · Muong-Man	143.2	1	1	0		285min	336min	316min	
		(0)	(3)	(1)		30.1km/h			
Muong-Man · Giaray	80.1	1	1	0		165min	187min	187min	
		(0)	(5)	(1)		29.1km/h			
Giaray · Bien-Hoa (Long-Kkank · Bien-HOa)	66.6	1	1	0	3	109min	131min	126min	(95min)
	(48.1)	(0)	(7)	(1)	(0)	36.7km/h			30.4km/h
Bien-Hoa · Saigon H.K.	32.2	1	1	0	7	54min	87min	73min	77min
	(32.2)	(0)	(7)	(1)	(0)	35.8km/h			25.1km/h
	1,109.3					2,054min	2,512min		1,235min
	(520.2)					32.4km/h	26.5km/h		25.3km/h

Note: 1) The section distance in Table 1 means traffic service section distances in 1973.
2) The number of trains means the number of special trains.
3) The time required and average speed are obtained from 1973 data.

1) Number of Trains

Subversive activities are vigorous in Viet-Nam at present, and 40% of the rolling stock is damaged and non-operative. Repair of this non-operative rolling stock and maintenance of operating rolling stock is so painstaking that inspection and repair in detail cannor be conducted. In addition to these, there are many sections where trains are forced to reduce speed to a level of 5 km/h or less because of poorly rapaired tracks, damaged bridges, and incomplete railway-crossing safety devices. Moreover, crossing and night running are impossible due to the destruction of station facilities and shortage of communication equipment; therefore the only alternative for the Viet-Nam Railway is to make the present number of trains secure.

2) Locomotives

The Viet-Nam Railway System has the following number of locomotives:

Steam locomotives 57
Diesel locomotives.................... 63

The sections operated at present use only diesel locomotives.

Table 3-2-2-3

Type	Power	Number	Tractive force	System
BB-90D	900 PS	53 (30)	450 t	Diesel-electric system
CR-8D	1,000 PS	10 (8)	500 t	Diesel-hydraulic system
U-8B	900 PS	2 (2)	450 t	Diesel-electric system

Note: The numbers in parentheses relate to movable locomotives. (From data by VNRS)

3) Train Consist

Train consist depend on the amount of rolling stock held in each operating section and the amount of stock capable of running. Viet-Nam Railway System generally adopts combined consist, such as a combination of two or three passenger cars with six or eight passenger cars remodelled from covered goods wagons. In the section between Saigon and Bien-Hoa, the passenger cars are most frequently used, while between Da-Nang and Hue, the remodelled passenger stocks from covered goods wagons are being used.

4) Running Speed of Trains

Because of the poor repair of tracks, deterioration or poor maintenance of rolling stock (especially the deformation of wheel trade), and bridge damage, the average running speed of trains is only 25.3 km/h, which is lower than the speed of 32.4 km/h in 1962 by 7.1 km/h. If the entire section of 1,109.3 km between Hue and Saigon opens, under this average speed the time required for a one-way journey (excluding stopping time, locomotive changing time, and switch-back time) becomes as long as 43.8 hours.

At present, there are many 'bottle neck' sections where the running speed must be reduced to 5 to 15 km/h because of incomplete maintenance of railway-crossing safety devices, failure of station-precinct safety devices, great hindrances in structural clearance, and obstacles left by inhabitants trespassing on the railway tracks.

5) Train Operation

Although semaphore signals and exclusive telephone circuits between stations were used before World War II, at present there are only disc emergency signals.

Inter-communications concerning operating information and dispatching between stations, between station and train, and between operating division and station are carried out through wireless telephones or wireless telegraph.

Trains are operated according to a time schedule but incorrectly maintained clocks usually cause errors of approximately 5 min. This operation method doesn't utilize any block equipment and there is not even the conception of block systems. Running is performed by a time separation method, and safety of trains is guaranteed by the use of smoke candles.

3-2-3 Ground Installations

1) General

(1) Track gauge
The track gauge in Viet-Nam is 1,000 mm, i.e. meter gauges, like that of adjacent countries such as Cambodia, Thailand, and Malaysia.

(2) Construction gauge
At present considerable temproary housing for refugees encroaches upon the railway right of way in Saigon, Hue, Da-Nang, Nha-Trang, and other main cities. For this reason the construction gauge is not satisfactorily secured.

(3) Line profile
Only the track and track bed profile are determined by VNRS. However, this stipulates only track construction and formation level width, and there are no civil engineering standard.

(4) Curves
The plane curves are shown in 3-2-3 Table 1.
There are curves of radius from 100 m to 500 m at 967 places, totalling 213.6 km of track (equivalent to 20.5% of the total main track length.)
There are also sharp curves of radius less than 300 m at 240 places totalling 32.8 km of track (equivalent to 3.1% of the total rail line length.)
Transition curves based on cubic parabolas are inserted between straight and curved portions of track. Their lengths are standardized by the following rules:

$R \geqq 200$ m curve L = 40 m

$R \leqq 200$ m curve L = 20 m

Table 3-2-3-1 Table of Curves between Hue and Saigon

	Hue · Da-Nang		Da-Nang · Phu-Cat		Phu-Cat · Saigon		Total	
Radius of Curvature	Number of Location	Length	Number of Location	Length	Number of Location	Length	Number of Location	Length
100m	125	8,630m	0	0m	0	0m	125	8,630m
150	7	700	0	1	70	8	770	
200	18	1,750	0	0	6	1,010	24	2,760
250	0	0	0	0	2	590	2	590
300	6	850	21	5,200	54	12,980	81	19,030

	Hue · Da-Nang		Da-Nang · Phu-Cat		Phu-Cat · Saigon		Total	
Radius of Curvature	Number of Location	Length	Number of Location	Length	Number of Location	Length	Number of Location	Length
350	1	180	0	0	3	970	4	1,150
400	3	640	14	3,270	43	9,630	60	13,540
450	0	0	0	0	3	850	3	850
500	27	6,720	46	11,090	148	38,720	221	56,530
600	0	0	83	17,700	69	17,550	152	35,250
700	1	90	0	0	5	1,770	6	1,860
800	1	20	12	3,120	21	7,470	34	10,610
1,000	5	510	40	10,820	177	45,570	222	56,900
1,200	1	440	0	0	0	0	1	440
1,500	0	0	0	0	2	420	2	420
1,600	0	0	0	0	1	30	1	30
2,000	0	0	1	30	12	3,080	13	3,110
3,000	0	0	1	110	4	540	5	650
5,000	0	0	1	70	2	380	3	450
Total	195	20,530	219	51,410	553	141,630	967	213,570

The use of 100 m as a minimum radius is a remarkable feature. These minimum radius curves are concentrated in a section of about 25 km in length going around Lang-Cost (located to the north of Da-Nang). There are 125 of these curves totalling 8.6 km in length.

(3) Gradients

Approximately 64% of the 1,041.2 km of main track lies on flat planes with gradients, of less than 3 0/00. However, sections with steep gradients of above 10 0/00 total about 97 km in length (equivalent to 9% of the total rail line length) and the steepest gradient is 15.2 0/00.

Steep grades of more than 15.1 0/00 are located in the sections described in item 4 as well as in the route between Nha-Trang · Saigon, totalling about 6.8 km in length.

Further, the construction standards for vertical curves were investigated, but could not be clarified.

2) Track

(1) Track Construction

(a) Rails

Rails of 27 kg/m and 30 kg/m with standard lengths of 12 m were installed, but total installed length for each type was unknown. Welded rails were said to be laid near Govap, Nin-Hoa and Da-Nang, but this could not be confirmed.

(b) Sleepers

In the main, steel sleepers are used, along with wood sleepers. PC sleepers are manufactured in a PC factory located at Thap-Cham and controlled directly by VNRS. Substitution of slpeepers with

PC units seems to be recommended but their usage was not actually found. In addition, the electrical insulation performance of PC's was not confirmed.

Standard sleeper placement is 17 pieces per 1m (1,420 pcs per 1 km). However, even on sections with sharp curves the above number is not increased, while the length of the rail employed is reduced to 11 m 871 or 11 m 975.

A suspended joint system is employed for joint support. Clearance is fixed at 480 mm, which is wider than the 380 mm under JNR standards.

(c) Ballast

As ballast, guarry gravel is used over the entire line. This was often noted as being of the granite type.

Ballast quality is not standardized by VNRS, while grading is standardized to the range of 20 mm to 60 mm. However, controls employing grading curves (such as JNR has) are not applied.

Since a crushed stone factory of 10,000 m^3/day ballast production capacity is onwed and other factories of small capacity are also available, the total supply capacity appears to be sufficient.

Ballast thickness beneath the sleepers is set at 330 mm (according to the basic railway section drawing of VNRS) but the value actually present is seen to be in the range of approximately 100 mm to 150 mm.

(d) Turnouts

Turnouts are classified according to the rail weight in to 25 kg/m, 26 kg/m, 27 kg/m and 30 kg/m. They are the ordinary single and double turnouts as well as such special types as three throw, scissor crossings, diamond crossings, single and double slip switches.

According to the VNRS station/track outline diagram, there are approximate 860 sets of turnouts employed in the stations between Hue and Saigon. Classification by station interval is shown in the following table.

Table 3-2-3-2

(Unit: Set)

Section	Number of Turnouts	Related to	
		Main line	Branch line
Hue · Da-Nang	76	58	18
Da-Nang · Phu-Cat	230	205	25
Phu-Cat · Saigon	553	384	169
Total	859	647	212

Of these turnouts, the number of sets in actual use as well as their classification by rail weight, type and frog number were not clear.

The skeletons for 30 kg single and double turnouts (which are installed in comparatively large numbers) are as shown in appended data 1. Their frog numbers, converted into JNR terminology, are

6 #, 7 #, 8 #, 9 # and 10 # for the single type turnout and only one kind, 5 #, for the double type turnout. While both wood and steel sleepers are used, the wide use of steel sleepers, was noticed. The length of turnout sleepers ranges from a minimum of 1,900 mm to a maximum of 4,100 mm, with 500 mm adopted as the length pitch step.

The longest steel sleepers are 3,150 mm and used only with turnouts of small frog number.

(e) Guard rails and related

Derailment prevention rails and level crossing guards were installed. As for safety rails and guard rails for bridges, no trace of their specifications were found.

Derailment prevention rail installations were restricted to only tracks intersecting with roads; they were not installed even at sharp curve sections of $R \leqq 300$ m. The clearance between derailment prevention rails and main track rails is 60 mm – 70 mm.

(2) Track Maintenance

(a) Inspection System

Track inspections are principally conducted once a month by visual check, patrolling either on foot or in inspection cars. We were informed that static tests using tools or leveling srings were carried out, but no specific personnel are designated as inspectors. The person in charge of the respective section is substantially engaged in inspection. Supervision through gauge measurement of train shaking and static discrepancies is not executed.

(b) Maintenance system

Maintenance operations are classified into three main types: overall system repair operations are to be performed once every 4 years, partial repairs once a year and limited repairs according to inspection results, but these operations are not being carried out as they should be because of a shortage of personnel and because reconstruction has priority.

Maintenance operations are as a rule performed directly by VNRS, but the operations are sometimes trusted partially to contractors. In these cases, rails and sleepers are supplied by VNRS, while ballast is supplied by the contractor.

(c) Track materials condition

The rails already have low joints, corrugations and other various discrepancies, and much wear and tear on them could often be seen. In addition, in sections where tracks and roads overlap (as in city areas), and in places of insufficient drainage, corrosion and breakage were remarkable.

Corrosion of and damage to steel sleepers was noted in several places, while deterioration of the fastening device due to rusting was present along the entire line.

Corrosion and cracking in wooden sleepers was also freavently seen.

(d) Status of track irregularities

Remarkable irregularities in alignment and level due to wear of materials, insufficient maintenance and so on, has frequently occurred, and their defective conditions can be easily seen even by visual surveillance from inspection cars and train windows.

Especially, depressions of joints, insufficient ballast sections, defective drainage, water accumulation within tracks, mud, growth of thick grass and so on, make the maintenance of the track more difficult. Moreover, among track irregularity control, those concerning horizontal plane irregularities are not taken into consideration.

(3) Countermeasures

Many problems are involved in the situations described above and various remedies are required for safe train operations between Hue – Da-Nang, Phu-Cat – Thap-Cham where trains are operated at present, as well as between Long-Khanh – Saigon where reconstruction of train operations is scheduled in the near future. These can be shown as follows:

(a) Remedies for depression of rails joints

The main causes of depression of joints, are poor rail strength and long joint support intervals. Accordingly, to correct these problems, reinforcements as by the insertion of one wood sleeper under each joint section, and by the use of treated joint plates are considered to be practical and probable remedies for the present.

Furthermore, correction of extremely depressed joints through repair within the extent of these readjustment operations seems so difficult that renewal of available stockpiled rails is also required.

(b) Remedies for rail damage

In view of the importance the prevention of damage has, it is necessary to inspect places where rail damage occurs frequently, such as track sections used jointly with streets, level crossings, places with poor drainage and the interior of tunnels; and to replace as promptly as possible the defective rails.

(c) Remedies for defective sleepers and the like

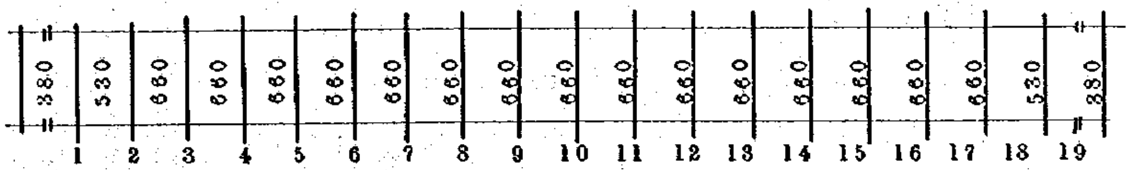
When defective sleepers are found, prompt replacement of them is recommended from the maintenance point of view. Renewal of parts and lubrication of the rusted rail fastening devices during general maintenance are considered to be indispensable.

(d) Increase in numbers of sleepers

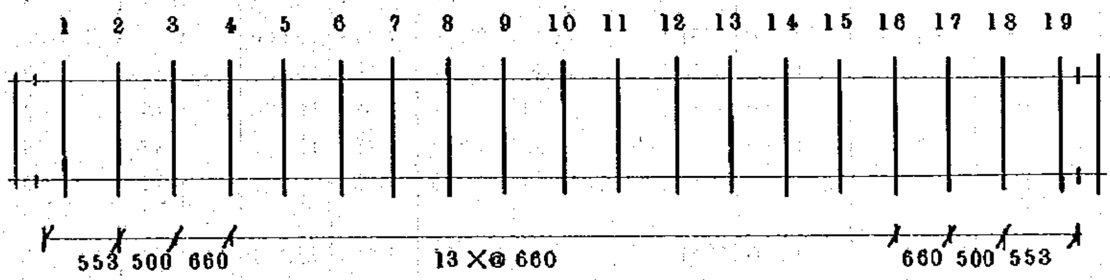
As the distance between sleepers is wide, particularly at joint sections, it is necessary to increase the number of sleepers, and reinforce them, as an effective remedy. As appropriate sleeper insertion executed jointly with the interchange operations of defective sleepers permits the expectation of early returns with minimum labour, simultaneous execution of these remedies, together with reinforcement sleepers at joint sections, as well as track repair, are considered to be preferable.

Moreover, when increasing the number of sleepers, their distribution must be arranged in an alternating manner as shown below.

(For suspended joints ------ 19 pieces per 12 m rail length)



(For supported joints ------- one sleeper is added under the joint section)



Furthermore, in this sleeper arrangement when rails are renewed with 40 kg 25-meter ones, the sleeper number becomes 39 pieces per 25 m (i.e., all 39 pieces must be used).

(e) Readjustment of ballast and weeding operations

A complimentary supply of ballast to maintain the predetermined rail bed profiles together with repair operations of the road bed are necessary for sections where the rail bed profile (width and thickness) is extremely reduced.

The execution of weeding operations within the rail line, jointly will decrease deterioration of the rail bed while elevating drainage effects, permitting prevention of causing track irregularities.

Data 1

..nout skeleton

According to the data from V N R S, turnouts are classified into four groups, 25, 26, 27 and 30 kg, depending on rail weight. As for the types of turnouts, a variety of turnouts were seen to be employed, such as single, double, and three throw as well as special types such as scissor crossings, diamond crossings, single slip switches, and double slip switches. For illustratin their skeleton, single and double turnouts employing 30 kg rails (considered to be most general) are referred to here.

The results obtained are shown as separate date, and the following can be said on these turnouts:

1. The construction of skeleton individual parts is unblaanced.

2. For the turnouts with 100 m and 90 m lead radius, restrictions on entering carriages and their

passing speed becomes necessary because of short lead lengths and small crossing angles.

3. Since data for obtaining turnout angles is not available calculation of the allowable speed at
each each turnout is very difficult.

Turnout Skeleton According to VNRS

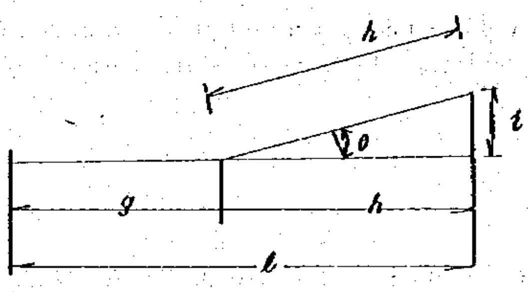
Type	Rail weight	Lead length	Lead radius R	θ	g	h	i	l	Nominal VNRS value	Value converted to JNR system
	kg	mm	m		mm	mm	mm	mm		
S	30	18,118	190	6°50'33"	11,546	12,466	1,449	24,012	0.12	8
i	30	12,154	90.0	8°31'50"	6,906	9,100	1,313	16,006	0.15	7
n	30	14,466	150.0	6°20'00"	6,669	11,331	1,260	18,000	0.11	9
g	30	12,154	90.0	8°31'50"	6,712	9,294	1,313	16,006	0.15	7
l	30	12,932	100.0	7°24'24"	5,867	9,790	1,283	15,657	0.13	8
e	30	16,605	162,647.0	5°42'38"	8,230	12,525	1,220	20,755	0.10	10
Double curved	30	11,413	130.0	11°51'35"	8,067	7,104	1,442	15,171	0.21	5

Method of calculation for normal VNRS value and crossing JNR frog number

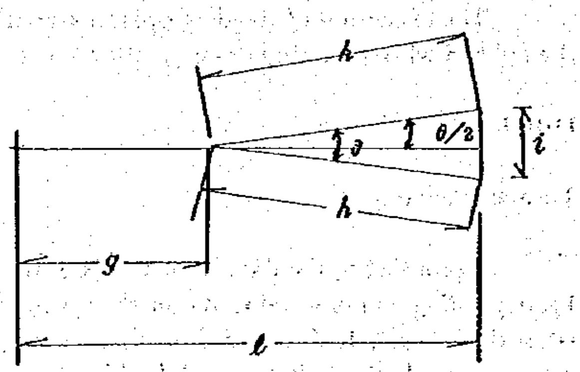
1. VNRS i/h
2. JNR system $N = \frac{1}{2} \cot \frac{\theta}{2}$

N: Crossing number
θ: Crossing angle

Single turnout



Double curved turnout



3) Road bed

Excluding bridges and tunnels, road bed having embankment or cut bank extends for 1,016.2 km and occupies 97% of the total length, from Hue to Saigon. The ratio between embankment to cut bank is approximately 3 : 1, and of this raod bed having less than 1 m of embanking or cutting comprises 43% of the total.

Of the embankment, sections with less than 3 m in embanked height comprise 91% of the total local embankments of approximately 5 - 6 m in height can be found only when the track crosses a valley profile in mountainous districts.

Also, of the cut banks, sections with less than 3 m comprise approximately 93% of the total, and those of more than 3 m in depth can be found only adjacent to tunnels.

Traces of collapses of embankment and cut bank due to flooding were not found despite the long period they were neglected because of the war. Traces of flood washouts of about 10 or 20 m around certain bridge groups between Da-Nang – Phu-Cat were noted as examples of the severest damage that had occurred. Therefore, with the present train speed limitation, use of this road bed seems allowable with only reinforcement and spot repair of profile arrangements.

Table 3-2-3-3

	Section / Height	Total (Km)	Total (%)	Hue・Da-Nang (Km)	Hue・Da-Nang (%)	Da-Nang・Phu-Cat (Km)	Da-Nang・Phu-Cat (%)	Phu-Cat・Saigon (Km)	Phu-Cat・Saigon (%)
Banking	1.0 m Under	265.5	26.2	5.7	5.8	27.2	10.0	232.6	36.0
	1.0 m ~ 3.0 m	416.2	40.9	59.7	60.9	172.3	61.2	184.2	28.5
	3.0 m ~ 5.0 m	60.5	6.0	8.0	8.2	24.7	8.8	27.8	4.3
	5.0 m Over	6.9	0.6	0.7	0.7	1.0	3.0	4.2	0.8
	Total	749.1	73.7	74.1	75.6	225.2	83.0	449.8	69.6
Cutting	1.0 m Under	171.4	16.9	9.3	9.5	21.1	7.7	141.0	21.8
	1.0 m ~ 3.0 m	76.0	7.5	10.0	10.2	20.4	7.5	45.6	7.0
	3.0 m ~ 5.0 m	13.9	1.4	3.6	3.7	4.7	1.7	5.6	0.9
	5.0 m Over	5.8	0.5	1.0	1.0	0.2	0.1	4.6	0.7
	Total	267.1	26.3	23.9	24.4	46.4	17.0	196.8	30.4
Total		1,016.2	100.0	98.0	100.0	271.6	100.0	646.6	100.0

4) Bridges

As this trunk line railway is connecting Viet-Nam along a north and south direction that extends substantially longitudinally along the plains district located between the Annan mountain summit line and the coast line facing the South China sea, there are many railway bridges of several sizes constructed as shown in 3-2-3 Table 4; there is also a bridge of 1,080 m in length.

The years of completion of the railway bridges between Hue and Saigon are classified into the following three periods:

(a) Hue – Da-Nang 1908 (b) Nha-Trang – Saigon 1913 (c) Da-Nang – Nha-Trang 1933-1936

It is said that among these bridges those of sections (a) and (b) were constructed without any design standards, and the rolling load used in their design varied for each bridge. It is also said that the bridges are designed for steam locomotives of approximately 10 tons of axial loads. Section (C), which is the newest section of the Viet-Nam railway, was constructed under definite design standards. The facts are that the 13 ton axial load steam locomotive of 'NOUVBAU CONVOI' tyep (equivalent to KS 16.1) was adopted as a rolling load employed in bridge design, while the steel girders (bottom girders and trusses being the main parts) were produced in Germany, and the understructure together with erection were performed by the French. However, almost all the installations in this section were destroyed during the various phases of the second world war (which started in 1939 - 3 years after the completion of the railway) and during the fighting subsequent to this war. Furthermore, conditions were such that it was unavoidable that maintenance of these installations was neglected during this long thirty-year period. Accordingly the degree of deterioration due to long use was so severe that only seve*al concrete bridges and parts of bridge under structure were assumed to remain as installations free from destruction and available for use in the 280 km of Section C, excluding the portion between Phu-Cat – Nha-Trang.

The number of bridges already installed are shown in 3-2-3 Table 5.

Almost all the foundations of the understructure are of pile.

Drawings that could yield detailed data on pile foundation and the like were searched for but were not available, except for a record concerning the Song Darang Bridge (between Da-Nang and Nha-Trang) stating that approximately 39 pieces of iron-reinforced concrete piles about 13 m in length and having a hexagonal cross-section of 40 cm inscribed-circle diameter, were used for each bridge base.

V N R S authorities at present directly own a prestressed concrete (pretension) factory in Thap Cham. This factory is said to have been established to produce girders for post-war reconstruction use in 1955 and is now continuing its manufacture of PC sleepers at one of the two jack stands previously erected.

Table 3-2-3-4

Section \ Assortment	Length	Total		Steel Bridges		Concrete Bridges	
		Number	Length	Number	Length	Number	Length
Total	Over 2 m	834	17,007	405	11,406	429	5,601
	10 m	260	13,185	150	10,122	110	3,063
Hue – -Da-Nang	"	90	1,894	85	1,838	5	56
		29	1,521	25	1,473	4	48
Da-Nang – Phu-Cat	"	267	7,134	22	3,744	245	3,390
		77	5,476	22	3,744	55	1,732
Phu-Cat – Saigon	"	477	7,979	298	5,824	179	2,155
		154	6,188	103	4,905	51	1,283

Remarks: Those over 10m will be referred to again.

5) Tunnels

There are 22 tunnels between Hue – Saigon, as shown in 3-2-3 Table 5. They total about 7,950 in length which is an extremely small 0.7% of the total route length.

Nine of these tunnels are concentrated in a 35 km section around Lang Co, st located about 38 km to the north of Da-Nang, and 7 tunnels are in an 11 km section near Dai-Lanhst, located about 83 km to the north of Nha-Trang.

The land topography in both of these districts consists of mountains protruding into the sea coast. These districts are in a granite zone that makes the mountainous area so rigid that no abnormalities (such as caveins) are seen, except for fountains with small quantities of water.

o Problems subsequent to emergency reconstruction operations.

Temporary reconstruction between Hue – Da-Nang and Phu-Cat – Saigon was completed by V N R S and train operations were reestablished (though with interruptions at some points) but the strength of the bridges when subjected to direct train loads appears insufficient are remains an obstacle to safety in train operations.

The reasons given for this are:

(1) Temporary materials such as I beams, old rail girders, wooden stagings, wooden sleeper saddles and so on are being used but this strengthening is insufficient. In particular, the numbers of metal side fastenings for old rail girders are too small in that there are fastenings at only one or two locations in a span interval of 5 m - 8 m.

(2) Steel girders that had not received any maintenance for more than 10 years (and some of them more than 30 years), and that had been left immersed in river water for several years and so on, are being reused. Thereby, corrosion of the steel girders has become serious; some of them were seen to have not been repaired of the deformations and damage that occurred during this long period and yet their strength has not been investigated.

(3) The rails used at present are 27 kg/m rails, but strains due to low joints occur at the rail ends and there is an increase in impact loads during the passage of trains. Accordingly the earliest possible reinforcement and repair, for the removal of these problems together with constant inspection for the maintenance of safety to prevent accidents, is highly desired

Table 3-2-3-5

List of Tunnel

Name of Tunnel		km spot	Length	Section
		k m	m	
Mui-Ne	T	725.156	200	Truoi - Cau-Hai
Cau-Hai	T	732.944	358	Cau-Hai - Lang-Co
Phu-Gia	T	745.913	445	——— " ———
Lang-Co	T	757.285	169	Lang-Co - Namo
Khe-Soi	T	757.841	124	Lang-Co - Namo
Hue Entrance	T	759.513	129	Lang-Co - Namo
Hai-Van	T	766.064	564	Lang-Co - Namo
Nam-Chon	T	770.665	322	Lang-Co - Namo
Lien-Chieu	T	774.675	944	Lang-Co - Namo
Binhde	T	997.999	583	Duc-Pho - Tam-Cuan
Phu-Cu	T	1,026.749	171	Bong-Son - Phu-My
Chi-Tanh	T	1,168.703	325	Phuoc-Lanh - Tuy-Hoa
Babonneau	T	1,224.771	1,277	Tuy-Hoa - Dai-Lanh
Vung-Ro	(No. 4)	1,227.119	369	Tuy-Hoa - Dai-Lanh
	(No. 3)	1,228.114	163	Tuy-Hoa - Dai-Lanh
	(No. 2)	1,228.702	248	Tuy-Hoa - Dai-Lanh
	(No. 1)	1,229.251	60	Tuy-Hoa - Dai-Lanh
Bay-Gio	T	1,231.188	394	Tuy-Hoa - Dai-Lanh
Co-Ma	T	1,248.463	403	Dai-Lanh - Ninh-Hoa
Ro-Tuong	T	1,290.226	119	Ro-Ruong - Nha-Trang
Ru-Ry	T	1,306.739	516	——— " ———
————	T	1,310.888	71	——— " ———

6) Stations

Upon checking the VNRS station arrangement diagram, a total of 141 stations were found between Hue and Saigon, as shown in Table 3-2-3, list 6.

At 14 stations (equivalent to 10% of the total), crossing installations are not present.

Table 3-2-3-6

Section	Number of total stations	No. of stations without crossing installation	Remarks
Hue – Da-Nang	11	1	
Da-Nang – Phu-Cat	48		
Phu-Cat – Saigon	82	13	
Total	141	14	

Confirmation of the number of stations among these 141 that actually exist at present was difficult, but so far as this was investigated the following was noticed:

(1) Features of the compound arrangements:

The main stations of Da-Nang,Tamky, Quang-Gai, Nha-Trang, Bangoi, etc. are arranged in a reverse station system.

(2) Effective length

Investigations on effective length standards, their calculation formulae and their actual lengths at present were impossible.

(3) Installations for passengers

It appears that from the beginning there was no consideration of lighting, ventilation, and so on in the main station buildings, so waiting rooms and the like are dark and untidy.
The plazas in front of the stations were occupied by refugees in several small cities, but these plazas were arranged in a regular manner in such main cities as Hue, Da-Nang and Saigon.

The majority of the passenger platforms were built as low-floor types, but their length, width, height and distance from the track could not be confirmed. Platform roofs were constructed only at main stations and over-bridges for passengers are not installed at all.

Some concrete pavement for passenger passage between tracks was seen; however, nearly all of the stations were not even provided with anything similar to passenger passages.

(4) Freight installations

With the present stagnation of freight transportation, the poor attention to freight facilities paid by VNRS authorities was understood. There was nothing worth remembering as loading and unloading equipment. Fences made of barbed wire to prevent theft was used to encircle cargo yards, such delimited areas being seen in Da-Nang and Hue.

7) Signals and telecommunications

(1) Signalling equipment

Signalling equipment is necessary to facilitate safe and efficient train operations, and depending on the quality of their maintenance large differences in railway transportation capacity may occur. The principle of train operation in Viet-Nam is a time interval system based on time schedules effected by wireless communication. Although this system is a primitive method, inferior in safety to modern train operation systems and dependent on the station master and other railway workers, it is still useable without any special inconveniences at present, owing to its following features:

4 section structures in each operating block, remarkably reduced train operating cycles per day (only 3 to 7 per day) and comparatively low train speeds of between 30 and 40 km/h.

Manual signal devices were used conventionally as normal signal systems, but now they are abandoned. Also, interlooking equipment is not yet adopted.

The point system is comprised entirely of the tumbler type and the branching points of the main line are locked with keys. The speed at the points and bridge sections is restricted to 5 km/h. The speed restriction at bridges is caused by temporary reconstruction.

In the Viet-Nam Railway reconstruction plan, adoption of more reliable blocking systems and interlocking devices is desired in the casue of modernization. Furthermore, installation of signals such as home, starting and distance signals, interlocking equipment provided with interlinkage between points and signals, as well as complete adjustment of wireless equipment for telephone blocking systems are required as the minimum indispensable safety installations. These must be installed when the train speed is increased to 65 km/h upon the opening of the full line from Saigon to Hue.

In addition, when designing the signals, equipment permitting future improvement corresponding to the speed increase to 120 km/h is highly recommended.

(2) Telecommunication installations

Though the telecommunication installations before the war relied upon wire equipment using telephone and telegraph, all of them were destroyed by war, and the only traces of them that remain are electric poles.

At present, because of the difficulty in telephone/telegraph reconstruction, remarkably simple wireless installations are used to preserve communication on a barely minimal level for train operations and information correspondence.

Wireless communication is principally classified into two systems for either short and long distan-

(a) Wireless system for short distances and train communications

In order to meet the requirements of information transmission for train operations, wireless devices using a VHF/FM system (161.5 - 161.2 MHz) are provided between main stations and trains to maintain communication. This system is simplex telegraphy using the same electrical frequency, but despite the various inconveniences of 1) the impossibility of simultaneous communications (since not only specified opposite stations but also other stations enter during communication) and 2) the short receivable distances (2 - 15 km) owing to the smallness of the railway wireless devices, use as a substitute for blocking telephones is permitted because of the small train frequency, the low speeds that minimize problems and finally the extremely small communication traffic.

Although almost all the wireless devices are manufactured by the General Electric Company in the U.S.A., and their installation capacities are shown in 3-2-3 Table 7. They need a large labour force for maintenance because there are many troubles caused by daily wear and tear.

(b) Long distance telecommunication

Wireless devices of in the HF/SSB system (1 KW at 7394 KHz including two sidebands) made by the Collins Company in the U.S.A. are set up for communications between the main office in Saigon and the Nha-Trang Operating Division as well as Da-Nang Local Division. The Saigon/Nha-Trang link is used in telephoning and the Saigon/Da-Nang link in telegraphing. The latter was used initially as a teletyping system but was later converted to a telegraph device due to problems with its printer. These are utilized as a communication system based on specified time limitations. This system permits only one simultaneous communication. There are difficulties with operation due to problems caused by weather and worn parts.

For railways, communication traffic usually required facilities capable of communicating quickly with the desired location, exchange of various information relating to passengers and goods as well as maintenance services for the traffic, therefore the number of required telecommunications installations increases as the transportation facilities increase. Of course in the Viet-Nam railway, when the entire system is completed, communication traffic will increase rapidly, and the smooth handling of communication traffic with the present system will be difficult. Therefore it is necessary to consider carefully all communication facilities, taking into account the possible difficulties with the present wireless system.

Table 3-2-3-7 Quantities of Wireless Apparatus

Wireless apparatus		Quantity		
Output	Source	In use	Out of order	Total
1 W	DC6V or 12V	30	10	40
10W	DC 12V	30	40	70
25W	DC 24V	20	1	21
25W	AC 110V	26	13	39
80W 330W	AC 110V	10	4	14
Total		116	68	184

(c) Power supply sources

The power transmission and distribution network is imperfect all over the country and many stations lacking a power supply still remain.

Electric power is supplied at present only to 10 principal stations, at 50 Hz low voltage (110 or 220V). In other stations, either engine generators or batteries are provided as sources for wireless communication.

Enacting the modernization plan as well as the eventual completion of the total line requires efforts to secure sufficient electric supply, together with a determined effort to preserve engine generators and batteries. Electric power demand increases steadily as expansion of signals and communications, as well as lighting installations, is carried out.

8) Level crossings

Though the true number of level crossings cannot yet be estimated accurately because of incompleted traffic areas at present, manual barriers with guards are provided at about 40 crossing locations where traffic is frequent in the area around Saigon – Bien-Hoa.

Viet-Nam railway authorities desire installation of automatic barriers and alarm devices in order to ensure safety.

Further, bridges for the combined use of trains and pedestrians requires facilities to maintain safety while trains are passing.

3-2-4 Rolling Stock

1) Rolling Stock

As shown in Table 1, the VNRS has steam locomotives, diesel locomotives, passenger cars and goods wagons, in operation, and their present state may be summarized as follows.

(1) Steam Locomotives

Steam locomotives had been chiefly used after the establishment of the VNRS, but today they are not widely used and all will eventually be scrapped. Only 6 to 10 locomotives with racks for the steep slope with a 120 percent grade between Thap-Chamcw and Em Da-Lat are expected to be retained for operation.

However, this section remains unopened to traffic and there is no possibility of operating locomotives.

(2) Diesel Locomotives

As shown in Table 3-2-4-2, it is only a short time since diesel locomotives were introduced. They are mostly Arstorme (France) and General Electric (America) BB type 900 P.S. Electric Diesel locomotives and Plymouth 1000 P.S. Liquid Diesel locomotives (America). Units damaged by bombing account for 25 of the 63. This means about 30 percent of them are not in operation. Trains are now scheduled to make one trip a day in the three sections opened for traffic, and there are no problems. However, if destructive activities occur hereafter, this operation will probably be impossible in these sections.

(3) Passenger Cars

Passenger cars total 156, including first class cars, second class cars, third class cars, combinations thereof, special cars, and dining cars, of which about 30 percent are damaged. As indicated in 3-2-4 Figure 1, the fact that about 70 percent of them are deteriorated cars which have been used for over 40 years, and of which about 30 percent have been used for over 70 years (since the establishment of the VNRS) is to be fully considered when attempting to secure safe operations in the future. Travel by trains in the three sections opened for traffic is so difficult that there is a shortage of cars locally. Goods wagons converted into passenger cars are meeting the demand as an emergency measure.

(4) Goods Wagons

As shown in 3-2-4 Table 1, goods wagons total 1,279 including covered wagons, open wagons, hopper cars, flat cars (long cars), ballast wagons, defensive wagons, and tank cars, about 30 percent of which are damaged. As shown in 3-2-4 Table 3, most of them are deteriorated and they are mainly cars made in the 1930's. Some of the double-axle cars which were made when the VNRS was established are deteriorated. Some of the bogie cars which were introduced during the period from 1940 to 1960 have been used chiefly for military purposes.

Freight transportation is not common now and the number of cars is estimated to be sufficient to meet the demand in these three sections, for the near future. It will be necessary, however, to examine the cars which are to be newly introduced as well as replacement of deteriorated cars with due regard to the demand of transportation, when the whole line is reopened.

2) Maintenance of Rolling Stock

(1) Workshops and others

Inspection and repairs of cars are done in the VNRS by 2 locomotive workshops, 4 passenger and goods wagons workshops, 6 inspection and repair sections. Actual states of inspection and repair capacity and personnel are as indicated in Table 3-2-4-4 and 5.

Judging from the actual state of affairs in recent years, it can be supposed that considerable labor is spend on repairing damaged cars as well as locomotives, passenger cars and goods wagons, and regular inspection and repairs which the workshops should be making can not be carried out.

There are not enough young engineers within the military system, and the VNRS is having difficulties in obtaining the required number of personnel and in conserving technical abilities.

Machinery and tools in workshop equipment have been gradually renewed. There are many deteriorated establishments and facilities left for long periods of time, and a considerable investment in facilities will be needed, before inspection and repairs can be performed as required.

For diesel locomotives, there is a dependence on imported materials, while for passenger cars and wagons, materials are self-sufficient within the country.

(2) Inspection and Repairs

The actual state of inspection and repair time is as indicated in Figure 3-2-4-2. Repairs must be done so frequently that inspection and repairs are not completely effected. Inspection bases and standards are not necessarily perfect, and this must be corrected in the future.

The actual state of inspection and repairs are as in Figure 3-2-4-6, 8 and 9.

Attached Table 1 Oct. 1973

TAble 3-2-4-1 Situation of Rolling Stock and Number of Cars

Type	Classification	Number of usable cars	Number of cars for military use	Number of unusable cars	Total
Locomotive	Diesel locomotive (electric)	30		23	53
	" (diesel & hydraulic)	8		2	10
	" (shunting engine)	2			2
	" (sub-total)	(40)		(25)	(65)
	Steam locomotive	10		47	57
	General passenger car				
	(1st class cars)	6		6	12
	(1st class + 2nd class cars)	9		4	13
	(2nd class cars)	8		3	11
	(2nd class + 3rd class cars)	4		3	7
	(3rd class cars)	77		24	101
	Special train	3		3	6
	Dining car	2		4	6
	(Sub-total)	(107)		(47)	(156)
Goods wagon	Covered car				
	(2 axle 5T)	1		5	6
	(2 axle 10T)	64		32	96
	(4 axle 12T)	1		1	2
	(4 axle 15T)	2			2
	(4 axle 20T)	32		14	46
	(4 axle 25T)	184		67	251
	(Sub-total)	(234)		(119)	(403)
	Open car				
	(2 axle 10T)	31		14	45
	(4 axle 20T)	9		6	15
	(4 axle 25T)	14		4	18
	(Sub-total)	(54)		(24)	(78)
	Hopper car	62		28	90
	Flat car				
	(2 axle 10T)	7		8	15
	(4 axle 15T)	1		2	3
	(4 axle 20T)	57		40	97
	(4 axle 25T)	76		25	101
	(Sub-total)	(103)		(103)	(306)

Type	Classification	Number of usable cars	Number of cars for military use	Number of unusable cars	Total
Goods wagon (cont'd)	Ballast car				
	(2 axle 5T)		2	1	3
	(2 axle 10T)	57		17	74
	(4 axle 20T)	1		4	5
	(Sub-total)	(58)	(2)	(22)	(82)
	Armoured car				
	(2 axle 10T)		7	5	12
	(4 axle 15T)		1		1
	(4 axle 20T)		29	28	57
	(4 axle 25T)		10	10	20
	(Sub-total)		(47)	(33)	(80)
	Tank car				
	(2 axle 10T)	12		2	14
	(4 axle 25T)	31		1	32
	(Sub-total)	(43)		(3)	(46)
	Cars for military use	169		25	194
	Total	873	49	357	1,279

Attached Table 2

Table 3-2-4-2 Tractive Power Situation

Type Designation	Freight Service Quantity	Hp. or CV.	Weight	Operating Date	Origin
Diesel Electric BB	5 (6)	850 CV.	52 T	1959	France
Diesel Electric BB	25 (47)	900	52 T	1964	U.S.A.
Diesel Hydraulic BB	8 (10)	1,000	52 T	1968	U.S.A.
Steam Locomotives	10 (57)	710	41 T	1923	France

( ) : Total

Attached Table 3

Table 3-2-4-3 Rolling Stock Situation

Type Designation	Freight Service Quantity	Operating Date	Origin
Coaches			
Passenger Cars			
1st class	6 (12)	1948, 1952	France
1st and 2nd class	9 (13)	1927, 1932	"
2nd class	8 (11)	1902, 1912, 1932, 1940	"
2nd and 3rd class	4 (7)	1900, 1902, 1927	"
3rd class	77 (101)	1902, 1908, 1952, 1963	"
Dining Cars	2 (6)	1940, 1948	"
Service Cars	3 (6)	1900, 1927, 1932	"
Wagons			
Refrigerator Cars	20 (22)	1967	
Box Cars	284 (403)	1902, 1925, 1947, 1955, 1964	France, U.S.A.
Gondola Cars	54 (78)	1902, 1935, 1955, 1962, 1967	France
Flat Cars	203 (306)	1912, 1925, 1939, 1947, 1955, 1967, 1971	France, Japan
Ballast Cars	58 (82)	1902, 1925, 1930, 1935	France
Service Cars	21	1900, 1902, 1947	"
Tank Cars	43 (46)	1902, 1955, 1966	France, U.S.A.
Armoured Cars	47 (80)	1900, 1935, 1947	France

(   ) : Total

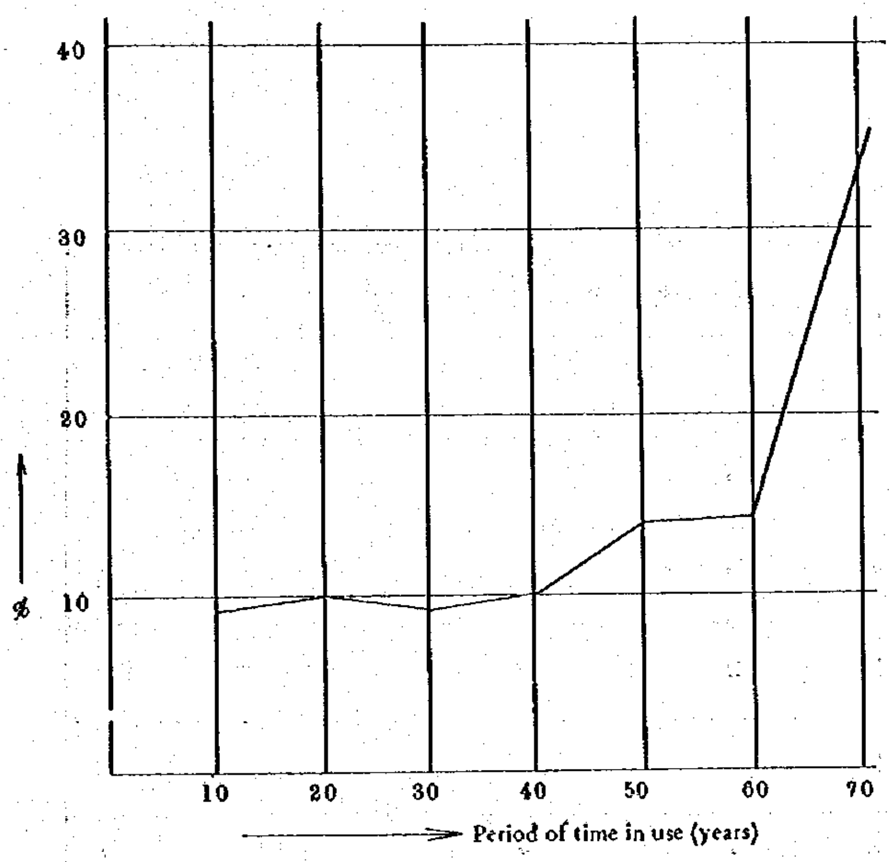


Figure 3-2-4-1 Age of Passenger Cars as % of Total

Table 3-2-4-4 Inspection and Repair Capability per Year

Workshop	Yearly Plan			
	Type	General Overhaul	Repair	Other Inspections
CHIHOA Workshop for rolling stock	Passenger car	0	200	
	Goods wagon	100	334	
DIAN Workshop	Passenger car	100	0	
	Goods wagon	67	0	
THAPCHAM Workshop	Passenger car	0	150	
	Goods wagon	67	334	
DA-HANG Workshop for rolling stock	Passenger car	0	150	
	Goods wagon	100	334	
CHIHOA Workshop for diesel locomotives	Diesel locomotive	17	50	100

Table 3-2-4-5 Arrangement of Personnel

Type / Workshop	Adjust-ment	Welding	Electri-city	Painting	Wood Working	Wooden Moulds	Ironwork	Machines	Smithing	Seaming	Total
DIAN Workshop	38	5	2	2	15	13	17	6	3	1	102
CHIHOA Loco Workshop	26	2	3	1			6	16			54
CHIHOA Car Workshop	29	3	1		4		12	1	2	4	56
THAPCHAN Workshop	20	1			4		1	2	1		29
DA-NANG Loco Workshop	2		2					3			7
DA-NANG Car Workshop	9			1	5		4		2		21
BIENHOA Depot	4										4
MUONG HAAN Depot	2										2
NHATRANG Depot	7				1		1				9
QUINHON Depot	3						1	1			5
HUE Depot	5								1		6
Total Number	145	11	8	4	29	13	42	29	9	5	295

Figure 3-2-4-2 Inspection and Repair

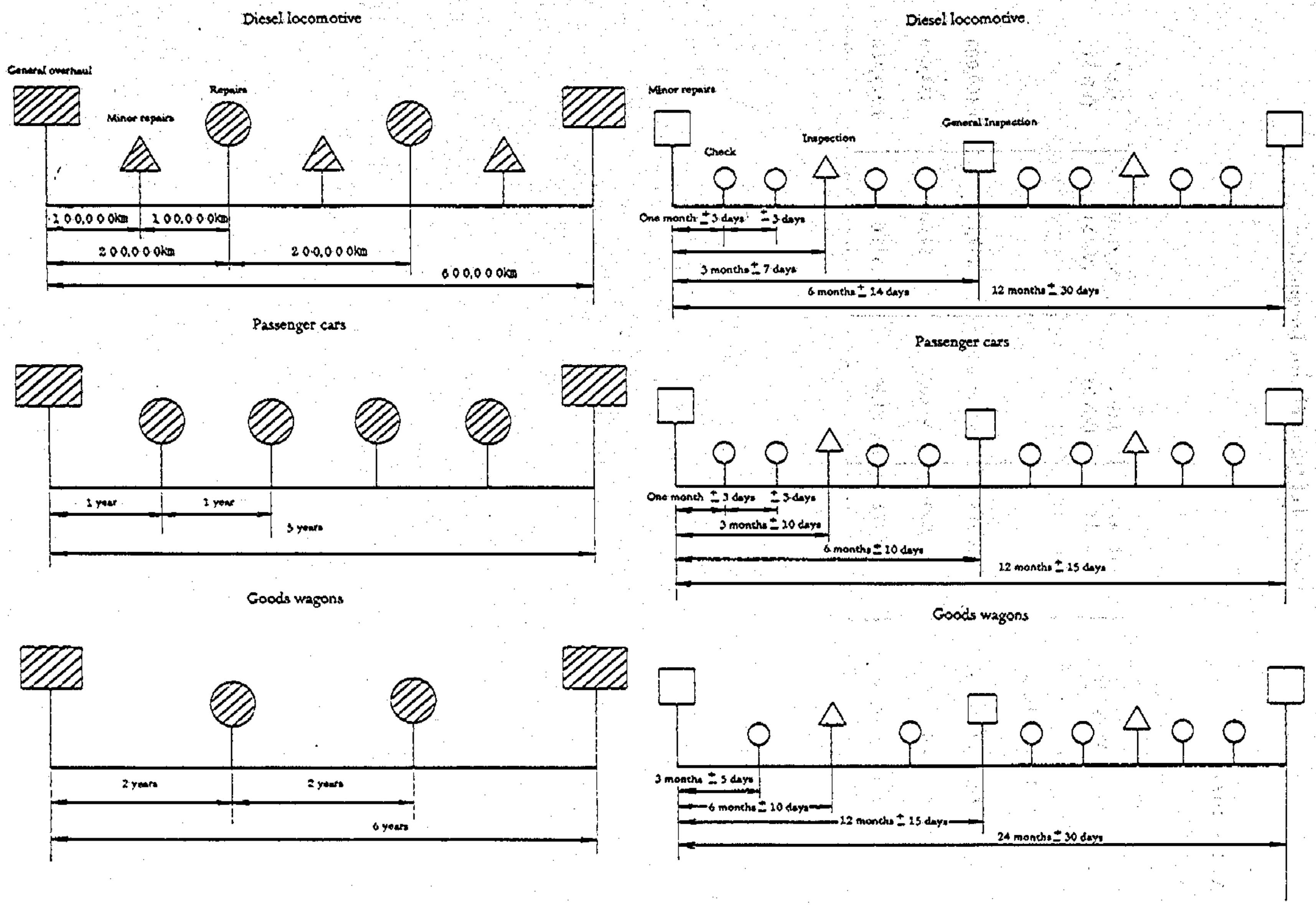


Table 3-2-4-6 Manhours and Expenses for General Overhaul & Overhaul of Diesel Electric Locomotives

VNRS, 1973

Designation	Hours Number	Labor (VN $)	Material (VN $)	Total (VN $)
Diesel electric locos				
General Overhaul	4,715	943,000	457,000	1,400,000
Overhaul	1,500	300,000	54,000	354,000
Sabotage Repairs	18,272	3,654,400	5,575,000	9,229,400

Table 3-2-4-7 Hours Number and Expenses for General Overhaul & Overhaul of Rolling Stock

Passenger Cars								
Type	General Overhaul				Overhaul			
	Hours Number	Labor (VN $)	Material (VN $)	Total (VN $)	Hours Number	Labor (VN $)	Material (VN $)	Total (VN $)
1st class sleeping cars	9,000	1,800,000	300,000	2,100,000	3,500	700,000	140,000	840,000
Service cars and dining cars	9,000	1,800,000	280,000	2,080,000	3,200	640,000	130,000	770,000
1st class + 2nd class and baggage cars	8,500	1,700,000	250,000	1,950,000	2,800	560,000	120,000	680,000
2nd class cars	7,800	1,560,000	230,000	1,790,000	2,000	400,000	110,000	510,000
2nd class + 3rd class cars	7,500	1,500,000	220,000	1,720,000	1,600	320,000	100,000	420,000
3rd class + baggage cars	7,500	1,500,000	200,000	1,700,000	1,500	300,000	90,000	390,000
Service cars	7,500	1,500,000	200,000	1,700,000	1,600	320,000	90,000	410,000
3rd class cars (Australia)	4,000	800,000	200,000	1,000,000	1,000	200,000	80,000	280,000
3rd class cars equipped alternator set (Australia)	5,000	1,000,000	220,000	1,220,000	1,500	300,000	90,000	390,000

Table 3-2-4-8 Hours Number and Expenses for General Overhaul & Overhaul of Rolling Stock

Type	Freight Cars							
	General Overhaul				Overhaul			
	Hour Number	Labor (VN $)	Material (VN $)	Total (VN $)	Hour Number	Labor (VN $)	Material (VN $)	Total (VN $)
Box cars (American)	2,000	400,000	30,000	430,000	500	100,000	14,000	114,000
Box cars (French)	2,000	400,000	90,000	490,000	800	160,000	54,000	214,000
Box cars for baggage	2,000	400,000	90,000	490,000	800	160,000	54,000	214,000
Hopper cars	1,500	300,000	40,000	340,000	600	120,000	20,000	140,000
Gondola cars	1,800	360,000	50,000	410,000	700	140,000	30,000	170,000
Flat cars & ballast cars	1,800	360,000	50,000	410,000	700	140,000	30,000	170,000
Box cars (2 axles)	1,800	360,000	50,000	410,000	700	140,000	30,000	170,000
Gondola cars (2 axles)	1,500	300,000	40,000	340,000	600	120,000	25,000	145,000
Flat cars & ballast cars (2 axles)	1,300	260,000	35,000	295,000	450	90,000	15,000	105,000

Table 3-2-4-9 Results of Inspection and Repairs of Rolling Stock (1968 - 1973-8-30)

Type \ Year	1968	1969	1970	1971	1972	1973 8 - 30
A. Locomotive						
1. Repair of damage						
Diesel locomotive	29	53	31	38	22	24
Steam engine	7			3		
2. General overhaul (periodical)						
Diesel locomotive			1	1	1	2
Steam engine			3		1	1
3. Periodical repairs						
Diesel locomotive				1		
B. Passenger and goods cars						
1. Repair of damage						
Passenger car	8	2	5	12	-	-
Goods wagon	102	94	120	150	119	43
2. General overhaul (periodical)						
Passenger car	27	5	14	3	16	11
Goods wagon	90	30	27	11	34	29
3. Periodical repairs						
Passenger car				5	10	10
Goods wagon		11	12	2	31	21

4. RECONSTRUCTION PLAN AND MODERNIZATION

[illegible]

4. RECONSTRUCTION PLAN AND MODERNIZATION

4-1 Estimate of Traffic Volume

4-1-1 Passengers

The volume of traffic on the Viet-Nam railways had been steadily decreasing because of the war. The volume reached its peak in 1961 and dropped to its lowest point in 1966 when the war was at its height. It then increased slightly but still, as in 1972, fell far short of the volume in 1961, because of the continuing tensions and outbreaks of fighting.

Table 4-1-1-1 Volume of Passenger Traffic on the Viet-Nam Railways by Year

Year	Number of passengers 1,000persons	Up 1,000 persons	Down 1,000persons	Volume of traffic 1,000persons km	Up 1,000persons km	Down 1,000persons km
1958	3,552	1,793	1,759	426,817	215,970	210,847
59	2,657	1,318	1,339	514,583	259,760	254,823
60	2,673	1,280	1,333	541,736	257,078	284,658
61	2,580	1,260	1,320	583,120	290,572	292,548
62	1,734	835	899	338,015	170,986	167,029
63	1,367	671	696	229,992	113,496	116,496
64	873	445	428	124,635	64,125	60,510
65	144	83	61	14,045	7,142	6,903
66	81	45	36	3,838	1,990	1,848
67	345	175	170	12,814	7,176	5,638
68	260	135	125	12,926	6,713	6,213
69	1,770	830	940	71,481	35,390	36,091
70	2,614	1,316	1,298	88,259	45,506	42,753
71	2,846	1,422	1,424	85,657	42,853	42,804
72				65,672		

Some sections of the railways in Viet-Nam have been temporise repaired by Viet-Nam Railway System, but there are few sections where trains run on time due to fear of attack from the guerrillas. Therefore, buses function as the main passenger service in Viet-Nam.

Table 4-1-1-2 Volume of Passenger Traffic by Various Means (1972)

Means	Volume of traffic 1,000 persons km	Component ratio %
Railway	65,672	0.6
Bus	11,287,640	95.1
Air	511,763	4.3
Total	11,865,075	100.0

o There is no data for marine transport, but its volume is insignificant.

Viet-Nam Railway System authorities estimates that the volume of passenger traffic by rail in 1975 (when all the temporary repair work will have been completed except for the section between Phu-Cat and Da-Nang) will be about 1.25 times as large as that in 1961, when the volume was the largest it had ever been. This estimate seems quite reasonable considering that the population of 1972 was 1.3 times that of 1961. In order to estimate the volume of traffic for the 10 year period after 1975, we must rely on the estimate made by V N R S authorities since the volume in the past can not be used for this purpose due to the state of war that exists at present. According to the 4-year economic program presented in 1972, the rate of increase of the population is considered to be 3% a year. If we estimate the volume of traffic by assuming the rate of increase to be 3% a year and using the volume of traffic in 1975 as a basis, the result will be as illustrated in Table 3. As can be seen from the table, the volume of traffic in 1982 almost matches that estimated by V N R S for the same year.

Table 4-1-1-3 Estimated Volume of Passenger Traffic

Year	Estimated volume of traffic	Volume of traffic estimated by VNRS
	1,000 persons-km	1,000 persons-km
1975	734,330	734,330
76	756,360	
77	779,050	
78	802,420	
79	826,493	
80	851,287	
81	876,825	
82	903,129	
83	930,222	990,221
84	958,128	
85	986,871	

Fig. 4-1-1 graphically shows the above result.

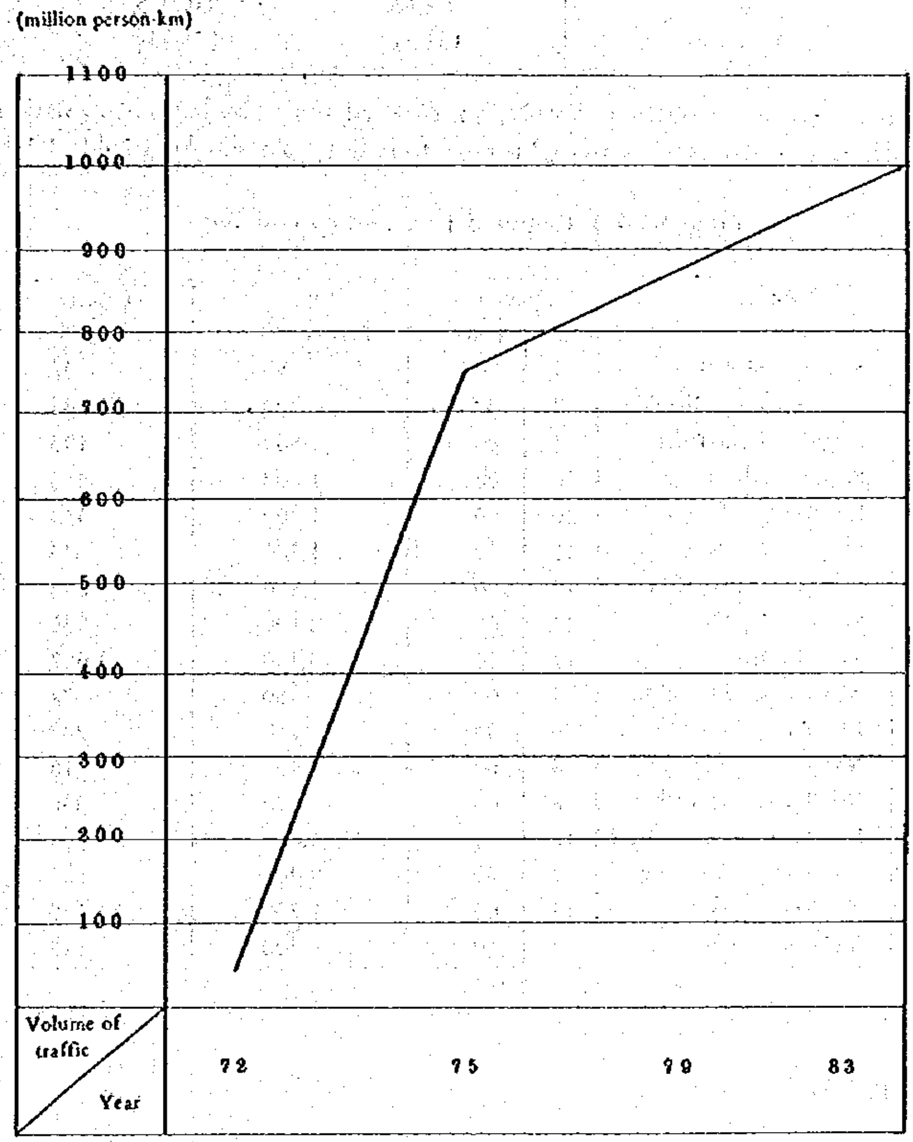


Figure 4-1-1

If a maximum speed of 95 km/h and an average speed of 70 km/h can finally be obtained upon completion of the reconstruction work on the Viet-Nam Railways, railway transport will surpass but transport as far as speed is concerned. Even when provisional repairs are done to the rails to obtain a maximum speed of 65 km/h and an average speed of 50 km/h, the speed of trains will still surpass that of buses. In addition, because of the recent petroleum situation, it is expected that a considerable portion of present bus transportation will be taken over by railways.

Table 4-1-1-4 Volume of Traffic by Various Means (1972)

Means	Volume of traffic	
	1,000 person	1,000 person-km
Bus	133,713	11,287,640
Taxi	99,420	919,025
Private car	133,358	1,276,939

The present passenger traffic in Viet-Nam is chiefly handled by buses using national roads. Time and fare specifications of buses when routed parallel to railways are shown in Table 4-1-1-5.

Table 4-1-1-5 Required Time and Fare of Bus

Route	Time		Fare	Distance
	h	min	Piaster	km
Saigon – Bien-Hoa	1	00	85	32
Saigon – Long-Khank	2	30	200	80
Saigon – Phan-Thiet	6	00	500	190
Saigon – Nha-Trang	10	00	1,000	413
Nha-Trang – Saigon	10	00	1,200	413
Saigon – Qui-Nhon	12	00	1,700	643
Saigon – Quang-Ngai	14	00	2,800	800
Saigon – Da-Nang	24	00	3,200	939
Saigon – Hue	27	00	3,700	1,052
Nha-Trans – Phan-Rang	4	00	250	92
Nha-Trang – Phanthiet	10	00	700	247
Nha-Trang – Tuy-Hoa	6	00	400	118
Nha-Trang – Qui-Nhon	8	00	800	230
Nha-Trang – Quang-Ngai	10	00	1,800	388
Nha-Trang – Da-Nang	12	00	2,200	527
Nha-Trang – Hue	15	00	2,700	640
Da-Nang – Hue	2	30	300	113

4-1-2 Freight

Regarding freight traffic, truck transport has the largest volume of traffic, accounting for 85% of all traffic. Freight traffic by rail is hardly practiced at present because of the danger of sobotage and guerrilla attacks. Freight traffic by rail in 1972 was the lowest since 1957.

Table 4-1-2-1 Volume of Traffic by Various Means (1972)

Means	Volume of traffic 1,000 ton-km	Component ratio %
Railway	6,626	0.6
Truck	987,376	85.8
Inland water transport	153,065	13.3
Air	3,291	0.3
Total	1,150,358	100.0

Table 4-1-2-2 Yearly Change of Volume of Freight Traffic by Viet-Nam Railways

(1,000 ton-km)

Year	Total	Up	Down
1958	84,085	58,603	25,482
59	107,584	81,858	25,726
60	143,848	107,291	36,557
61	166,844	112,157	54,687
62	151,798	111,730	40,068
63	183,510	127,318	56,192
64	134,069	88,032	46,037
65	31,714	21,286	10,428
66	14,171	6,770	7,401
67	28,578	19,442	9,136
68	18,369	13,864	4,505
69	41,196	32,190	9,006
70	52,850	42,671	10,179
71	38,273	23,969	14,304
72	6,626		

V N R S estimates that the volume of freight traffic in 1975 (when the temporary repair work has been completed) will be 186,630 ton-kms, which is comparable to that of 1963. It is also estimated that the volume of freight traffic in 1983 will be 824,836 ton-kms. The estimated value for 1975 seems reasonable. However, it is difficult to estimate the volume for 1983 since no information is obtainable due to the war.

4-1-3 Traffic Plan

A) Basic Plan :

Because of the war and subversive activities, railways can only run a total of 520.2 km in Viet-Nam; 103.1 km in the DA-NANG region, 336.8 km in the NHA-TRANG region and 80.3 km in the SAIGON region. However, these sections are only provisionally repaired, and, therefore, safe and fast mass transport is almost impracticable.

The following should be taken into consideration for the future reconstruction of the Viet-Nam Railways.

(a) Complete reconstruction of the sections that are at present blocked.

(b) Complete reconstruction of the sections that are only temporarily reapird

(c) Increase of capacity of rolling stock

(d) New installation of maintenance facilities for operating the trains

(e) New installation of maintenance facilities for the station precincts

(f) New installation of maintenance facilities for the crossings

(g) Consolidation of the maintenance system

(h) Establishment of standards

(i) Ungrading staff quality by training

(j) Reinforcement of the electric power facilities

(k) Repletion of the communication facilities

Considerable time and money are required to solve these problems so that transportation capacity should be built up gradually in consideration of modernization in future.

1) Before the total reconstruction of the entire route is completed, the present track should be reinforced, the turn outs in stations should be improved, and safety devices should be newly installed.

   By equipping the crossings, installing maintenance facilities for the same and fully utilizing the existing rolling stock, it should be possible to achieve the desired speed of 65 km per hour.

2) When the total reconstruction work on the full line has been completed, the efficiency of the rolling stock should be improved, and blocking system and facilities should be improved to potentiate a maximum speed of 92 km per hour.

3) A maximum speed of 120 km/h is possible by improving rolling stock and reinforcing the maintenance facilities and operation control system.

On the other hand, it is estimated that the volume of traffic in 1983 will be:

o Volume of passenger traffic 930,222,000 persons-kms

(These volumes are almost equal to those in the jurisdiction of the Kushiro railway operating division of JNR in 1971.)

These volumes, when the volumes of the Viet-Nam Railway in 1962 is assigned to 100, will be

275 for passenger traffic. The number of trains are expected to be 2 - 4 times as large, that is, 20 - 30 trains per month, (excluding commuter trains to the cities.) This number of trains can be easily handled even with single-track operations. A switch-back system for the stations on the section between THUHAI and LIENCHIEU and some other stations and elevation of the railway around SAIGON are not considered here.)

B) Passenger Traffic

There are two types of passenger traffic.

1) Long distance transportation between cities

There is one line from HANOI to SAIGON. Since this railway runs on the plain along the coast, large cities are dotted along the railway. According to the railway schedule of 1962, there were three series of trains between SAIGON and HUE and it took three days to reach each point by making connections between these three trains.

However, the time required between SAIGON and HUE should be decreased to about 15 hours for the future economic development of Viet-Nam, and by which the area long the railway will be developed rapidly. Furthermore, it is expected that operations at 120 km/h will be very construction to such development.

2) Short-distance transportation

It is expected that reopening of the line between HANOI and SAIGON and the economic development will result in gravitation of population toward cities. Even at present, the commuting traffic in SAIGON has many problems. Along with the development of the roads, elevated railways should be introduced, and a commuting system should be established in the city planning.

3) Freight traffic

In Viet-Nam, there are plains along the coast, but most of the inland areas are mountainous. However, the good ports are only DA-NANG, CAMRANH and SAIGON. It will be necessary for industrial development that materials be transported to the cities and transported back to the ports by rail. Therefore, freight traffic will rapidly increase in future. However, the facilities for freight depots are not good at the moment because freight traffic is not operative. Modern freight depots and facilities should be planned for future development.

4) Traffic Planning

The Viet-Nam Railways have been very badly damaged by the war, and a lot of time will be required for its total repair. We shall consider traffic planning when all the line have been restored. In this report we shall only make a basic investigation.

(1) Reduction of the time required

The required time for each section is shown in Table 4-1-3-1. For the section between SAIGON and HUE, 21 hours and 25 minutes at a maximum speed of 65 km/h and 14 hours and 55 minutes at a maximum speed of 95 km/h. Thus the time can be reduced 12 – 19 hours.

The above times were calculated in the following ways.

(a) The train is assumed to stop at every station and the stopping time is not included.

(b) Entry speed is such that a speed when the train passes the outer-most point is 45 km/h.

(c) Sixty-five km/h was calculated for the case when passenger cars are pulled by a diesel locomotive. Ninety-five km/h was calculated when pulled by a railcar.

(d) The speed limit on JNR single track was applied to that of the 65 km/h operation.

Table 4-1-3-1 Time Required at Each Speed for Each Section and Average Speed

Type of speed / Section	Time required for each section and average speed		
	1962	65 KM/H	95 KM/H
Dong-Ha – Hue	(139min) (29.3KM/H)		
Hue – Lang-Co	129min 31.2KM/H	99min 40.7KM/H	70min 57.5KM/H
Lang-Co – Da-Nang	85min 25.4KM/H	100min 21.6KM/H	61min 35.4KM/H
Da-Nang – Tam-Ky	121min 36.3KM/H	86min 51.1KM/H	61min 72.0KM/H
Tam-Ky – Quang-Ngai	103min 36.9KM/H	69min 55.0KM/H	48min 79.1KM/H
Quang-Ngai – Tam-Quan	149min 30.8KM/H	85min 54.0KM/H	63min 72.9KM/H
Tam-Quan – Dieu-Tri	143min 38.9KM/H	112min 48.8KM/H	77min 71.0KM/H
Dieu-Tri – Tuy-Hoa	202min 30.3KM/H	124min 49.3KM/H	87min 70.3KM/H
Tuy-Hoa – Nink-Hoa	171min 29.2KM/H	96min 51.9KM/H	68min 73.3KM/H
Nink-Hoa – Nha-Trang	58min 35.4KM/H	41min 50.0KM/H	28min 73.3KM/H
Nha-Trang – Thap-Cham	141min 39.5KM/H	104min 53.4KM/H	75min 74.3KM/H
Thap-Cham – Muong-Man	285min 30.1KM/H	143min 60.1KM/H	98min 87.7KM/H
Muong-Man – Gia-Ray	165min 29.1KM/H	103min 46.7KM/H	74min 64.9KM/H
Gia-Ray – Bien-Hoa	109min 36.7KM/H	77min 51.9KM/H	54min 74.0KM/H
Bien-Hoa – Saigon-HK	54min 35.8KM/H	46min 42.0KM/H	31min 62.3KM/H
	2,054min 32.4KM/H	1,285min 48.6KM/H	895min 69.8KM/H

(2) Increase of transportation capacity

All the Viet-Nam Railways are single track. The transportation capacity of the line can be calculated by using the following formula.

$$N = \frac{1{,}440}{t + c} \times f$$

When N: transportation capacity of a line
t: average travelling time of a train between two stations
c: blocking time (1.5 minutes of automatic, interlocked or tokenless block sections; 2.5 minutes for other areas)
f: coefficient of utilization (0.6 as a rule)

According to the above formula, the transportation capacity of a line becomes smaller as the travelling time becomes longer. Therefore, if we use the maximum travelling time for the calculation,

a) section between LIEN-CHIEU and LANG-CO

$$N = \frac{1{,}440}{82 + 2.5} \times 0.6 = 10 \text{ trains}$$

b) section between SONG-PHAN and MUONG-MAN

$$N = \frac{1{,}440}{40 + 2.5} \times 0.6 = 20 \text{ trains}$$

These are the transportation capacities of the lines for operating at a maximum speed of 65 km/h. If 95 km/h is used for the same sections,

for the section in (a)

$$N = \frac{1{,}440}{49 + 2.5} \times 0.6 = 16 \text{ trains}$$

for the section in (b)

$$N = \frac{1{,}440}{30 + 2.5} \times 0.6 = 26 \text{ trains}$$

Thus, in order to increase the transportation capacity of line.

- o increase the speed of a train
- o install a crossing facility for two trains between two stations
- o lay double-tracks on some sections

If the speed up measure between LIEN-CHIEU and LANG-CO is taken (since there are continuous curves of R = 100, a new line and tunnels must be built), about 20 trains can be run. And by adopting the automatic block system, trains will be able to run continuously, which results in an increase of the transportation capacity.

As a result of the above investigation, it is desirable that the traffic plan of the Viet-Nam Railways should be made by investigating the station facilities at the time the other facilities have been completed.

4-2. Plan of Execution

In the light of the present situation on this trunk line, it seems necessary that the reconstruction work be executed as soon as possible in order to attain the two goals, namely, safe operation of the trains and early opening of the full line.

V N R S hopes to draw up a reconstruction plan that covers not only the work that would have been done there had not been at least thirty years of vacuum, but also the measures necessary to eliminate obstacles to future modernization. This sounds quite natural.

There are many things to be done for modernization. However, it seems that the following two are what V N R S eagerly desires.

1. Reduction of travelling time of passenger cars by increasing the speed

2. Increase of transportation capacity that has been low due to the shortage of trains.

Compared with the traveling time and the transportation capacity of airplanes and long-distance buses now in operation, the above two are certainly necessary for the railway.

Some investigation has been made to establish the standard of the facilities, in order to implement the reconstruction plan when the above factors are taken into account.

As a result, we would like to suggest the following:

At a ECAFE meeting, it was suggested that the maximum speed should be 100 km/h - 120 km/h for the Asian trunk line network project. Considering the present situation of V N R S and the experiences of JNR with operations at 120 km/h, the future goal should be such that there will be no setbacks when 120 km/h is achieved.

1) Track gauge

Since it is on the route of the South East Asian Railway that is to be laid in future, the track gauge is to be 1,000 mm to match the railways in Thailand, Malaysia and Cambodia.

2) Radius of curvature

The minimum radius of curvature is to be 400 m. However, this is to be reduced up to 250 m if necessary.

3) Gradient

The maximum gradient on this line except at stations shall be less than 10%. However, it can be up to 20% if necessary. The gradient at stations is to be less than 3.5%. Curve friction must be taken into consideration for gradient with curve.

4) Standard design rolling load

In consideration of various investigations, it shall be KS-14 (maximum axial force 14t).

5) Structure gauge

The structure gauge shall be as presently used. However, a structure gauge for tunnels and special bridges must be newly set out, which will not be described here.

The above are basic facility standards for the 120 km/h operation. However, the 120 km/h operation requires high technology and many facilities, including those for stocks, tracks and stations, operation maintenance facilities, maintenance facilities for crossings, communication facilities, train control facilities and maintenance facilities.

Therefore, fundamental constructions such as bridges and tunnels are to be made in accordance with the facility standard for the 120 km/h. Other facilities should be planned for the 65 km/h operation as the first stage and for the 75 km/h operation as the second stage. Now, we will describe the details of the plan.

4-2-1 Implementation

(General)

As a result of our study, we would like to suggest the following for implementation of the plan for reconstruction and modernization:

1) Extent of the modernization plan to be enforced at the time of reconstruction

The extent of the modernization plan to be enforced at the time of reconstruction must be examined. In order to achieve the required speed of 120 km/h, it is certain that in spite of the foreign aid expected, the operation will be a lengthy one. The reasons are as follows, 1) financial limitations involved; 2) uncertainty regarding the efficiency of the executing forces; and 3) the absence of a guarantee regarding the continued and sufficient supply of materials necessary to carry out the work.

In the light of these possible setbacks, we have decided to adopt a limited modernization plan rather than attempt something too ambitious that may result in setbacks harmful to the whole. Nevertheless, we feel certain that by increasing the safety of the railways we can open all the lines and therefore improve their effectiveness. When the trunk line has been so restored that it can guarantee safe passage resulting in the stabilizing of the carving capacity, it is certain to help promote the economic development of the country.

If this happens, it is expected that popular support for developing the railways, namely thorugh increases of speed and transportation capacity, will be accelerated.

As the climate of opinion is favourable, it would be unfortunate to miss opportunities by delaying too long. Our investigations must be carried out in the light of future attitudes and changes.

2) Priorities

In implementing this plan there appear a number of problems concerning priority areas.

This does not apply to the facilities, as railways can operate only when the facilities are equally balanced. Therefore, basic technical procedures can be naturally determined.

This problem applies to the sections. As a result of the field survey, the following two sections should be considered.

(a) The section between Da-Nang and Phu-Cat

This section is badly damaged by the war and is superannuated. It is considered better economically and in respect to the period required for repairs if the section is rebuilt completely without provisional reconstruction work.

(b) The sections between Hue and Da-Nang and between Phu-Cat – Nha-Trang – Bien Hoa – Saigon.

These sections have already been temporarily reconstructed and operated. The following can be said about the above sections.

If it is necessary politically and economically to connect the area north of Da-Nang, which is isolated from the central and southern regions, with the cities in the south central region including the capital of Saigon, the section mentioned in (a) should be reconstructed first.

On the other hand, if the stable transportation capacity is to be obtained by increasing the safety of the section now in operation, then section (b) should be reconstructed first.

As for the period required for the reconstruction, almost the same period of time should be necessary for both sections.

When we consider the effect that the complete reconstruction of all lines will have on economic development, it would be best if all the lines are reconstructed as soon as possible. Therefore, those two sections should be reconstructed at the same time.

Next we will consider the priority of work within each section. As a result of our survey, we would like to suggest the following:

Section (a)
The construction process that is to be taken when now lines are laid must be applied to this section. The work should be started from both ends. In this case, Da-Nang and Qui-Nhon should be sued as bases.

Section (b)
Although trains are already running, there are many problems as to safety. Since the purpose of the reconstruction of this section is to increase safety, we must first consider the section between Hue and Da-Nang, which is considered unsafe.

Next we should reconstruct the section between Long Khanh and Saigon where the carrying capacity should be the greatest. Later we should reconstruct the section between Nha-Trang and Long Khanh in order to achieve safe traffic between Nha-Trang and Saigon and between Dalat and Saigon. The last reconstruction should be on the section between Phu-Cat and Nha-Trang where only a small number of bridges are required and the rolling load used in their design is the largest.

However, there are two problems we must discuss here.

1. Improvement of the curves on the section of about 30 km between HoiMit and Namo, which lies between Hue and Da-Nang, where there are about 125 curves of a radius of 100 m.

2. Improvement of the section between Bien Hoa and Saigon where trains must run at their lowest speed because of houses built in violation of the structure gauge.

These problems will be discussed in more detail later, since they should be discussed as individual projects.

(Track)

The reconstruction plan and modernization of V N R S can be divided into two parts.

1. Temporary reconstruction work

2. Reconstruction including modernization to reach the same level as that of the meter-tracks in the neighboring countries.

As for the section between Hue and Saigon that we surveyed this time, the reconstruction work is progressing except for the section between Da-Nang and Phu-Cat which was very badly damaged. The line is scheduled to be open in June, 1974 including the section between Thapcham and Saigon which is now suspended.

We investigated the priorities, period necessary for the reconstruction and costs of work to implement the reconstruction and modernization plan.

1) The sections between Hue and Da-Nang and between Phu-Cat and Saigon where trains can run should be further rebuilt and modernized by the time the section between Da-Nang and Phu-Cat will be reopened.

   (a) Trains can run at speeds of about 30 km/h on this section. However, as mentioned before, the track condition is quite poor because of the fatigued track materials, shortage of maintenance labor and the poor maintenance control system.

   Therefore, we should promote the reconstruction work in accordance with the facility standards in order to increase the speed (65 km/h in the first stage) while removing dangerous factors so as to obtain safety of operations.

   (b) We should first reconstruct the sections where the speed can be increased, sections where the track condition is poor and sections where the maintenance is difficult.

Then we should replace rails with heavy ones, improve sleepers and restore rail beds, thus gradually covering the whole line.

(c) While improving tracks in station compounds necessary to maintain signal and safety facilities, improvement of points (replacement by heavier ones and increase in numbers, improvement of sleepers and improvement of drainage facilities (in order to prevent short-circuit) should be made. It is desirable that the above work be done in connection with the work on the track beds, bridges and signal and safety facilities. Then the speed should be increased on the sections as they are reconstructed.

2) The section between Da-Nang and Phu-Cat should not be temporarily reconstructed. It would be most profitable if the modern tracks described in the facility standards are laid.

This section has not been used for twenty years, and the facilities for this line are badly damaged by nature as well as by the war. Therefore, small scale reconstruction work would not be good enough for business operations.

Even if conventional facilities that are usable, such as track bed, are fully utilized, it is reconstruction equivalent to new construction. Thus, we believe that tracks should be newly installed based on the new standard, as should be civil structures such as track beds and bridges.

In working out a plan of execution of construction on this section, satisfactory study should be performed on the construction procedure and its effects, since partial opening (as VNRS authorities claim) between Phu-Cat and Quang-Ngai seems necessary.

3) Rough estimates

Fig. 4-2-1-1 shows the rough estimates for the track reconstruction work on the sections between Hue and Da-Nang and between Phu-Cat and Saigon and for track laying work on the section between Da-Nang and Phu-Cat.

Table 4-2-1-1

Section / Item of work	Hue -- Da-Nang	Da-Nang – Phu-Cat	Phu-Cat – Saigon	Total
Weight increase of rails	103 km		659 km	762 km
Turnout improvement	58 set		384 set	442 set
Sleeper improvement	103 km		659 km	762 km
Sleeper increase	12,360 pcs		79,080 pcs	91,440 pcs
Ballast reconstruction	103 km		659 km	762 km
Track installation		280 km		280 km

The work to improve curves that are in about 35 km on the section between THUALUU and LINECHIEU (which is between Hue and Da-Nang) should be started after the relationship of this work with the modernization plan has been clarified. The same applies for the modernization of Saigon city and vicinity, and to the section between Bien Hoa and Saigon which lies between Phu-Cat and Saigon.

The specifications for the improvement plan of points are as shown in Table 4-2-1-2. However, since the station plan in the reconstruction plan has not been discussed, those figures are expected to change considerably. In particular, the figures for the section between Da-Nang and Phu-Cat are expected to change greatly.

Table 4-2-1-2

Item \ Section	Hue – Da-Nang	Da-Nang – Phu-Cat	Phu-Cat – Saigon	Total
Required number to be laid	76	230	553	859
Improvement in numbers	58	205	384	647
12#, weight increase	35	104	163	302
Other weight increase	23	101	221	345
No improvement needed	18	25	169	212

4) Execution Procedure

(a) Sections between Hue and Da-Nang and between Phu-Cat and Saigon:

The main tasks on these sections are to increase the weight of rails by replacement, to replace and increase the number of sleepers, to improve the switches and reconstruct rail beds. We think it will increase the execution speed if rails and sleepers are replaced in a block by the track panel method as used in the military bases that have been built at several places.

We think that it will be economical if we fill in the track ballast to keep the required profile, as soon as the track panel work has been completed.

The reason for adopting the track panel method is that, in addition to the increase in speed and efficiency, the safety of train operations in executing the work must be guaranteed. There is a problem with the structure of the iron sleepers when the weight of rails is increased using the existing iron sleepers. This problem is shown in the attached data - 2.

(b) Section between Da-Nang and Phu-Cat

The most economical and effective way is as follows.

Track panels should be laid by the track panel method on the new track bed starting from both ends, Da-Nang and Phu-Cat, when the civil engineering has been completed. Then discharge the ballast from freight cars, and arrange the track to keep the required profile.

(c) Long rail

The rails laid by the procedures in (a) and (b) can be welded on to the rail bed after the required profile has been obtained and the bed has been stabilized.

On the other hand, after 25 meter rails have been laid on the track panel for a certain distance and the track bed has been arranged to the required level, these rails can be replaced by long rails that have been welded elsewhere.

In order to decide which method to use, the conditions of the sections, type of welding and costs of work must be compared.

The important conditions for laying long rails are as follows:

i) Long rails should not be laid on a curve, whose radius is less than 800 m.

ii) Continuous long rails should not be laid on a curve of reverse slope, whose radius is less than 1500 m.

iii) Long rails should be avoided on a bridge of more than 25 m long, where there is no rail bed.

iv) Long rails should be avoided on bad track bed or creeped rails.

(d) Improvement of turnouts

In increasing the weight and the number of rails, the line arrangement in the stations will have to be changed. This is because of the change of the crossing angle and the theoretical point of intersection. This will result in the reduction of the effective length of the rail and have an effect on the functioning of stations.

Therefore, in planning to improve the points, a careful field survey must be made to avoid traffic interference during construction.

5) Construction Procedure

According to the plan presented by V N R S, all sections are scheduled to be opened in five years. However, although reconstruction and opening of the section between Da-Nang and Phu-Cat is technically possible, we believe it very difficult if we consider the fact that the sections between Hue and Da-Nang and between Phu-Cat and Saigon will be modernized at the same time.

Therefore, we assumed that it would take 10 years to open all sections by using the facilities suggested in the modernization plan. On this assumption, we have investigated the standard periods of time required for the track work.

(a) Production of P.C. sleepers

If we assume that P.C. sleepers are used in all are as where P.C. sleepers can be sued except on points, crossings, bridges with no rail bed and sharp curves, the number of sleepers required will be about 1.6 million.

It is evident that the P.C. factory in THAPCHAM (present production capacity 20 sleepers per day) alone can not produce enough sleepers for all the lines.

Therefore, even if the facility of the THAPCHAM factory is improved and two other factories with a production capacity of 400 sleepers per day are newly built, it will take about five years to complete the work.

(b) Renewal of Track Skeleton of the sections already opened

Total length is about 730 km. Even if we divide it into four parts, since about 6 km/month is considered to be the standard amount of work, about two and a half years will be requured,

(c) Reconstruction of ballasts on the sections already opened.

The required amount of ballast is about 580,000 m^3. If this amount is transported by work cars of 500 ton traction assuming two loads a day as standard, only 15,000 m^3 can be transported per month. Therefore, about three and a half years will be required.

(d) Construction procedure on the sections not yet opened.

If we calculate the required time for the work of track skeleton and ballasts similar to the above, the results are as follows.

i) track skeleton 280 km/(6 km x 2 points) $\fallingdotseq$ approximately 2 years

ii) ballast 420,000 m^3/15,000 m^3 $\fallingdotseq$ approximately 2½ years.

(e) Conclusion

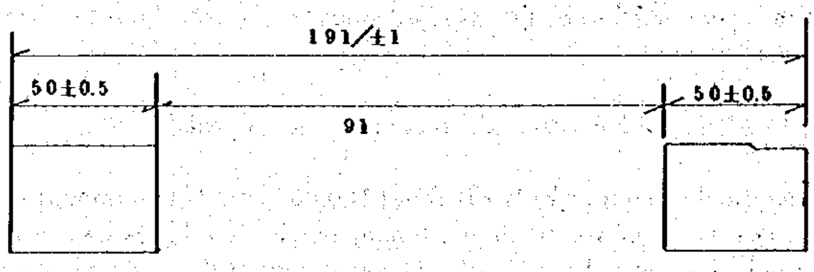
In addition to the above, if we consider the whole process including the improvement of the sharply curved sections between Hue and Da-Nang, track maintenance, and other accompanying works in relation to the civil works and signal construction, the following procedure can be set up.

Further investigation in reference to the above will be necessary to develop the plan. But the above can be used to determine the priority of the various aspects of the track construction work and when to put the cars on the rails.

Data - 2

Examination of Increasing Rail Weight through Use of Present Iron Sleepers

1. Condition of fastening holes on the Surface of the Present Iron sleepers



(Unit: mm)

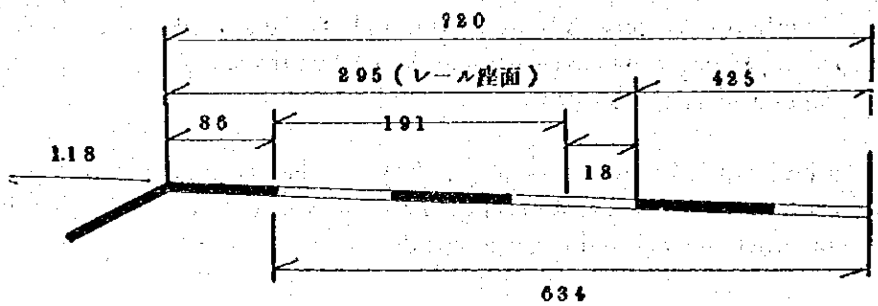
2. Base width of the Present 30kg Rail

106 ± 1

3. Base width of the Heavy Rail (Standard type used by JNR)

37kg	122	(+16)
40kg	122	(+16)
50N	127	(+21)

4. Present condition of the Rail-bearing surface



Construction Schedule (Track Construction Work)

Section			Quantity	Execution speed per month	Required time	1st year	2nd year	3rd year	4th year	5th year	6th year	7th year	8th year	9th year	10th year
1) Da-Nang – Phu-Cat	Civil Engineering														
	Track Work	Production of P.C. sleepers	431,000pcs	20,000pcs	22months										
		Assembly of track skeleton	280km	12.5km	23months										
		Laying of track skeleton	280km	25km	12months										
		Transport and laying of ballast	420,000m^3	30,000m^3	14months										
		Track arrangement	280km	25km	12months										
		Others													
	Signal facility work														
2) Hue – Da-Nang	Civil Engineering														
		Production of P.C. sleepers	105,000pcs	20,000pcs	6months										
		Renewal of track skeleton	68km	6km	12months										
		Reconstruction of ballast	54,000m^3	7,000m^3	8months										
		Track arrangement	68km	12.5km	6months										
		Others													
	Signal Facility Work														
3) Hue – Da-Nang	Civil Engineering														
		Production of P.C. sleepers	54,000pcs	10,000pcs	6months										
		Layout of track skeleton	35km	6km	6months										
		Transport and laying of ballast	52,000m^3	7,000m^3	8months										
		Track arrangement	35km	12.5km	3months										
		Others													
	Signal facility work														
4) Pu-Cat – Saigon	Civil Engineering														
		Production of P.C. sleepers	1,015,000pcs	30,000pcs	34months										
		Renewal of track skeleton	659km	18km	37months										
		Reconstruction of ballast	527,000m^3	15,000m^3	36months										
		Track arrangement	659km	25km	27months										
		Others													
	Signal facility work														
Overall	Trial run											2)		3) 4)	Overall 1)

5. Method of Increasing Rail Weight

The fastening holes can be cut out by one-half of the base width to be extended, on the external side of the skeleton. The bearing surface is sufficient for the weight of both 40 and 50 kg rails.

6. Problems

Because of the decrease in the thickness of the area that the tie clips clamp to the rail base, the rail is bound to be unstable. Long periods of disuse are considered dangerous, for fear of irregularity in alignment or in track gauge by side pressure.

(Improvement of Track Bed and Curves)

The standards for the track bed designated by V N R S is set forth only in the cross profile diagram of the track and track bed.

Only the track construction and the formation level width are set forth in this view, and so-called civil engineering standards do not seem to exist as yet.

In this cross profile diagram of the track and track bed, the conventional formation level width is 4,400 mm, while the width to be adopted during improvements is still only 4,700 mm. These re inevitably too narrow to secure the ballast thickness necessary for speed up and for maintenance of the track.

Thus it seems necessary to extend the formation level width by up to about 3,800 mm by at least the end of this reconstruction plan. Next, as regards curved track, and considering the 30 km between Hoimit and Namo described in 4-2-1 (General Section 2), when the Saigon-Bien Hoa section is excluded there are only 15 locations with a curve radius of less than 250 m (as set forth in 4-2) totaling 2,010 m in length. Six locations with a total length of 1,110 m are close to or inside the station compounds of Hue (2 locations with a total length of 230 m) and Nha Trang (4 locations with a total length of 880 m). Of the others, 4 locations in the Nha Trang compound, located on the dotted line shown in Fig. 4-2-1-2, are not in use and have been scrapped. Two locations of curved track near Hue should be investigated and improved along with the improvement and effective extention of the Hue station compound.

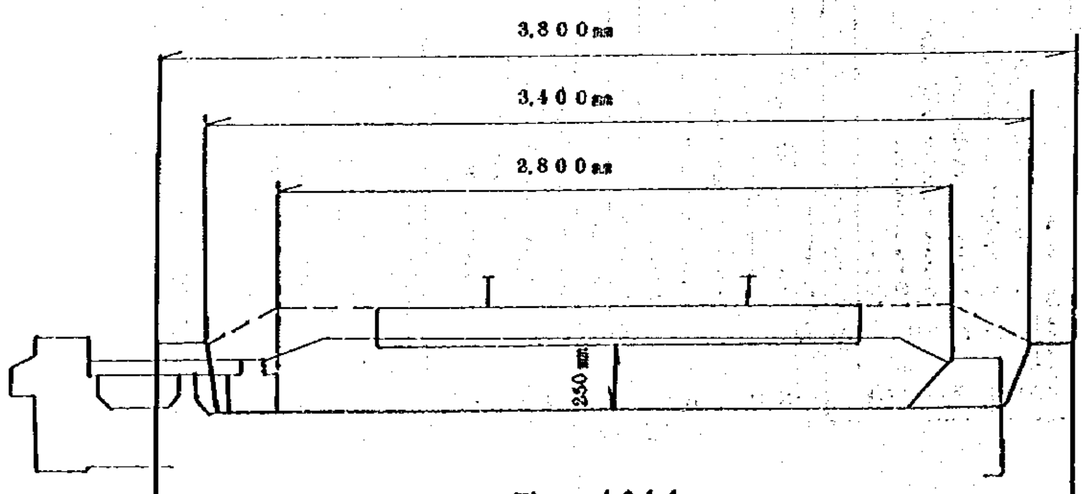
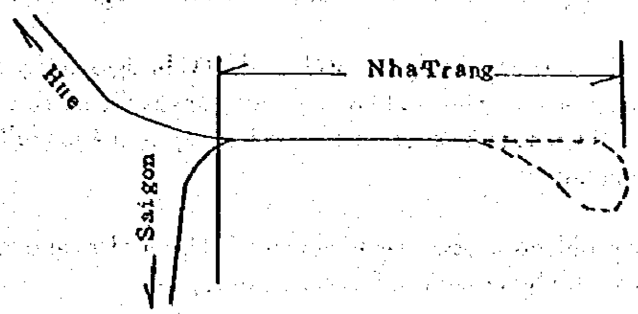


Figure 4-2-1-1



Rough Sketch of Nha-Trang Compound

Figure 4-2-1-2

This analysis shows that there are only 9 curves of less than 250 m radius with a total length of 960 m. One of these is near the starting point of Phu Gia Tunnel (745 K 915 m) and 8 locations are on the line of about 4 km beginning with its terminal point. As far as these are concerned, it may be advisable that in this reconstruction plan the former be improved to a curve of 300 m radius, and the latter to a 4 km straightened track.

Since the steepest gradient at present is 15.20/00 and track having grades over 10.10/00 being only 62.9 km in length (6% of the entire track) there is no particular need for a gradient improvement plan to be taken into consideration.

(Bridges)

Girders were exmained to classify them for reconstituction work. This trunk line railway has remarkable conditions for the corrosion of steel bridges, since the major part of it runs along the coastline. Therefore it is desirable to adopt concrete girders and prestressed concrete girders. However, in consideration of the weight increase in the girder itself, the effect of girder height increases, and the relative difficulty of rebuilding bridges while the track is in use, the use of steel girder cannot be indiscriminately ended.

As a rule, the following ideas are acceptable here:-

(a) Unstressed concrete girders should be used for spans of less than 8 m.

(b) Prestressed concrete girders (pretension) should be used for spans of 8 - 15 m.

(c) Through-bridge plate girders should be used for those spans of 20-40 m.

(d) Througoh-bridge trusses should be used for those of over 40m span.

However, for sections with dead tracks, and when there is no problem in bridge height and the lower structure is newly built or is rebuilt at the same time, prestressed concrete girders (post tension) should be used for spans over 20m.

Special attention must be paid here to the width of concrete bridges and PC bridges.

The width of the existing concrete bridges as well as the PC bridges designed for reconstruction work is 2.8 m as shown in Fig. 3, 4-2-1. This is along the same lines as the narrow construction surface width in the previous pages, and needs to be extended by at least up to 3.4 m (full desired extension being 3.8 m) for high-speed operations.

Next, there are many problems in assessing how many bridge girders and lower structures should be changed as well as how many bridges need reinforcement or repair.

(Signal and Telecommunication Facilities)

1) An illustration of the present condition and problems in signal facilities is that there are no interlock devices in station compounds and it depend on the engineer's attention.

Because of this, the point passage speed is necessarily limited to under 5 km/h. The block system among stations utilizes a time interval method based on a train operation schedule, along with supplementary wireless communication. This operation maintenance system is elementary and of the lowest level of security, depending only on the operating crew's attention. VNRS desires to adopt safety signalling equipment of a higher security under the modernization plan. Since it is imagined that the existing system is not enough to secure safety when operations at 70 km/h are realized over the full line, it is necessary to install at least the minimum quantity of safety signalling equipment.

Basic ideas are as follows:-

(a) The blocking system between stations should be of the wireless telephone type.

(b) Entry and starting signals installed at a station should be interlocked with the related points

(c) Points should be of the manual type

In carrying out the plan, signal installation work should be started in priority sections beginning from the area where rails, ballast, track bed, station equipment, etc., have already been reconstructed.

In order to improve safety at the time of modernization, a new block system and relay interlocking devices, capable of matching the high speed and density of the trains, should be installed as safety signalling equipment.

2) Summing up the present situation and problems of telecommunication facilities, it can be seen that everything is based on wireless communication due to the lack of wired apparatus and that the facilities are incomplete, deteriorated, defective, and can not be used in the future. In consideration of these, a facilities standard has been determined, and its objective is to carry out a temporary reconstruction using the existing wireless system. This inevitably depends on

the increase and renewal method of wireless a apparatus planned by VNRS, but such an operation should be kept to a minimum. Rather, together with its execution, the most basic work of modernization, that is establishment of wired telecommunication lines should be carried out. The present blocking systems based on wireless communication should be replaced by wired telecommunication starting successively from the completed sections where ballast and track bed have been reconstructed. The wireless apparatus thus replaced should be used for the reconstruction of other sections. When wired telecommunication lines have been fully completed, the wireless apparatus may be used for its original purpose of movements telecommunication that is, train and maintenance communication. Establishment of telecommunication lines should be based on the idea that sections of about 100 km between main points can be considered as one block. It is necessary to consider, from the beginning of the plan, the need of establishment of SHF stations and automatic telephone stations at these main points.

(Level Crossings)

With the future economic development and rise of living standards, the number of automobiles and traffic at the level crossings may remarkably increase. It is not too much to say that this will have adverse effects on the road traffic network since traffic jams at level crossings may possibly paralyze city functions.

On the other hand, from the railway point of view, the number of accidents as well as their severity are expected to increase along with the increased speed of the trains. Since a loss of operations is bound to cumulatively increase thereby, so the necessity of improving level crossings will also inevitably increase. Therefore, in consideration of the above problems, the following standards should be established in order to promote full equipment at level crossings:

a. A standard for solid crossings or continuous solid crossings.

b. A standard for safety facilities at level crossings.

4-2-2 Problems in Plan Finalization

(Bridges)

The first thing to examine in plan finalization is the comparison between the dimensional rolling load at construction time, train load based on the rolling stock now in use, and that estimated to be purchased in the future.

As described in 3-2-3 (4), this truck line railway is divided into 3 sections of different construction age of which the respective dimensional rolling loads are as follows:

Section	Maximum axle load	Axle arrangement	KS-Equivalent	
			Max.	Min.
Hue – Danang	10 t	unknown	(12°) Assumption	(8.6) Assumption
Da-Nang – Nha-Trang	14 t	4-2-2 table 1	16^{1}	10^{3}
Nha-Trang – Saigon	10 t	unknown	(12°) Assumption	(8.4) Assumption
Proposed Load	14 t	4-2-2 table 2	12.9	11.4
B-B 900 Type	15	4-2-2 table 3	10.6	8.0

As a result of the survey, the data of the standard rolling load used for design of bridges between Da-Nang – Nha-Trang could be found, though as for the others, it was possible to learn only that the dimensional shaft weight is 10t; however, shaft and load arrangements are quite unknown.

V N R S authorities estimate the load bearing capacity of bridges only in comparison with the dimensional shaft weight, but it may be more convenient to compare and examine the bridges of each span with K.S. - equivalent values when the dimensional rolling load is different, as in this case.

However, not knowing the main characteristics of the locomotive which is said to have a shaft weight of 10t as mentioned above, tehre is no formula to estimate the load bearing capacity of bridges between Hue – Da-Nang, Nha-Trang – Saigon.

Thus, in order to continue the survey, we assumed that the dimensional rolling load between the above two sections was equal to the '1965 Load' (refer to 4-2-2, table 4) used in Thailand from 1912 to 1934.

The comparison under this procondition of the relation between each dimensional load capacity and proposed rolling load now in use or expected to be used in the future leads to the following:-

a) The brdiges between Da-Nang – Phu-Cat have a load bearing capacity more than enough for the existing train load and proposed load.

b) In other sections, bridges of 2m span are designed with a load bearing capacity of about 81% of the existing train load. Bridges over 3 m in span are designed with a load bearing capacity of 112 - 130% of the present train load, which is sufficient in every respect.

On the other hand, as for the proposed rolling load, bridges less than 10 m in span are designed with a load bearing capacity of 85 – 88%, and those over 15 m in span with 91 - 93%.

But now comes the problem of the actual load bearing capacity condition of the bridge beams, bridge piers and bridge legs that remained free from destruction by war.

The following discussion is divided into two sections, the upper and lower construction parts.

o Upper Construction

Steel Girder

As a rule, the actual durability rate method is used to determine the degree of load capacity, and whether replacement or reinforcement of steel girders is necessary.

Actual durability rate is calculated by the following formula.

$$\text{Actual durability rate} = \frac{\text{KS equivalent value of steel girder}}{\text{KS equivalent value of actual load}} \times 100$$

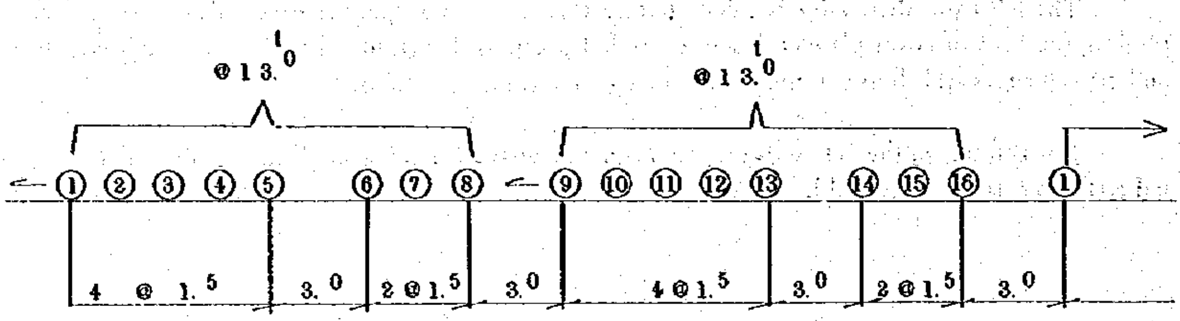
In this formula, the KS equivalent value of the actual load, the KS equivalent value at the absolute maximum bending moment (M) is used for calculating the bending moment of the entering locomotives at the section containing steel girders, and the KS equivalent value (shown in Table 4-2-2-1, 2, 3, 4) of the greatest reaction(s) is used for calculating the shearing force capacity and reaction.

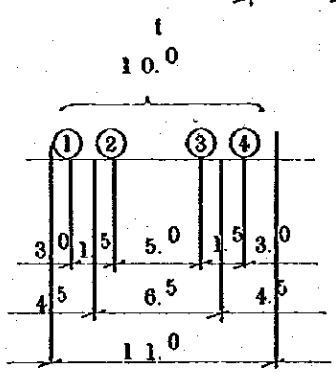
The KS equivalent value is calculated by surveying the respective materials size for the central section, sections of cover plate ends and corroded portions, longitudinal girders and their coupling parts, and cross girders and their coupling parts, using strength calculations.

For reference, the actual durability rate, a standard for replacing bridge girders at Japan National Railways, is shwon in Table 4-2-2-5.

Table 4-2-2-1

NOUVEAU CONVOI (SL)-Type





M : Absolute maxmum
Bending moment

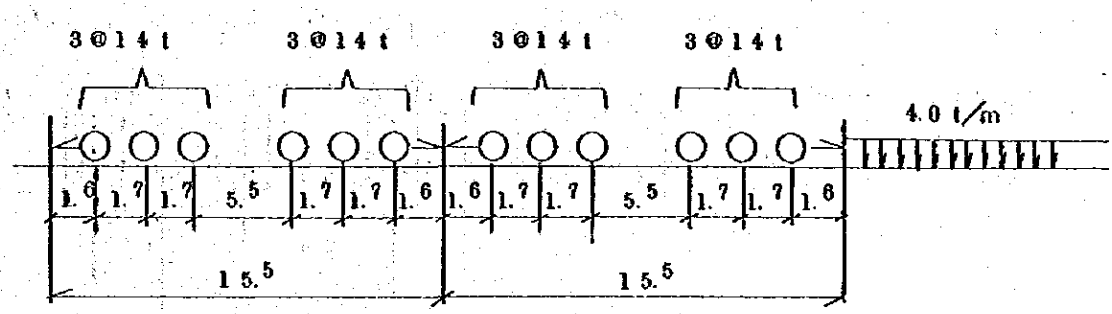
S : Maxmum Shear Force
($x = 0$; Reaction)

KS – Equivalent

Span m	M	S	Span m	M	S	Span m	M	S
1.00	10.6	10.6	8.20	14.2	13.8	30.00	16.1	15.3
1.50	10.6	10.6	9.80	14.3	13.8	31.50	16.1	15.3
1.90	10.6	12.9	10.00	14.3	13.9	40.00	15.7	15.2
2.20	10.6	12.9	12.90	14.1	14.3	45.00	15.4	15.1
2.90	11.7	12.0	15.00	14.5	14.5	60.00	14.6	14.6
3.55	13.0	12.8	16.00	14.7	14.7	62.40	14.6	14.5
4.15	13.0	13.0	19.20	15.3	15.1			
5.05	13.0	13.0	20.00	15.4	15.2			
6.00	13.0	13.0	22.30	15.6	15.2			
6.70	13.3	13.5	25.40	15.7	15.2			

Table 4-2-2-2

Proposed Loading Diagram (O−O Type)



M : Absolute maxmum
Bending moment

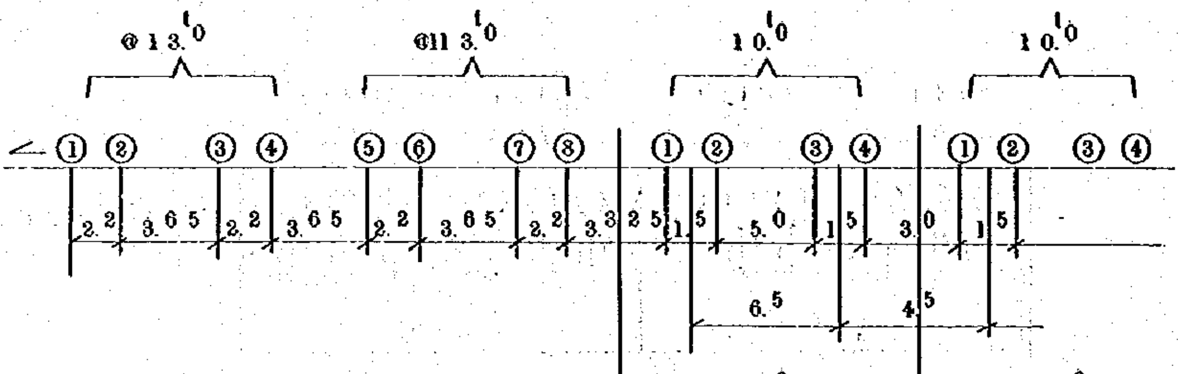
S : Maxmum Shear Force
(x = 0 ; Reaction)

KS − Equivalent

Span m	M	S	Span m	M	S			
1.0	11.4	11.4	50.0	12.3	12.2			
2.0	11.4	12.9	60.0	12.2	12.2			
3.0	11.8	12.3	70.0	12.3	12.2			
4.0	12.1	12.9	80.0	12.3	12.2			
5.0	12.7	12.6						
10.0	11.6	12.4						
15.0	12.6	12.8						
20.0	12.2	12.9						
30.0	12.6	12.4						
40.0	12.5	12.2						

Table 4-2-2-3

B－B900 Type(DL)



M : Absolut maxmum Bending moment

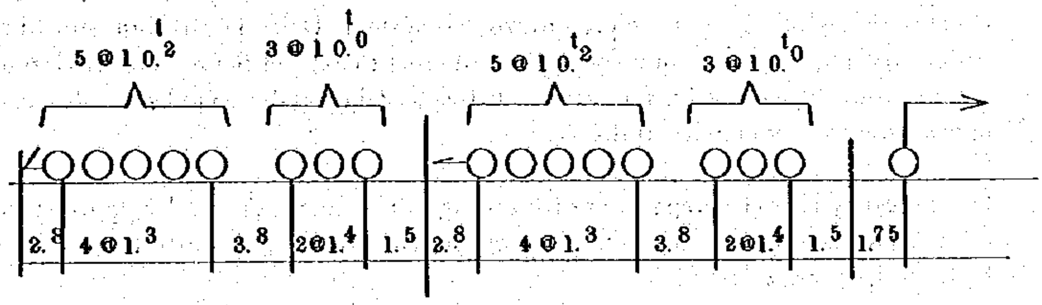
S : Maxmum Shear Force (x = 0 ; Reaction)

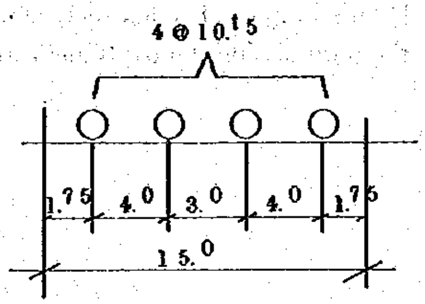
KS－Equivalent

Span m	M	S	Span m	M	S	Span m	M	S
1.00	10.6	10.6	8.20	8.1	9.1	30.00	10.3	9.8
1.50	10.6	10.6	9.80	8.4	9.2	31.50	10.3	9.8
1.90	10.6	10.6	10.00	8.4	9.2	40.00	9.9	9.9
2.20	10.6	9.9	12.90	8.7	9.3	45.00	9.9	9.9
2.90	10.6	10.1	15.00	9.2	9.6	60.00	9.9	10.0
3.55	9.9	10.2	16.00	9.4	9.7	62.40	9.9	10.0
4.15	9.0	10.0	19.20	9.6	9.9			
5.05	8.8	9.2	20.00	9.6	9.9			
6.00	8.4	8.8	22.30	9.9	9.9			
6.70	8.0	8.8	25.40	10.1	9.9			

Table 4-2-2-4

1965 Load (Thailand)





M : Absolut maxmum Bending moment

S : Maxmum Shear Force (x = 0 ; Reaction)

KS－Equivalent

Span m	M	S	Span m	M	S			
1.0	8.6	8.6	50.0	11.4	11.4			
2.0	8.6	11.0	60.0	11.1	11.2			
3.0	10.5	10.6	70.0	10.9	11.0			
4.0	11.5	11.1	80.0	10.7	10.8			
5.0	11.2	11.3						
10.0	12.0	11.5						
15.0	11.4	11.7						
20.0	11.6	11.8						
30.0	11.8	11.8						
40.0	11.7	11.7						

(2) Training of maintenance personnel is required for the introduction of new facilities.

3) Telecommunication Facilities

(1) A wire telecommunication railway line should be established along wiht temporary reconstruction while using of the present wireless system. Delay in establishment of this system will require a large sum for equipment costs to expand the present wireless apparatus, resulting in an excessive investment, as well as delaying the completion of telecommunication facilities modernization.

(2) It is necessary to make preparations for underground cable routes and supporters for a railway line having wire telecommunications in relation to the reconstruction work of rail beds, bridges, and tunnels.

(3) It is necessary to decide the construction of the cable for a railway line having wire telecommunications in accordance with the results of the transmission standards and estimation of telecommunication traffic.

4-2-3 Surveys Required in the Future

(Track)

1) Change of Station Line Arrangements

In addition to the line change accompanying the improvement of turnouts, the mission and function of each station should be surveyed to eliminate unnecessary facilities and to examine a plan for reinforcement of required facilities.

2) Basic Construction Standards of Railway Line

Since there is no data at V N R S on such basic items concerning the railway line as moderate curved track or longitudinal curved track, research on this should be performed in advance of high speed operations as a safety measure.

3) Regulations for limits of slack, or warping of can track are lacking, therefore a maintenance standard should be instituted suitable for high speed operations.

4) Survey of Actual Conditions of Turnouts and Preparatory survey of New Turnout Design.

Since a collection of VNRS 's figures on turnouts is lacking and the incidence angle is unknown, examination of speed limitation is impossible, so that a survey of the conditions actually present is required. Preparatory research is also necessary for the design of a new turnout.

Establishment of these standards is indispensable for high speed operations in the future. It is necessary to secure train operation safety and to establish a danger prevention system for the public, making clear the relation of train operations with road traffic.

Concrete girders and PC girders

The soundness of concrete girders and PC girders must be judged by survey, consisting chiefly of on-the-spot examinations such as materials examination, effective section survey, stress calculation and survey, damage condition and crack investigation.

o Lower Construction

To judge the soundness of bridgepiers, it is necessary to make numerous on-the-spot investigations for such items as material examination, effective section survey, stress calculation and survey, examination of skeleton and foundation size, scour research, soil nature research, stability research, research for progression of subsidence and dip, research for changes caused by damage, and dynamic tests during train passage. The above mentioned examinations necessary for the technical judgement have never been performed to date. Moreover, under the present circumstances in Viet-Nam, other survey mission could not effect a satisfactory investigation.

From this fact, we cannot help but say that it is very difficult at present, from a technical point of view, to decide the number of bridges requiring replacement or reinforcement for the finalization of the reconstruction performance plan.

Table 4-2-2-5

	Converted train frequency	Allowed stress	Actual durability rate	Target durability rate
1st class line	1.8 million times	1,470 kg/cm^2	86 %	89 %
2nd class line	1.5 million times	1,520 kg/cm^2	83 %	86 %
3rd class line	1 million times	1,630 kg/cm^2	78 %	81 %
4th class line	0.6 million times	1,770 kg/cm^2	71 %	74 %

(Telecommunication, Level Crossing Facilities)

1) Signal Facilities

(1) It is necessary to decide the operating system for entry and departure to and from the compounds, and for shunting of trains.

(2) Training of signal operators and maintenance personnel is required for the introduction of new facilities.

(3) Improvement of turnouts and sleepers is necessary for the installation of electric points at the turnouts in the station compounds.

(4) Improvement of sleepers is necessary, because iron sleepers will not allow construction of a track circuit.

2) Level Crossing Facilities

(1) It is necessary to decide the speed and classification of trains for construction of the control circuits of level crossing safety facilities.

(Bridges, etc.)

In the previous item we have already stated that one of the problems in the execution plan finalization is the lack of completed on-the-spot surveys. These surveys must be performed in the future. For execution of these surveys, a number of survey members, a long period of surveying and a large sum of survey cost may be required.

Though the analysis and judgement of the survey results can be carried out at present with foreign technical assistance, it is necessary for V N R S to have the ability for research, surveys and tests by themself. This will also become a necessary technique for maintenance and inspection after reconstruction, so that we consider it necessary to start immediately training the technical experts required for these purposes.

(Signaling System including Level Crossings)

1) Detailed study of the line arrangements in the station in order to determine the location of the signals.

2) Study of the installation routes of the blocking circuit (communication cables)

3) Study of the condition of the power supply equipment for signals and level crossings.

4) Study of the operation plan for signals and level crossings.

5) Study of present conditions and a prestimate of traffic volume on the roads near the level crossings.

6) Study of the data for determining the installation basic for the safety facilities at level crossings.

(Telecommunication System)

1) Elaboration of standard and transmission quality basis, as well as study of a preestimate of communication traffic in order to determine the structure of the communication circuits and cables.

2) Study of installation routes of the communication cable.

3) Study for construction of a concrete communication circuit. (Determination of the short distance communication block, PCM terminal station and location of repeaters, and terminal devices such as telephones).

4) Study for determining the purchasing time of the SHF multiple wireless repeater system and others. (Preestimate of long distance communication traffic. Determination of long distance communication circuit construction. Determination of location of the automatic telephone exchange and telephone sets).

5) Study for minimizing the number of wireless devices in the present wireless system.

6) Study on how the train wireless system should be,when the modernization is carried out. (Pos-

sibility of using present wireless devices).

For these studies, engineers of the J.N.R. and/or a telecommunication consultant will be sent to the site to consult with the persons concerned in V N R S in order to determine a concrete method for putting this plan into operation.

4-2-4 Rolling Stock

o Rolling stock corresponding to the modernization plan

1) The work to be carried out before the whole line is put into service by the modernization plan of VNRS is repair of the rolling stock which will be used for high speed service. For this, an important condition is to be equipped with train structures suitable for high speed, especially as regards bogies and brakes capable of safety stopping the train when running at high speeds. Therefore, as it is too difficult to maintain safety with the present vacuum brakes, it is recommended to change to air brakes, with which braking power may be controlled freely.

   There are two types of interlocking devices in the VNRS system, the screw and the combined (screw automatic) but when the trains are operated at high speeds, it may be better to use only automatic interlocking devices because they are safe and easy to operate. But taking into account adaptation with the existing screws, temporary use of the combined type will be inevitable. Therefore, it is necessary to study the time when all of them are changed to automatic interlocking devices.

2) Repair of rolling stock

   As for transportation with the present rolling stock, according to the DEL capacity and after repairing the damaged cars, it will be possible to haul passenger cars of 500 t (65 km/h, 0%) and freight cars of 1,000 t (45 km/h, 0%). In consideration of gradient curve conditions, and even when some improvement in speed is taken into account, it will still be possible to operate using double headings. With regard to the speed improvement based on the modernization plan, it is necessary to consider the purchase of DEL's with 6 driving shafts (shaft weight 14t) at approx. 2000 pc (According to the March, 1973 report of a study related to rolling load of railway bridges requested by ECAFE) in line with the planned train shape and the plan for repair of railway bridges (Figures 4-2-4-1, 2, 3, 4 and 5).

   With regard to the transportation of passengers, the number of passenger cars is insufficient, but by repairing the existing cars it may be possible to satisfy the demand.

   Before completion of the last stage of the modernization plan for ground facilities, it is necessary to determine the cars which must be repaired for use at high speeds.

   For this purpose, it is necessary to select the most deteriorated cars and replace them with new ones. Therefore, the replacement of third class passenger cars must be considered; in the future these will be most in demand and even now are insufficient. Taking into account the estimated train plan, it is necessary to consider the purchase of about 20 new cars (price ¥700,000,000) in order to satisfy the demand of the Danang-Hue section (a part of the Saigon – Hue section) where more cars are needed. Of course, these new cars must have an adequate structure to match the high speed planned for the future. (For these passenger cars, refer to annex 3). (See Table 4-2-4-1).

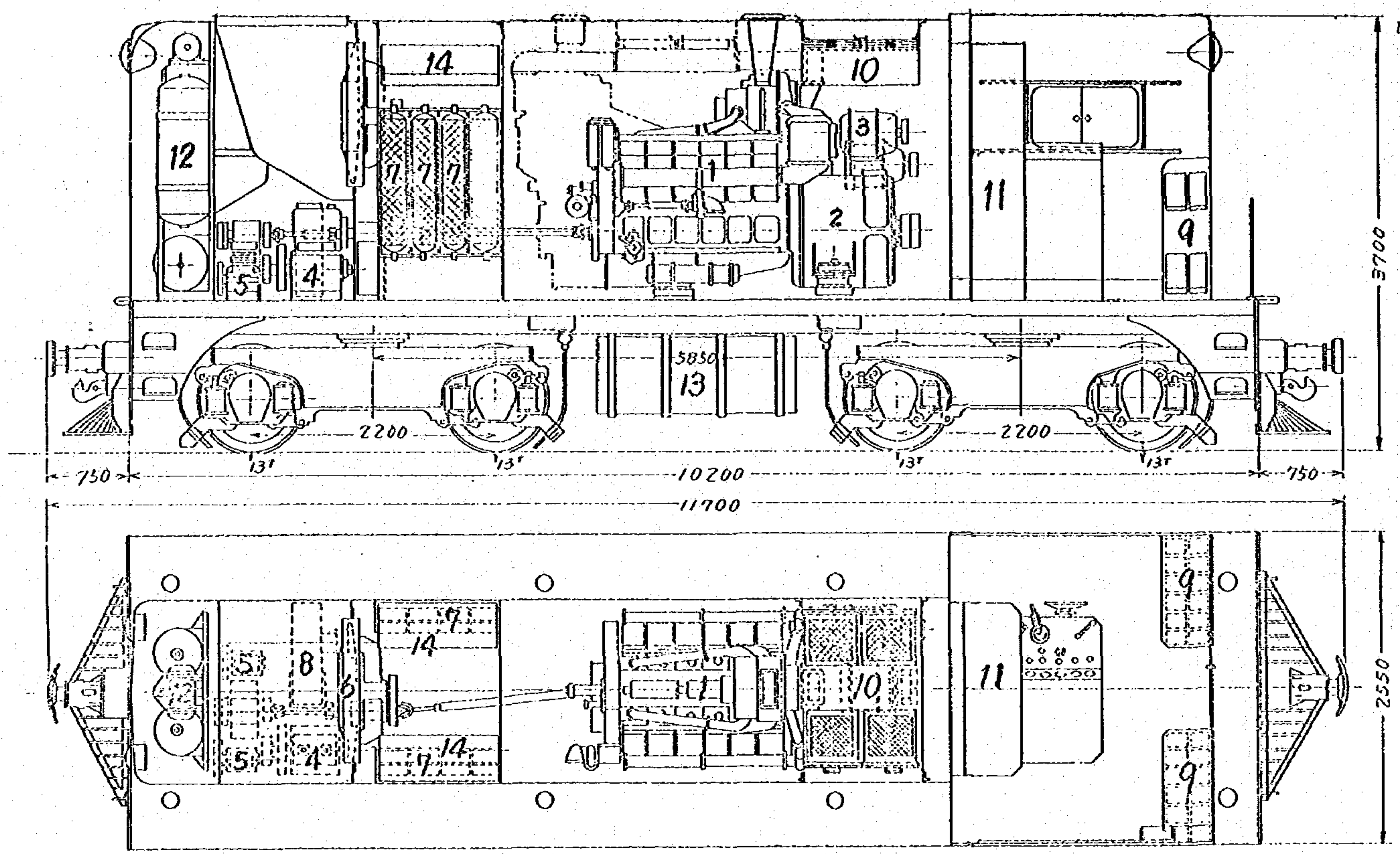
With regard to goods wagons, there are enough to satisfy the transportation demand. In consideration of transportation increases, the most deteriorated cars must be selected and replaced with new ones, or repaired. But taking into account braking capacity and safety, it will be too difficult to carry out immediately the speed improvement plan. Therefore, it will be necessary to study a plan with consideration for the relationship to demand.

With regard to the above mentioned speed improvement, it is necessary to carry out a separate study regarding the mutual relation between the rolling stock structure and the track structure from the operating safety point of view.

Table 4-2-4-1 Estimate of Passenger Cars Required (Classified by Sections) VNRS

Section \ Type of passenger cars	First stage (1973)								Second stage (1975)										
	Special coach	Ordinary & special coach	Dining car	1st & 2nd class coach	2nd & 3rd class coach	3rd class coach	3rd class 2-axle coach	3rd class converted coach with wooden body	Special coach	Ordinary & special coach	Dining car	1st class coach	1st & 2nd class coach	2nd class coach	2nd & 3rd class coach	3rd class coach	3rd class 2-axle coach	Freight 2-axle coach	3rd class converted coach with wooden body
Saigon — Hue									2	2	2	2		2		10	2	2	
Hue — Saigon									2	2	2	2		2		10	2	2	
Saigon — Qui-Nhon	1	2	1			5	1	1	2	2	2	2		2		10	4		
Qui-Nhon — Saigon	1	2	1			5	1	1	2	2	2	2		2		10	4		
Saigon — Nha-Trang		1	1		1	6		1		2	2		2		2	10	4		
Nha-Trang — Saigon		1	1		1	6		1		2	2		2		2	10	4		
Dong-Ha — Hue													2		2	6	2		2
Hue — Dong-Ha													2		2	6	2		2
Hue — Da-Nang				1		4	1	4					1			6	3		3
Da-Nang — Qui-Nhon													1		1	5	1		2
Qui-Nhon — Da-Nang													1		1	5	1		2
Qui-Nhon — Nha-Trang				1		4		4					1		1	6	1		2
Nha-Trang — Qui-Nhon				1		4		4					1		1	6	1		2
Nha-Trang — Phan-Thiet													1		1	6	1		2
Phan-Thiet — Nha-Trang													1		1	6	1		2
Phan-Thiet — Saigon				1	1	5		4					1		1	5	8		3
Saigon — Phan-Thiet				1	1	5		4					1		1	5	8		3
Saigon — Bien-Hoa						3		3							1	3	1		2
Number of cars in use	2	6	4	5	4	47	3	27	8	12	12	8	17	8	17	125	50	4	27
Number of Reserve cars	2	2	1	1	1	5	1	6	2	3	3	2	4	2	4	25	10	1	6
Number fo required cars	7	7	6	6	5	61	5	33	7	7	6		6	9	5	61	5		33
Shortage		1							3	8	9	10	15	1	16	89	55	5	
Excess	3		1			9	1												

Fig. 4-2-4 (1) Form BB-900 Diesel-Electric Locomotive



Main Introduction:

- Form ——— BB
- Number of radial-axle ——— 4
- Wheel diameter ——— 950 mm
- Reduction ratio of year ——— 77/16
- Height ——— 3 m 700
- Width ——— 2 m 550
- Length ——— 11 m 700
- Length of the frame ——— 10 m 200
- Rigid wheel-face (locomotive) ——— 2 m 200
- Tare weight ——— 45 t
- Loading rate ——— 7 t
- Continuous output ——— 925 ps/1,500 r.p.m.
- Power ——— 1,017 ps
- Available power ——— 850 ps
- Capacity of fuel tank ——— 2,100 L
- Capacity of sand box ——— 500 L
- Maximum rate ——— 82 km/hr.
- Haulage capacity of maximum rate of the starting ——— about 14,000 kg

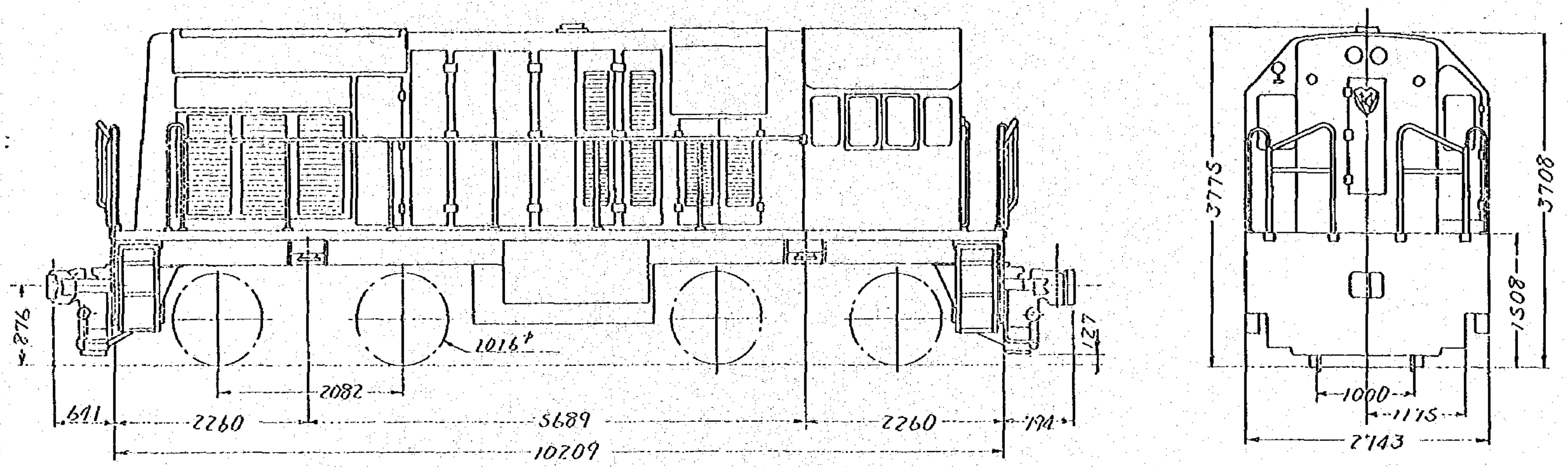
Name of

1. Diesel engine
2. Main generator
3. Sub generator
4. Vacuum pump
5. Compressor
6. Fan for cooling (for the radiator)
7. Radiator
8. Motor for fan
9. Battery
10. Filter
11. The plate of the electric service
12. Air area
13. Fuel tank
14. Tank for cool water

Haulage Capacity

Rate : km/h	20	30	40	50	60	70	80
Slope 0 0/00	900	900	900	720	502	360	270
5 0/00	882	558	387	288	216	153	117
10 0/00	513	346	234	162	117	90	
15 0/00	360	234	153	108.	88		
20 0/00	270	180	108	81			

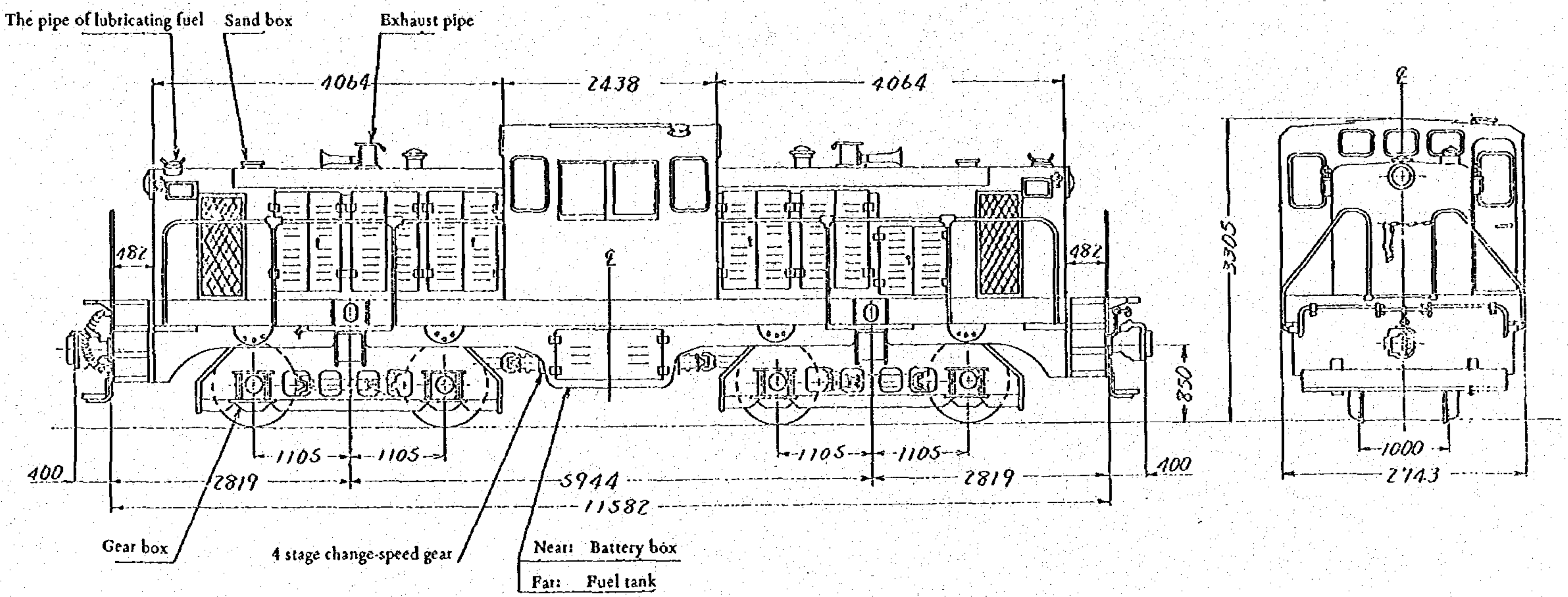
Fig. 4-2-4 (2) Diesel-Electric Locomotive



Main Introduction:

Form	U8B
Number of driving axle	4
Wheel diameter	1,016 mm
Height	3,775 mm
Width	2,743 mm
Length	11,644 mm
Length of the frame	10,209 mm
Rigid wheel-base	2,082 mm
Coupling gear	Automatic coupling form E
The height of coupling	876 mm
Weight in working	52 t
Available power	900 ps
Capacity of fuel tank	2,600 L
Maximum rate	114 km/hr.
最高速度	114km/hr

Fig. 4-2-4 (3) Hydraulic Diesel Locomotive



Main Introduction:

Form	CR-8D	Rigid wheel base	2,210 mm
Weight	52 t	Reduction ratio of gear	914 mm
Axle load	14 t	The height of coupling	850 mm
Length	12,382 mm	Haulage capacity	15,420 kg
Width	2,743 mm	Maximum rate	80 km/hr.
Height	3,305 mm		

Figure 4-2-4-4

Needed Engine Output of Passenger Car

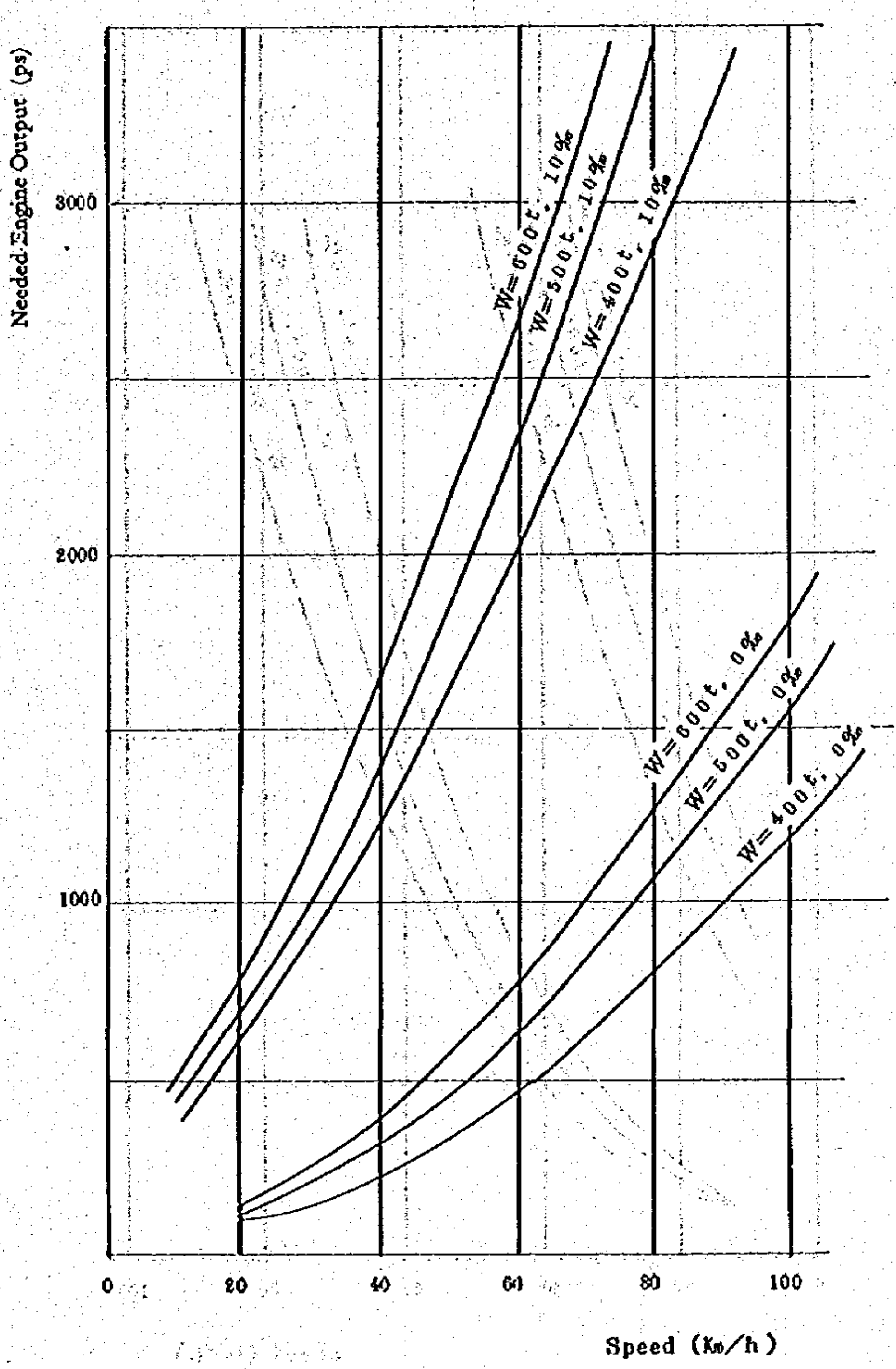
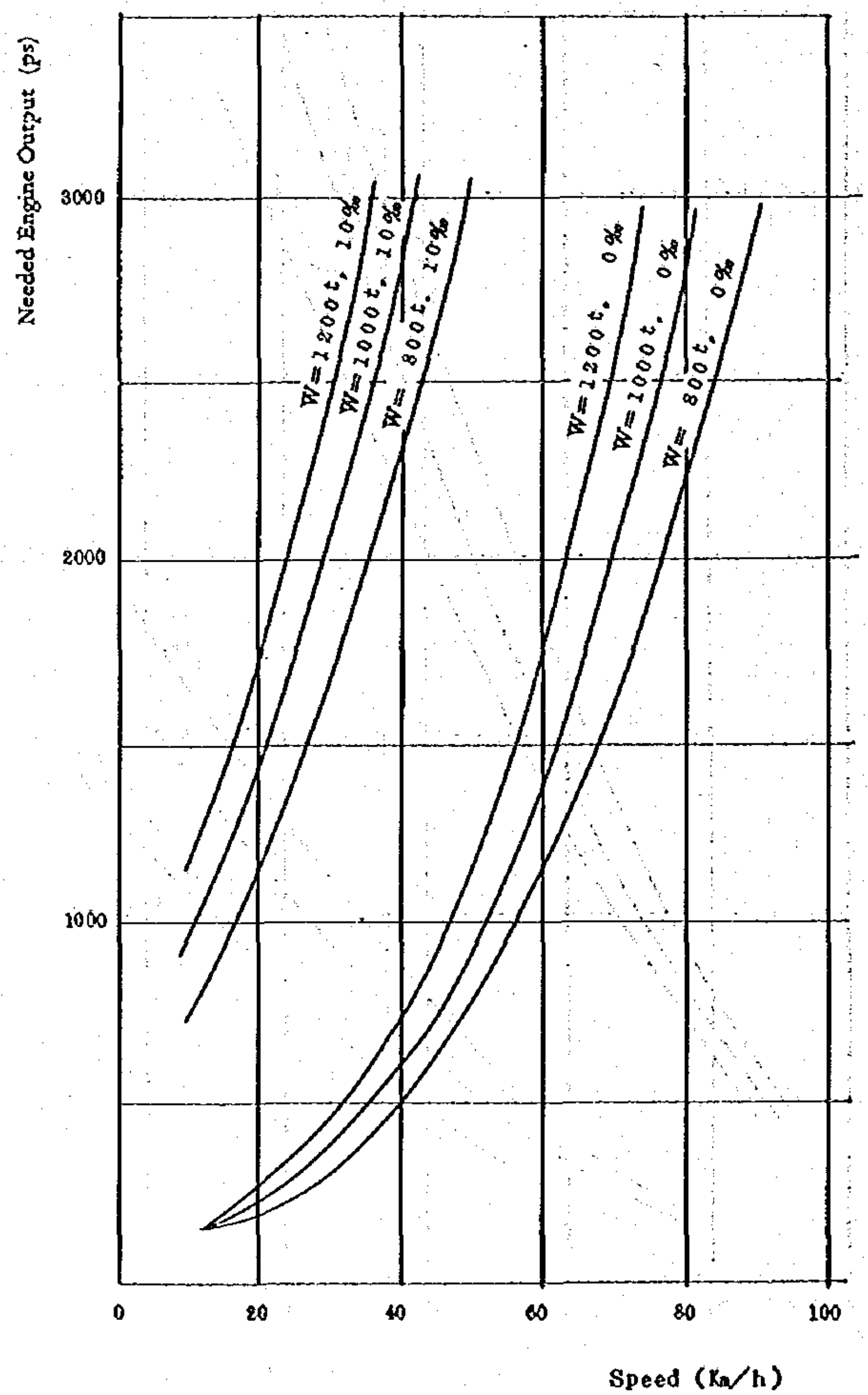


Table 4-2-4-5

Needed Engine Output of Ordinary Freight Car



Appendix

Specifications of Passenger Cars (Proposal)

1. The principal features of the passenger cars shall meet the following conditions:

1)	Overall length (Outside body)	62' 6" (19,050 mm)
2)	Passenger room length	52' 6" (16,000 mm)
3)	Overall height	12' 2" (3,708 mm)
4)	Overall width	9' 2" (2,794 mm)
5)	Truck center distance	42' 6" (12,954 mm)
6)	Truck rigid wheel base	6' 6" (1,981 mm)
7)	Nominal capacity	100 persons, including seats for 80 persons
8)	Tare weight	Approximately 30 tons
9)	Type of truck	Truck supporting: Bolster hanging type Axle-box supporting: Box pedestal type
10)	Braking system	Air brake and hand brake (or vacuum brake and hand brake)
11)	Coupling gear	Automatic coupling with buffer, and screw coupling
12)	Coupling center height:	Automatic coupling: 34 ½" (876 mm) Screw coupling: 22 7/16" (670 mm)
13)	Maximum speed	100 km/h
14)	Minimum curve radius	Main line: 100 m Service line: 75 m
15)	Track clearance and rolling stock gauge	See Fig. VBC-0026 of V N R S

2. Body structure

1) The external appearance and arrangement of the body shall be determined according to the form diagram attached.

2) The outer sheets, chassis, side frames, and roof frames shall be of stainless steel. End framing shall be of carbon steel. All of these shall be of welded construction.

3) The chassis and the floor shall have sufficient strength to withstand without permanent deformation a static end load of 800,000 pounds (363,000 kg).

4) The floor structure shall be made by the welding of weatherproof high-tension-steel keystone plates to the upper part of the chassis, and filling in with unitex. Polyvinyl-chloride floor tiling in sheets shall be laid over this.

5) The entire roof shall be covered with stainless steel blinds to make the traffic service in the tropics comfortable. Rain gutters shall be attached to the upper part of the side doorways, side windows, and end passages.

6) As heat insulation material for the body, glass fiber of 2½ in. (63 mm), in thickness shall be used on the underside of the roof sheetings, and glass fiber of 2 in., (50 mm) in thickness shall be adopted for the inside faces of side and end outside sheets. The lower side of the keystone shall be sprayed with bituminous anticorrosive insulating paint of 1/8 in., or 3 mm,

in thickness.

7) For the lining of the passenger room and the vestibules, aluminium sheets shall be attached with screws, while the joints and the corner edges of the sheets shall be fixed in place with alumite retaining bars made of extruded aluminium.

3. Windows and doors

1) The side windows of the passenger room and the toilets shall have no panes but shall have vertical sliding shutters, which can be stopped at any position.

2) Each side doorway shall have double steel doors opening to the inside.

3) Each end passage shall have steel doors opening to the insde.

4) Laminated safety glass of 1/4 in. (6.3 mm) in thickness shall be placed in the side and end doors with H-shaped rubber stripping. Door locks, latch-type night locks, and door studs shall be attached to these doors. The door hinges shall be of the pivot type.

5) The toilet doors shall have no panes. The passenger room side of this door shall be covered with aluminium sheeting, while the toilet side shall be covered with stainless steel sheeting. A door lock and a night lock shall be attached to each door.

4. Toilets and water supply system

1) The toilets shall be placed in the first and fourth passenger cars, and their doors shall open into the toilet from the passenger room. There shall be a space between the bottom of the door and the doorsill of 1½ in. (12.7 mm) for toilet room ventilation.

2) The toilet stool shall be a Western-style device manufactured from one pressed stainless steel sheet, and shall be equipped with a foot-pedal type toilet stool washer valve.

3) The wash bowl shall be of stainless steel, and shall be equipped with a self-closing water supply valve.

4) The water supply system shall be of gravity type. A water tank of which capacity is 100 gallons (455 litre) shall be placed on the roof of the vestibule.

5) The wainscot of the side frame shall be equipped with a commode handle.

5. Body equipment

1) Each side door shall have fixed steps of steel. The surface of these steps shall be of a non-slip type.

2) The inside and outside of both entrance columns at each side door shall be equipped with buffed stainless steel handholds.

3) Both entrance columns of the end passages shall have buffed stainless steel hand-holds. Folding safety tail gates of carbon steel shall be attached to the passages.

4) The first and fourth ends shall be equipped with grips and steps for climbing to the roof.

5) Ventilation of the passenger room shall be performed through suction ventilators attached on the roof.
There shall be twelve ventilators in all; ten for the passenger room, and one for each toilet.
The ceiling shall have air flow vanes.

6) The seats shall be of the fixed type, and shall have three components: a carbon steel frame, with a back and a seat cushion made of FRP and colored polyester.

7) The baggage racks shall be of steel tubing and strongly built, and shall be attached above the window, extending the full length of the passenger room.

8) Each pier panel of the passenger room shall have two coat hooks.

6. Coupling gear

1) Each end of the car shall have a short-lever automatic coupling with a rubber buffer.

2) This automatic coupling shall be of the bottom operating type, and be such that it can be operated only from the left side of the car.

3) Both ends of the car shall be equipped with a hook, a link-type coupler, and tension equipment, which are shown in Fig. MF1906D of V N R S.

4) Couplings shall be designed to suit the uses of V N R S. The cast steel buffer, which engages the automatic coupling by the buffer action produced through the operation of the hook and the link-type coupling, shall be the same type as that shown in Fig. MF1058A of V N R S.

7. Interior finish of cars

1) Painting and marking shall be performed in accordance with MT2145 of V N R S.

2) The room paint shall be of two colors. The paint design shall be submitted to V N R S by the manufacturer to obtain V N R S approval.

3) The exterior metal sheets, except the stainless steel sheets on the roof and the sides, shall be painted.

4) Exterior and interior fittings of such metals as phosphor bronze, stainless steel, aluminium, bronze, and chrome plated brass shall not be painted. These room fittings shall include lock cases, handles, keyhole covers, coat racks, switch panels, and so on.

5) The surfaces of contact between different metals (such as, stainless steel and aluminium, and stainless steel and carbon steel) must be zinc-chromated or coated with another appropriate anti-corrosive material to prevent corrosion.

6) All sections under the floor, except these of stainless steel, shall have black enameling.

8. Electrical system

1) The power supply cables shall be as follows:
(See Fig. 2144 of V N R S)

AC 240V 1ϕ 50 Hz 30A: 2 circuits (One for electric power, one for control)
DC 24V: 1 circuit

2) The electric cable connections between cars shall be on the upper part of the end passage.

3) Electrical equipment

a) 20W fluorescent lamps without globes: 11
along the center line of the car centered on the aisle between facing seats
b) 20W fluorescent lamps without globes: 1 each
in the center of each vestibule
c) 10W fluorescent lamps without globes: 1 each
in the center of each toilet room
d) 40W red signal lamps with hemisphere lens: 4
attached to the outside upper part of both ends of the body, located 5 feet (1,524 mm) from the platform surface and approximately 8 in. (about 210 mm) from the body side.
e) Electric fan, 12 in. (300 mm) in diameter: 20; 1 each centered on the aisle between two bacing seats.

9. Bogies

1) The supporting system for the body shall be of the bolster hanging type with three-point suspension system using a center plate and two side brackets.

2) The axle-box supporting system shall be of the box pedestal type.

3) The bogie frame shall be of welded construction only.

4) Coiled springs and oil dampers shall be used as bolster springs. Coiled springs shall be adopted as axle springs.

10. Braking system (air pressure type)

1) The C62 air braking system shall be adopted.

2) The main components shall be 26C-1 brake control valves, release nozzles, brake cylinders, double-chamber air reservoirs, air supply reservoirs, main reservoirs, and so on.

3) Emergency brake valves shall be installed.

4) Hand brakes shall be installed in the vestibule.

5) Clearance adjusters shall be provided.

10'. Braking system (vacuum type)

1) The main components shall be brake cylinders (21 in. in diameter), release devices, and two vacuum chambers.

2) The vestibules shall be equipped with a vacuum brake operating valve with a pressure gauge (similar to conductor's valve).

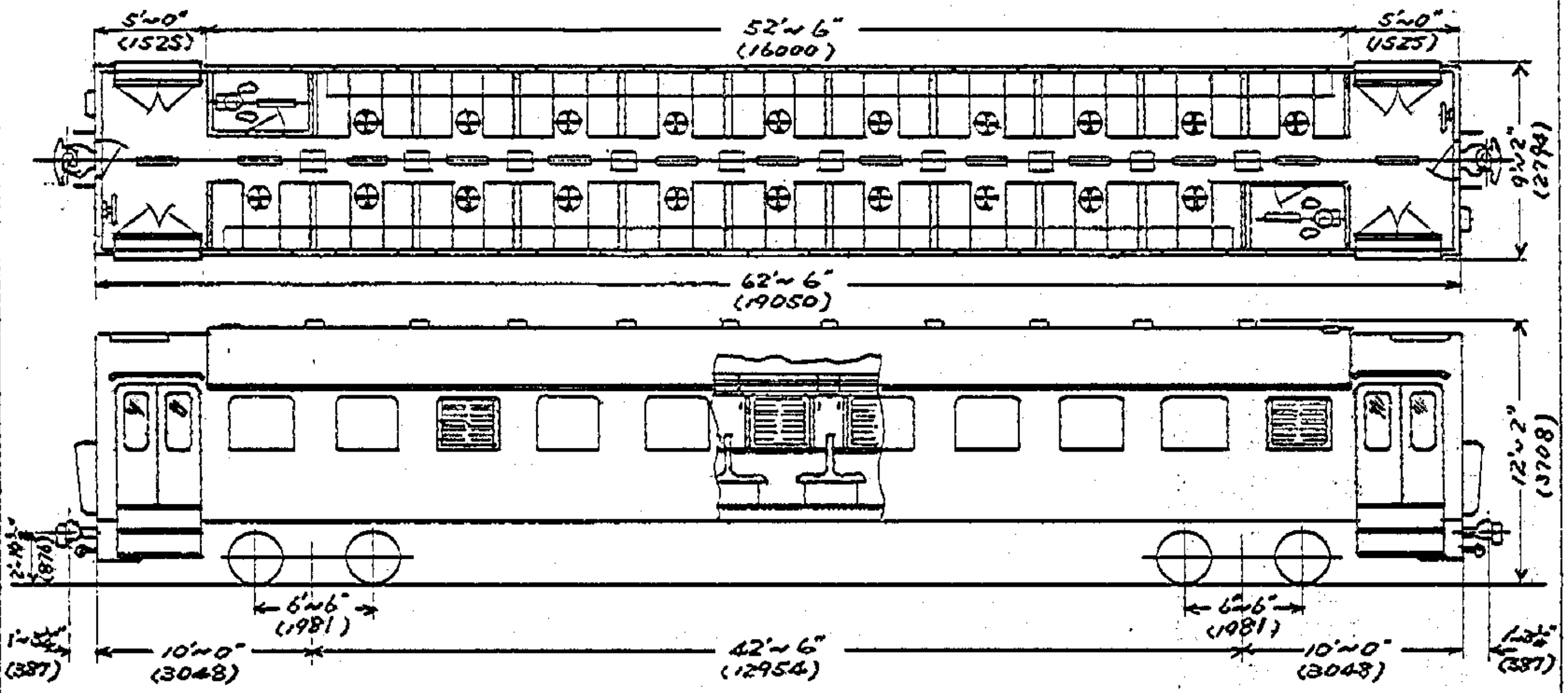
3) Hand brakes shall be installed in the vestibule.

4) Clearance adjusters shall be provided.

Figure 4-2-4-6

THIRD CLASS PASSENGER CRA

SCALE : 1/100



5. MODERNIZATION PLAN TO BE EXAMINED

5. MODERNIZATION PLAN TO BE EXAMINED

(Improvement in curved track between Hoimit and Namo)

As mentioned above, the section of approximately 30 km between Hoimit and Namo, located north of Danang, has 139 positions with curved track (9,960m in total length): 125 very small curves with a radius of 100m or less, and 14 small curves with a radius of 120 to 200m.

This section is a mountainous line built in a district where the mountains rise sheer from the seashore. As a result, there are 8 tunnels and the maximum gradient is 15.2%.

Accordingly, if the present route is retained, the speed limit (20 to 35 km/h) cannot be increased over this section of curved track, because no large-scale improvements in curve construction can be performed.

The mountainsides near this section have numerous huge outcroppings of granite, from which rocks sometimes fall onto the tracks. There are also many problems concerning prevention of disasters.

To solve the said difficulties, there is only one possible way: the construction of a new route having a long tunnel to connect the position at 750,300 m with the position at 780,000 m in a straight line.

Fortunately this section has only two stations; namely, the Lango-Co station located approximately 2.1 km from the starting point junction and the Lien-Chieu station approximately 4.3 km from the junction at the end of the section. As a result, if one new station is built near the starting point junction, the abolition of the present route will not present any serious problems, because the abovementioned Namo station can continue to be used as the station near the end of the line.

This new route (approximately 14.5 km in total length) is shorter than the present route by approximately 15.5 km, but requires a long tunnel of 8 to 9 km in length.

The complete reconstruction of the present route permits a running time in this section of approximately 82 min, while the establishment of the short route would permit an operating time of approximately 20 min at most (in the case of passenger cars). A speed-up by approximately 60 min can be obtained, and this effect must be very great.

The use of the rolling stock presently held by this railroad may give no great trouble in regards to traffic service on these small curved tracks. But, if the use of newly-manufactured stock on the present route is initiated for an increase or replacement of stock, or if the adoption of neighboring countries' rolling stock on this route is adopted for the operation of international trains, it can be expected that serious hindrances may occur, and even running through this section may become impossible in some cases.

The shortening in running time and the limit on additional investment for this purpose should be determined in relation to the effects of the quantity of transit passengers and freight through this section and of this time shortening on the national economy.

Accordingly, the starting time for this construction should be determined after taking into account the above points. Especially, changes in the national economy situation must be accurately studied so as not to miss an opportunity.

From this point of view, the scale of reconstruction of the present route must be decided according to the length of time it will be used in the future; therefore the determination of this new route project is very important.

6. IMPROVEMENT OF MAINTENANCE

6. IMPROVEMENT OF MAINTENANCE

(Track)

1) Method

As mentioned in the method to improve the running speed, keeping operations at the maximum speed of 65 km/h (the initial objective) or 120 km/h (the final objective) requires the following measures: improvement in track maintenance, retention of safety by augmentation of the number of track-maintenance personnel or equipment, and tighter measures for the elimination of natural calamities or track sabotage.

2) Improvement in maintenance of track

The track, packed with ballast, is not an elastic structure; therefore, the repeated load of trains produces many types of distortions and deformations on various portions of the track, especially on ballast, this causes track irregularity.

The increased track irregularity may cause shaking of the train and give door riding quality, and sometimes may cause a derailment accident.

Accordingly, the degree of irregularity must always be checked correctly by routine or periodical inspection, and inferior portions must be repaired as promptly as possible to retain good maintenance conditions at all times.

To obtain speed-up, closer maintenance of track irregularity is especially required. In our recent survey, questions about the tolerance of track irregularity were put to persons concerned in many districts (such as Saigon), but no clear answers were obtained.

As a result, we felt strongly the necessity of standardization of the danger limit, desired maintenance value, and finishing reference value in actual maintenance work to make it efficient.

3) Increase in maintenance personnel and equipment

It is thought that there are many difficulties in increasing maintenance personnel and equipment, but the extension of route kilometers and speed up demands a review of the system and the organization of maintenance.

Since the effective operation of the present equipment (such as multiple tie tampers) may allow efficient track maintenance, the formation of a plan is required for the guiding and training for maintenance staff to obtain modern track maintenance.

4) Tighter measures for elimination of natural calamities and track sabotage

The speed-up of trains increases natural calamities or accident damage due to outside causes, such as track sabotage. Sufficient consideration should be paid to the prevention of such troubles.

Track sabotage is a problem of politics including morals; therefore, it is considered that preventive measures must depend on aspects at the national level.

5) Track breakage and amount of maintenance work

(A) Track structure and breakage

The relation between track structure and track breakage is given as follows:

$\Delta = L \times M \times N$

Δ :	Modulus of breakage
L :	Load factor
M :	Structure factor
N :	Condition factor

L increases according to the degree of speed-up or the increment in transit weight. Structure factor M is a modulus to show the ease of vertical breakage of a track depending on the type of track structure (its method of calculation and the factor corresponding to each track component are given in appendix data 5).

N shows the degree of track breakage depending on the condition of the same materials (such as, the oldness of rails, the proportion of defective sleepers, the mixture ratio of earth and sand in ballast, and the number and the condition of rail joints), but this factor N must be excluded in this calculation because of the difficulty in control of quantification.

M shows the ratio of the strength of track structure, determined to be 1 when the weight of a rail is 50 kg/m, the number of PC sleepers is 1,760 pieces /km, and the thickness of crushed ballast is 200 mm. Accordingly, if M=2, the track breakage rate is twice as fast as when M=1 under the same load conditions. If speed-up is obtained under the same M, Δ will increase. To prevent the increase in the modulus of breakage, as mentioned above, a new and superior track structure must be adopted.

(B) Speed-up and amount of maintenance work

Speed-up results in two factors that increase the amount of maintenance work: one is the above-mentioned direct cause, and the other is the indirect cause corresponding to the decrease in track maintenance reference values required for high speed running.

It is throught that the former increases at the same rate as the average speed, while the latter increases at the same rate as the maximum speed.

Let's discuss the maximum speed in two cases: the initial case (70 km/h) and the future case (100 km/h).

(a) *Initial case of 70 km/h*

If the present maximum speed is 45 km/h, the increase in the maximum speed is 56%. Then, if the increase in the average speed is 20%, the amount of maintenance work increases as follows:

$$1.56 \times 1.20 \doteqdot 1.87$$

In this case, the structure factor M required to obtain roughly the same amount of maintenance work as before is given by the formula $\Delta = L \times M \times N$ so:

$$M = 4.84 \div 1.87 \doteqdot 2.59$$

Note: M = 4.84 in the present track structure (the weight of a rail is 30 kg/m, the number of sleepers is 1,420 pcs/km, and the thickness of crushed ballast is 150 mm).

The value M = 2.59 of this track structure is nearly equal to the value M = 2.43 of the said new track structure (the weight of a rail is 40 kg/m, the number of sleepers is 1,540 pcs/km and the thickness of crushed ballast is 250 mm), and it is thought that this value scarcely needs an increase in the amount of maintenance work.

(b) Future case of 100 km/h

The maximum speed of 100 km/h is to be achieved after the operation at 70 km/h or after the completion of track reinforcement. If the increase in the maximum speed is 43%, and that of the average speed is 15%, maintenance work amount increases as follows:

$$1.43 \times 1.15 \doteqdot 1.64$$

If track reinforcement is performed in this case to prevent an increase in the amount of maintenance work, such a track structure will require the following structure factor:

$$M = 2.43 \div 1.64 \doteqdot 1.48$$

This structure, needing not only the use of 50 kg/m rails but also an increase in the number of sleepers is very costly. Accordingly, it is considered that an increase in the size of the maintenance staff is more profitable for V N R S.

An accurate estimate of the needed increase in the staff can not obtained, because the present number of personnel per kilometer of track is not correctly known. It is thought that approximately 1.5 persons per kilometer (which is equal to that of the State Railway of Thailand having traffic service at 70 km/h) may be needed. For running at 100 km/h, it is thought that the following increase in the staff is necessary:

The above-mentioned rate of increase (1.64) in the amount of maintenance work will be lowered if efficiency (of approximately 20%) is promoted through the following measures: construction of track bed stability (widening and improvement in drainage) the elongation of the sleepers, efficient use of multiple tie tamper, and so on.

Then:

$$1.64 \times (1 - 0.2) = 1.31$$

The necessary size of the staff is:

$$1.5 \times 1.31 = 1.95 \text{ (persons/km)}$$

Thus the increase in the size of the staff is:

$$1.95 - 1.5 = 0.45 \text{ (persons/km)}$$

(Structures)

Structures such as bridges and tunnels in the Viet-Nam railroad are not maintained or inspected at all.

As mentioned briefly in 4.2.2 (Bridges), it seems that not only is the actual state of these structures unknown but also no system to check their condition is established.

It is obvious that a maintenance and inspection system for these structures will be required by all means, if the repair and the modernization of this railroad is to be carried out (presupposing future high-speed traffic service).

Moreover it is a plain fact that engineers who will participate in this work cannot be educated or trained in a short period.

Therefore, as a tentative measure, it is very important to plan at once a training program of systematic education in order to secure the staff required for this weighty job.

(Telecommunication facilities)

The greater part of the telecommunication facilities are very old, having been produced about 1964, and at present maintenance standards for them are not established. Instruction on their maintenance is done by an electrical machinery chief according to necessity. The most important problem may be as how to keep the equipment functioning normally, when completeness of telecommunication facilities, including new equipment, is achieved along with the progress of modernization in the future. Special attention should be paid to the following items.

1) Establishment of a maintenance system
2) Establishment of maintenance standards
3) Establishment of maintenance procedures
4) Provision for a full complement of gauges and maintenance materials
5) Technical training of staff for modernized equipment, etc.

Particular attention must be given to the above five items in reference to signal equipment and crossing safety devices, which are newly adopted facilities.

7. CONSTRUCTION EXPENSES

7. CONSTRUCTION BXPENSES

As mentioned before, it is considered that the period for repair and modernization construction requires 10 years. The starting time of this construction is not determined, and future increases in wages and material cost cannot be estimated easily; therefore, the conditions for the calculation of construction expenses were decided as follows:

a) Prices as of December 1973 were used as a basis.

b) The exchange rate was: US$ 1 = VNR 560 = ¥ 280

Consequently the total estimate reached US$ 328 million, namely 91.9 billion Yen. This construction expense must be carefully inspected during the examination for actual planning and execution, or must be corrected at the initiation of construction over the course of the construction.

The total estimate can be divided into the following items according to the types of construction (Unit: million yen)

Track	33,300
Track beds, bridges, etc.	33,358
Signal equipment	6,256
Telecommunication facilities	18,260
Total for ground facilities	91,174
Rolling stock	700
Full total	91,874

Details of these items are shown in the following sections.

1) Track

(a) This item cannot be subdivided because of the many indefinite factors that cause error.

(b) The estimated amount is for construction expenses.

Section	Amount of estimate	Remarks
Hue – Da-Nang	3,300	
Da-Nang – Phu-Cat	9,000	
Phu-Cat – Saigon	21,000	
Total	33,300	

(Unit: million Yen)

2) Track beds, bridges, etc.

(1) Conditions

(a) In regards to steel girders, it is difficult to estimate the amount of replacement and reinforcement because of insufficient investigation on their actual state, and so on. But all of them must be replaced in the future because of corrosion or deterioration.

(b) As described in 4.3.1 (4), all concrete girders and PC girders must be replaced because of widening.

(c) In regards to bridge substructures, the calculation of construction expenses is performed for about half of them, and the expenses calculated are assessed as enough to cover the actual cost of replacement and reinforcement repair.

(d) The widening of the track bed must be done in all sections where banking or cutting should be performed.

(e) The expenses for improvements in curve construction are calculated only for the section from 745,300 m to 750,300 m. The improvement work of the curve (200 m in radius) near the point at 1,229,340 m is to be performed under the category of track bed widening.

(f) As concerns the section from 750,300 m to 778,000 m only the estimate for new route construction is calculated. It is thought that reconstruction work on the present line is not particularly necessary.

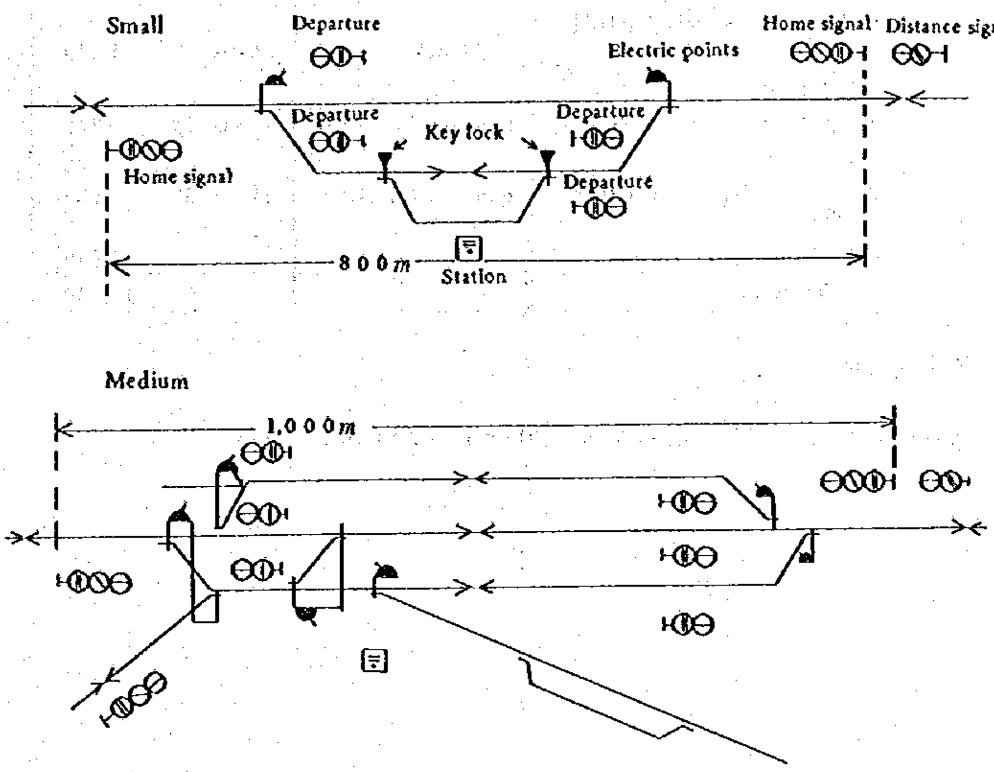
(g) As investigations required for design or planning (such as soil testing or survey) are not yet finished, this estimate is calculated under the following conditions, that the structures built as well as the construction process are of standard type.

	Total		Hue – Da Nang		Da Nang – Phu Cat		Phu Cat – Saigon	
	Length or number (km)	Amount (Unit: million yen)	Length or number (km)	Amount (Unit: million yen)	Length or number (km)	Amount (Unit: million yen)	Length or number (km)	Amount (Unit: million yen)
Steel bridge	11.4	17,500	1.8	2,104	3.8	5,168	5.8	10,228
Concrete bridge, including PC bridge	5.6	5,463	0.1	22	3.4	3,061	2.1	2,380
Culvert	489point	184	42point	16	87point	33	360point	135
Track bed widening	983.5	1,201	65.3	107	271.6	420	646.6	674
Curve improvement	5.0	510	5.0	510	0	0	0	0
Route change	14.5	8,500	14.5	8,500	0	0	0	0
Total		33,358		11,259		8,682		13,417

3) Signal facilities

Classification of station size	Number	Equipment cost (Unit: million yen)
Small	97	(33.0 x 97) 3201.0
Medium	17	(65.0 x 17) 1105.0
Large	15	(130.0 x 15) 1950.0
Total	129	6256.0

Note: The classification of station size is done as in the following figure.



(Remark) Large figure is larger than Medium

4) Telecommunication facilities

1) Reconstruction project

Classification	Number	Equipment cost (Unit: million yen)	
Short wave telecommunication HF/SSB	64 sets	(2.5 x 64)	160
Ultra-short wave telecommunication VHF/FM		Base station 2.0 x 120 Mobile station 1.5x100	390
Others			110
Total			560

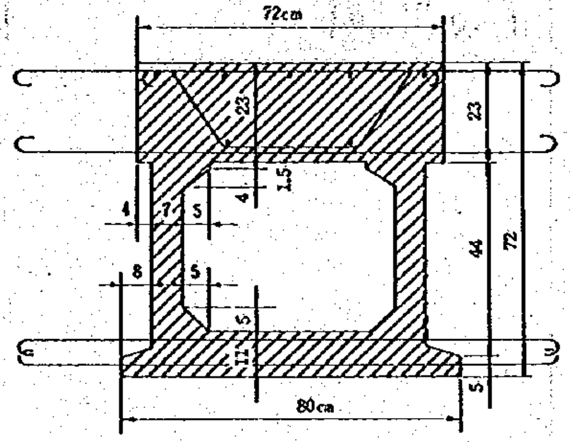
(2) Modernization project

Classification	Number	Equipment cost (Unit: million yen)	
Wire channel	14 block	(287x14)	4,118
Telephone facilities	14 block	(8x14)	112
Multiple wire relaying facilities	14 block	(75x14)	1,050
Multiple wireless relaying facilities	7 block	(690x 7)	4,830
SHF 60/240			
Telephone instruction facilities	5 instruction office	(55x 5)	275
Teleprinter			
Automatic telephone exchange facilities	6 instruction office	(130x 5)	650
Other			2,950
Total			17,700

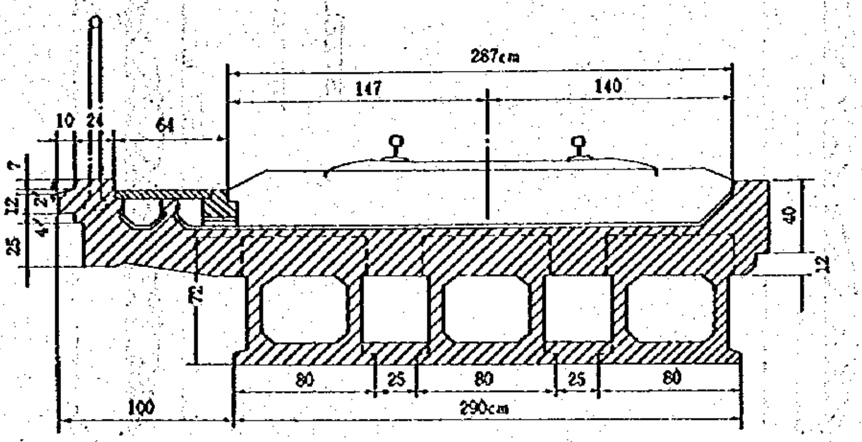
5) Rolling Stock

Passenger car: 35 million Yen x 20 units = 700 million yen

CROSS SECTON
OF A PRESTRESSED CONCRETE GIRDER

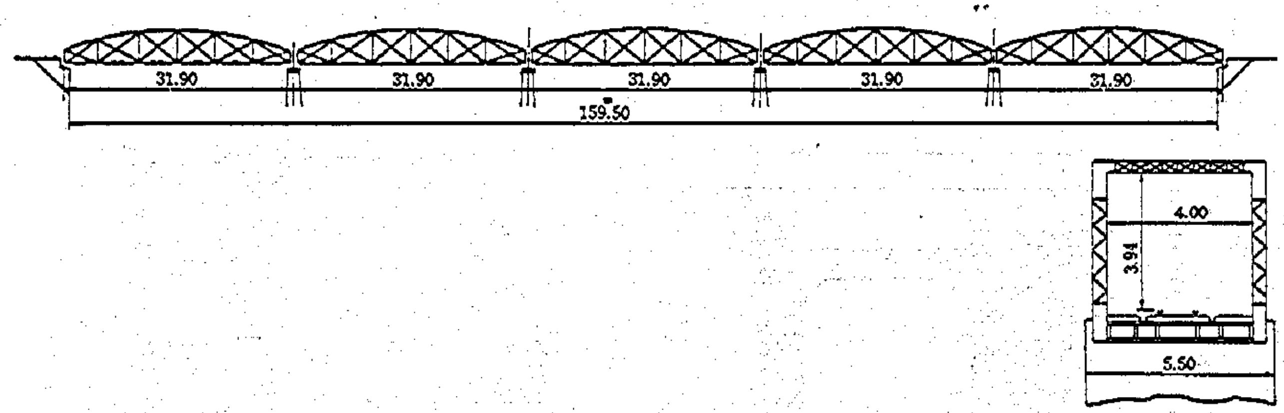


CROSS SECTION
OF A PRESTRESSED CONCRETE BRIDGE



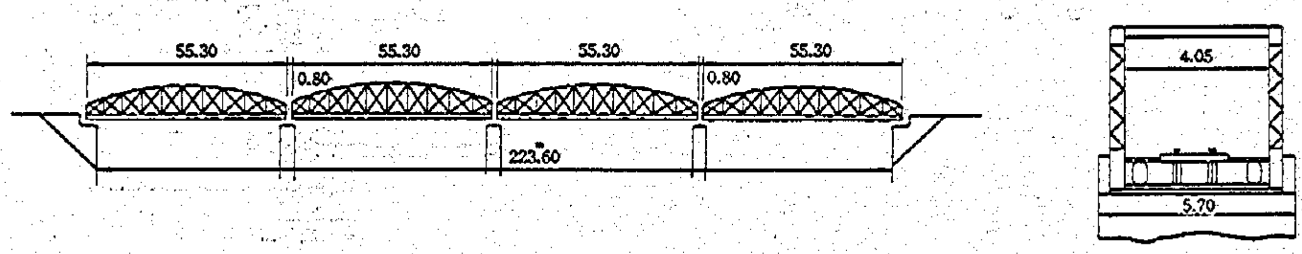
STEEL BRIDGE

TYPE "DAYDE PILLE"

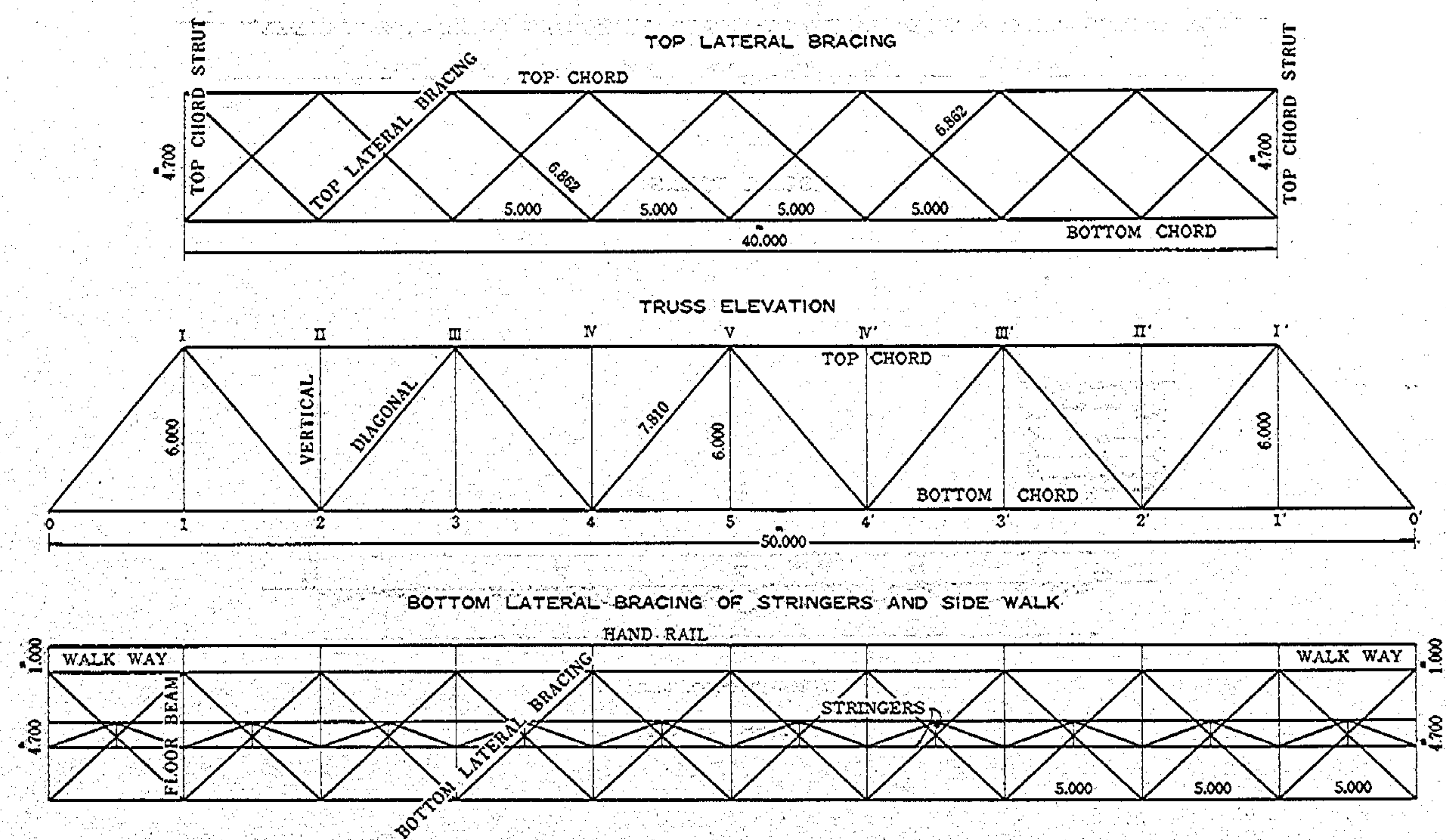


STEEL BRIDGE

TYPE "LEVALOIS PERRET"

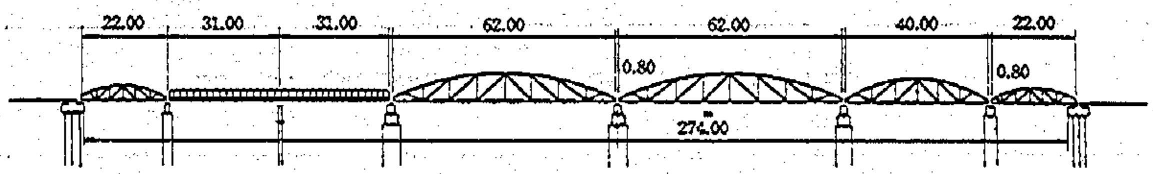


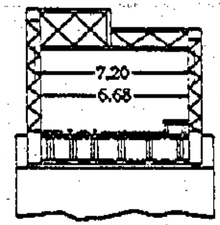
ERECTION DIAGRAM OF 50M "KRUPP" BRIDGE SPAN



STEEL BRIDGE

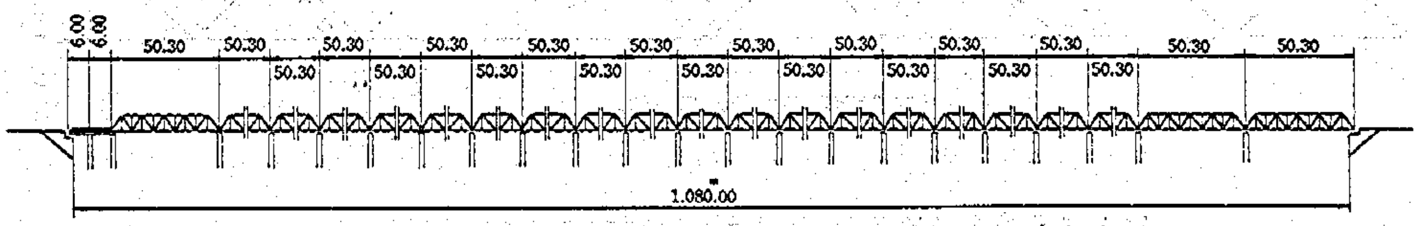
TYPE "LEVALOIS-PERRET"





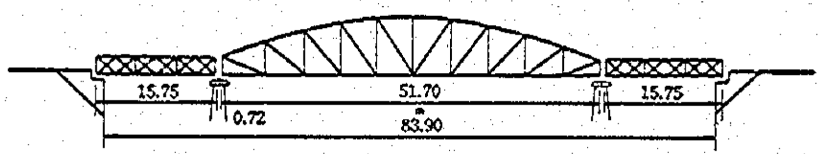
STEEL BRIDGE

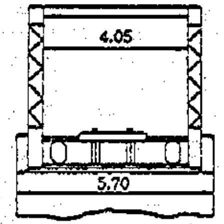
TYPE "KRUPP"



STEEL BRIDGE

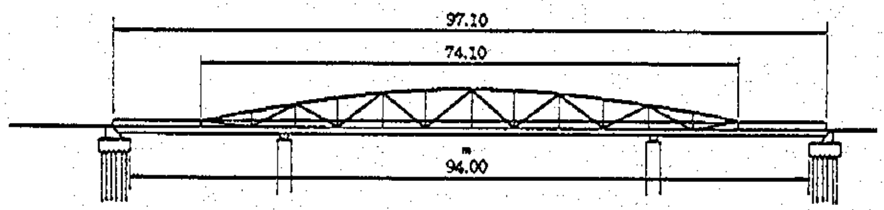
TYPE "EIFFEL"

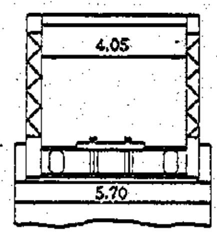




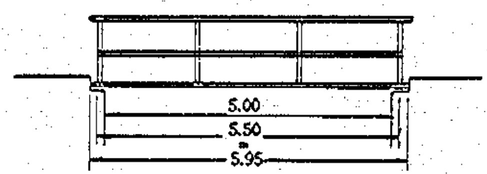
STEEL BRIDGE

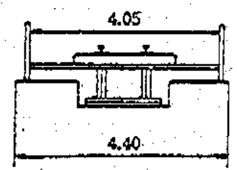
TYPE "LEVALOIS-PERRET"

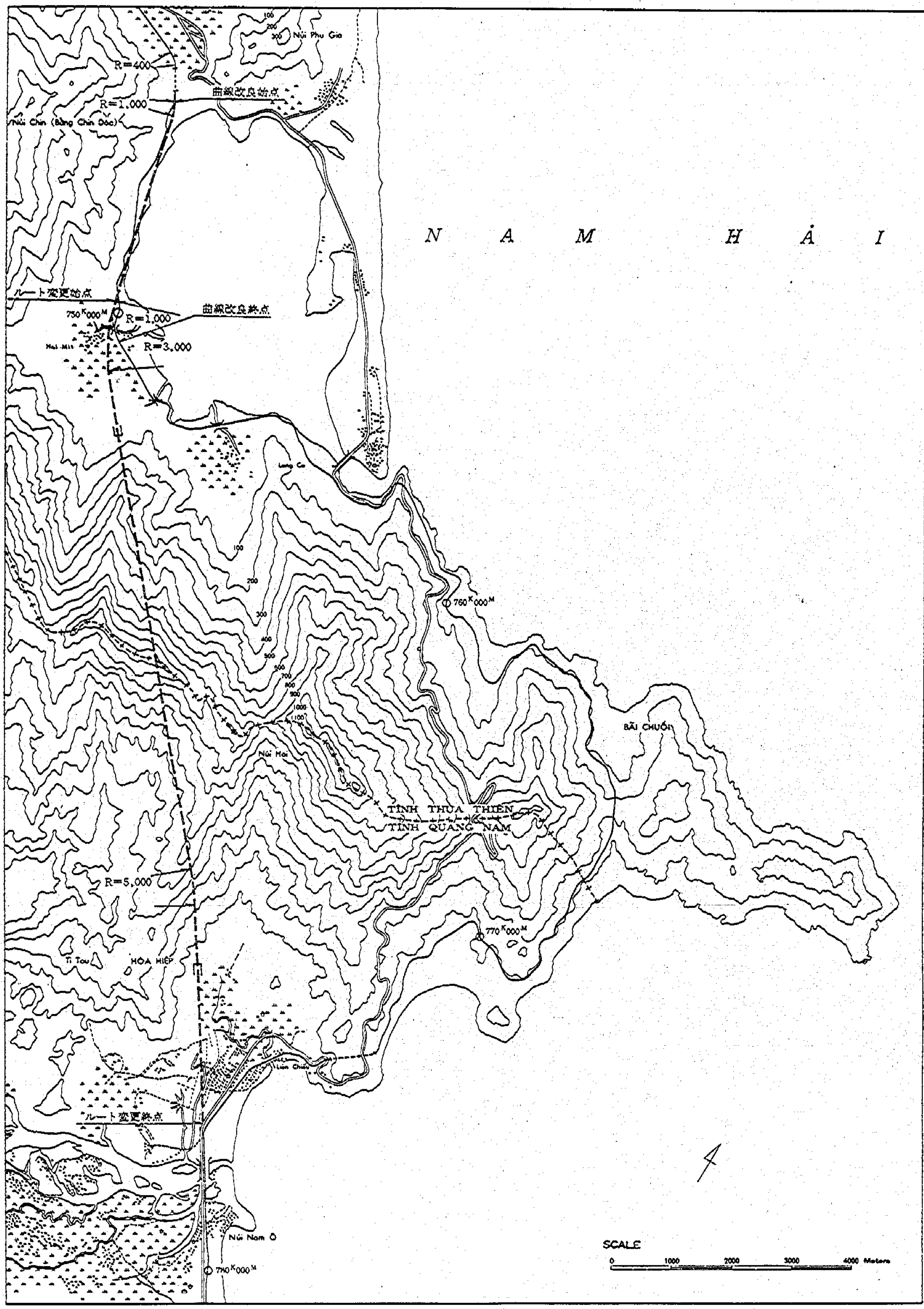




STEEL BRIDGE

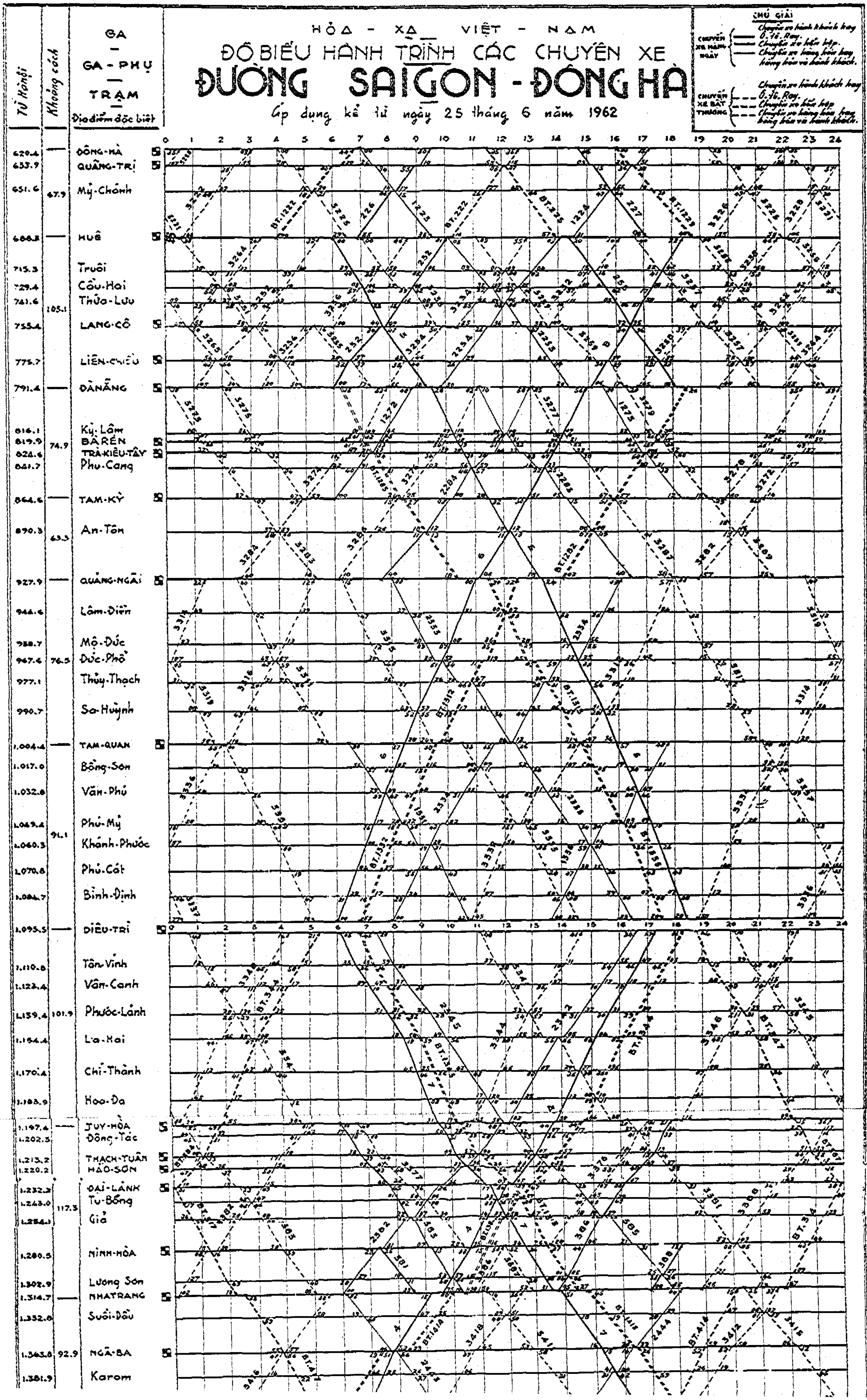


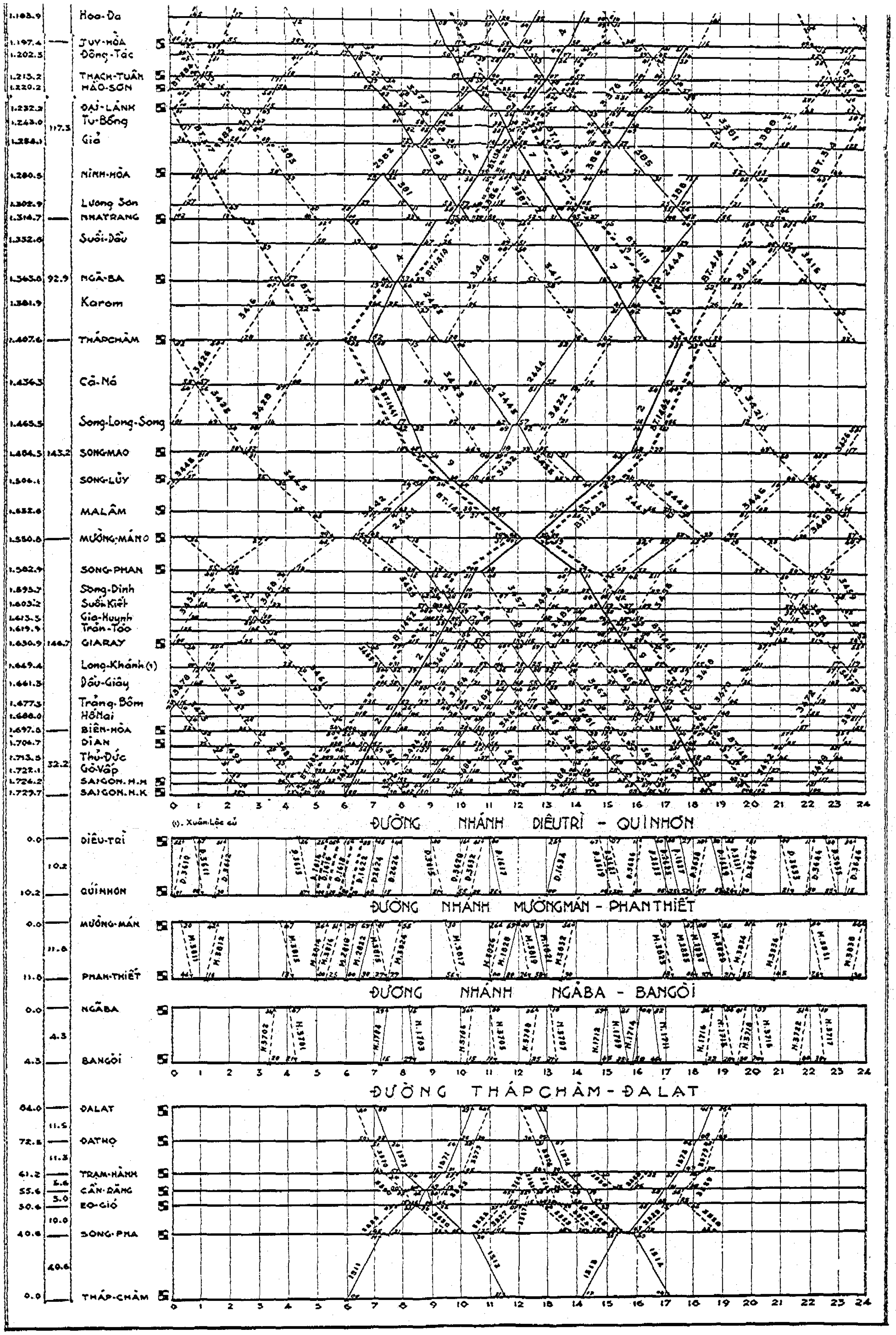




N A M H Ả I
Núi Phu Gia
R=400
曲線改良始点
R=1,000
Núi Chin (Bằng Chin Đốc)
ルート変更始点
750K000M
R=1,000
曲線改良終点
R=3,000
Long Co
100
200
300
400
500
700
800
900
1000
1100
Núi Hoi
TỈNH THỪA THIÊN
TỈNH QUẢNG NAM
760K000M
BÃI CHUỐI
R=5,000
770K000M
Ti Tou
HÒA HIỆP
Lien Chieu
ルート変更終点
Núi Nam Ô
760K000M
SCALE
0
1000
2000
3000
4000 Meters

- Operated up to 1964 -





Hoa-Đa
Juy-Hòa
Đông-Tác
Thạch-Tuân
Hảo-Sơn
Đại-Lãnh
Tu-Bông
Giả
Ninh-Hòa
Lương Sơn
Nhatrang
Suối-Dầu
Ngã-Ba
Karom
Tháp-Chàm
Cà-Ná
Sông-Lòng-Sông
Sông-Mao
Sông-Lũy
Ma-Lâm
Mường-Mán
Sông-Phan
Sông-Dinh
Suối-Kiết
Gia-Huynh
Trản-Tảo
Giaray
Long-Khánh (1)
Dầu-Giây
Trảng-Bôm
Hố-Nai
Biên-Hòa
Dĩ-An
Thủ-Đức
Gò-Vấp
Saigon.H.H
Saigon.H.K
(1). Xuân-Lộc cũ
ĐƯỜNG NHÁNH DIÊUTRÌ - QUINHƠN
Diêu-Trì
Qui-Nhơn
ĐƯỜNG NHÁNH MƯỜNGMÁN - PHANTHIẾT
Mường-Mán
Phan-Thiết
ĐƯỜNG NHÁNH NGÃBA - BANGÔI
Ngã-Ba
Bangôi
ĐƯỜNG THÁPCHÀM - ĐALAT
Đalat
Đathọ
Trạm-Hành
Cần-Đăng
Eo-Gió
Sông-Pha
Tháp-Chàm
1.183.9
1.197.4
1.202.5
1.213.2
1.220.2
1.232.3
1.243.0
1.254.1
1.280.5
1.302.9
1.314.7
1.332.6
1.363.0
1.381.9
1.407.6
1.436.3
1.465.5
1.484.5
1.504.1
1.532.6
1.550.8
1.582.9
1.593.7
1.603.2
1.613.5
1.619.9
1.630.9
1.649.4
1.661.5
1.677.3
1.686.0
1.697.5
1.704.7
1.713.5
1.722.1
1.724.2
1.729.7
117.3
92.9
143.2
146.7
32.2
10.2
11.8
4.3
11.5
11.3
5.6
5.0
10.0
40.6