2.3.3 Project scope

2.3.3.1 Route plan

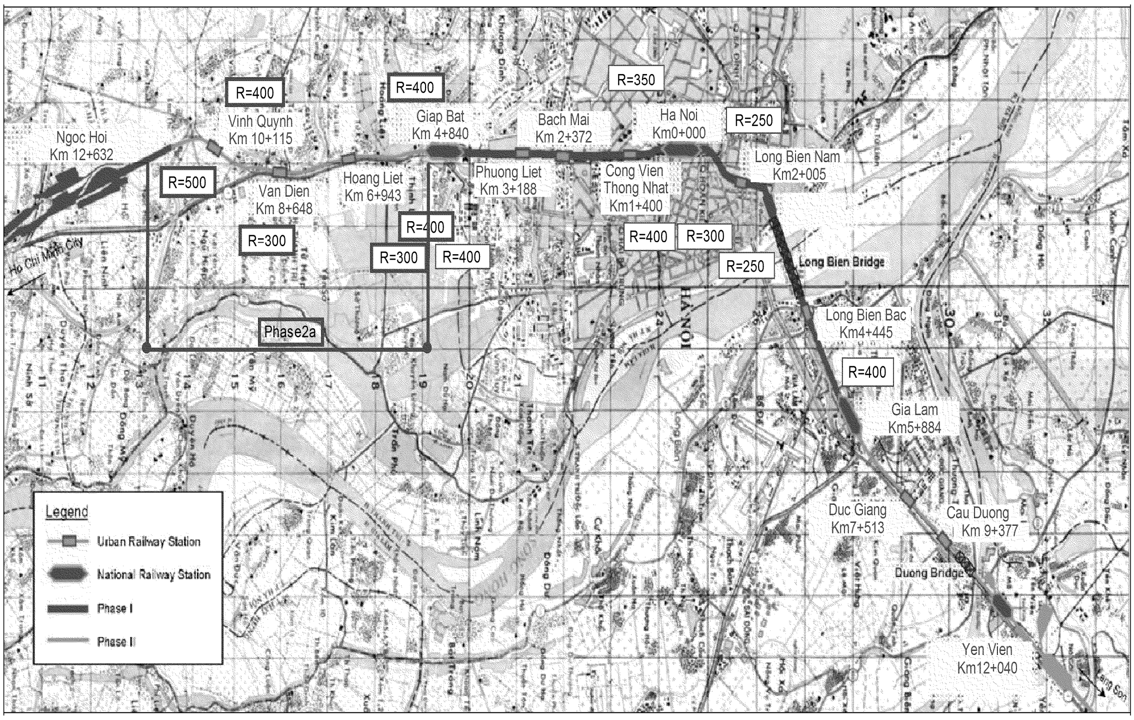
Because existing trains (narrow and standard gauge) and electric trains (standard gauge) will run on the same (dual gauge) track on Line 1, the alignment, track, power, signaling and telecommunications systems, etc. have to comply with both existing railway regulations and new regulations that will be prepared for the electric trains. Line 1 uses the following track alignment parameters:

Number of tracks:	Double track
Main line track center distance:	4.2 m
Maximum design speed:	120 km/h
Minimum radius of curvature:	250 m
Maximum grade:	18 ‰ (maximum grade at stations is 1.5 ‰)

These parameters are used for the whole length of the line and the alignments of both Phase 1 and Phase 2a are therefore compatible. Phase 2a consists of the section between the south of Giap Bat (Km5+221) and the north of Ngoc Hoi.

1) Horizontal alignment

Although the curve radius on both sides of the Phase 1 Long Bien Nam station is R=250m because of land acquisition issues, the curve radius on other sections is at least R=300m. Fig. 2.3.3.1-1 shows the horizontal alignment of the entire line. Only locations with a curve radius smaller than 500m are indicated in the figure. The length of the horizontal alignment sections of Phase 2a are shown in Table 2.3.3.1-1.



Source: JICA Survey Team

Fig. 2.3.3.1-1 Horizontal Alignment of the Entire Line

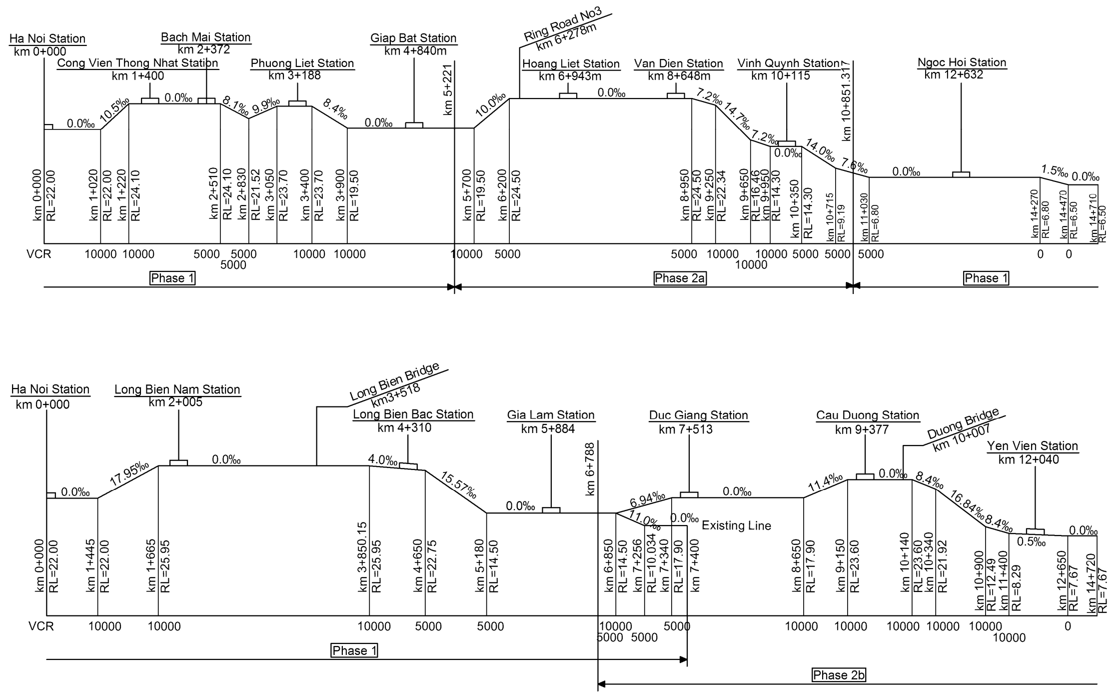
Table 2.3.3.1-1 Length of the horizontal alignment sections of Phase 2a

Items	Unit	Total length
Length of main line track	km	5.649
Length of track at tangent	km	2.952
Length of track at curves In which R<400m 400m<R<600m R>600m	km location/Km location/Km location/Km	2.697 4/0.938 1.5/0.385 8/1.374
Curve rate	%	47.74

Source: JKT

2) Vertical alignment

The height of the viaduct has been determined based on the clearance needed for road and river crossings and the height required for station facilities. In addition to these requirements and the track alignment parameters, passenger riding comfort and the appearance of the railway from nearby roads were also considered when determining the vertical alignment. Fig. 2.3.3.1-2 shows the vertical alignment of the entire line while the length of the vertical alignment sections of Phase 2a are shown in Table 2.3.3.1-2.



Source: JKT

Fig. 2.3.3.1-2 Vertical Alignment of the Entire Line

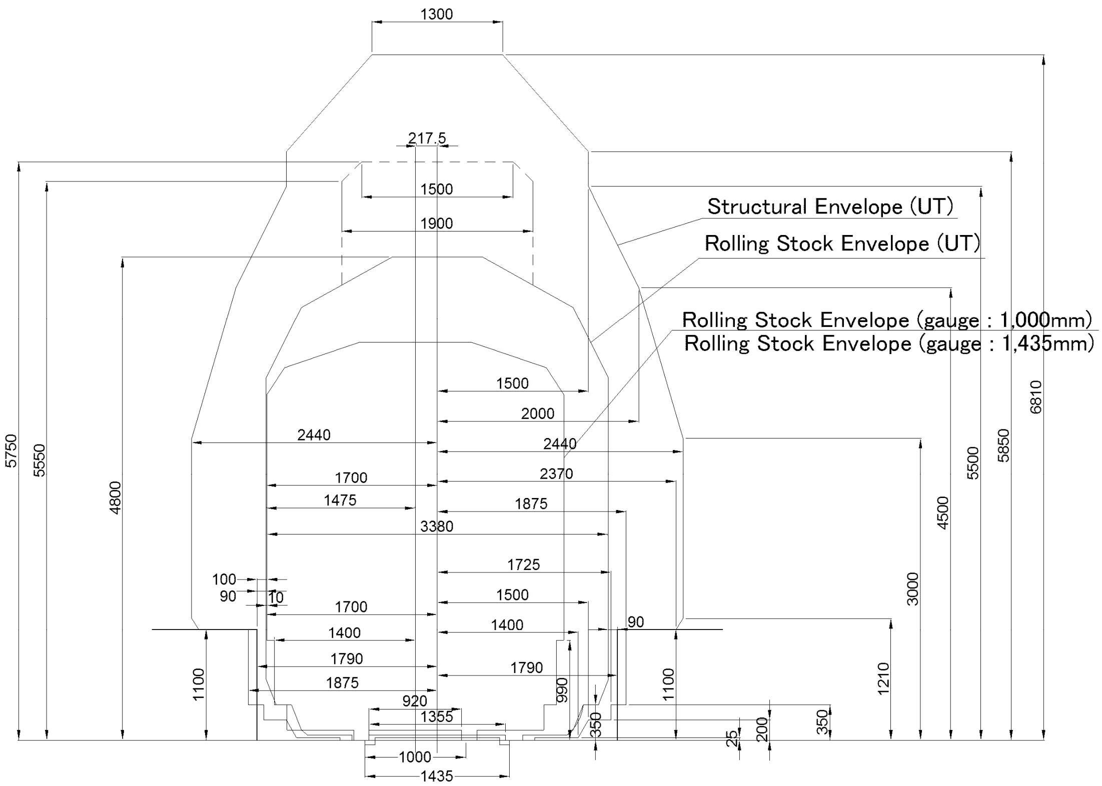
Table 2.3.3.1-2 length of the vertical alignment sections of Phase 2a

Items	Unit	Total length
Elevated	km	5.319
Viaduct	km	5.259
River bridge	km	0.105
On ground	km	0.258
Retaining wall	km	0.258
Embankment	km	0
Gradient		
i = 0	km	4.129
6<i<12	km	1.236
12<i<18	km	0.765

Source: JKT

3) Construction gauge

Both 1,435mm and 1,000mm gauge trains will run on Line 1. The structural design has to consider different construction gauges and rolling stock gauges because different rolling stock will share the same dual gauge track. The construction and rolling stock gauges are shown in Fig. 2.3.3.1-3.



Source: JKT

Fig. 2.3.3.1-3 Construction and Rolling Stock Gauges

2.3.3.2 Vehicle design specifications

The validity of railcar specifications indicated on the Phase 2a FS Report was analyzed. The details of the analysis are indicated in Annex 2.

1) The comparison of the specifications of the Basic designs (BD) and the detailed designs (DD) for Phase 2a FS and Phase 1

As indicated in the Annex 2, though there is a difference in the Basic designs (BD) and Phase 2a FS Report, as a result of discussions with TRICC, it was found out that there were errors in description. The errors in the descriptions should be corrected upon finalization of the Phase 2a FS Report.

Vehicle parameter
The vehicle is planned based on the STRASYA vehicle. The vehicle parameter is the following tables.

Table 2.3.3.2-1 Outline of vehicle parameter

No.	Item	Outline of parameter
1	Track gage	1,435mm
2	Car Width	3,380mm
3	Vehicle length (Length for two joining center)	20,000mm
4	Platform height	1,100mm
5	Gap between platform edge and car floor edge	100mm
6	Power supply	overhead contact line AC25KV, 50Hz
7	Design speed	120km/h
8	Max. axle load	18,000kg
9	Car height	3,655mm
10	Car floor height	1,100mm<H<1,150mm
11	Distance between bogeyes	13,800mm
12	Wheel diameter	860mm

Source: JKT

Installation of vehicle made in Japan
The following problem existed from a regulated difference of a Japan and a Vietnam. However、A Vietnamese country is scheduling the revision of a domestic law and the rule from the idea of basically accepting BD.

- The issue of concerning setting of clearance gauge and rolling stock gauge.
- The issue of concerning the gap between overhead line and car body.

The car width is larger than general city railway vehicles. However, it is the same level as the width of the Shinkansen vehicle. This vehicle is a range that can be produced in Japan.

2) Structure envelope and rolling stock envelope

VNR is currently conducting evaluations of basic design(BD)s and detailed designs (DD) for Phase 1. As for rolling stock, structure envelope and rolling stock envelope are not yet approved. Since this is the first construction of double track electrified lines, applications for approval from MOT will be delayed. Since structure envelope and rolling stock envelope are prerequisites for designing, by this delay in approval, progresses of projects in Phase 1 would be affected. For these issues, based on Japanese standards, our team evaluated their safety.

As for the basic design (BD)s in Phase 1, structure envelope and rolling stock envelope are proposed for raised floor platforms for 3 track gauge. These include scaling down of the current structure envelope for the platform section and widening of the rolling stock envelope. As a result of reviewing these issues, there were no effects for operations by rolling stock specified by rules and regulations related to rolling stock envelope in Vietnam.

As for the structure envelope for the Line No. 1, since it has more restrictions than existing rules and regulations, it is necessary to either revise the regulations or to obtain special approvals by improving regulations for transport exceeding Vietnam's rolling stock envelope. General descriptions of transport restrictions include the following 3 points.

a) Expansion of the rolling stock envelope
Regular rolling stock envelope (Please refer to Figure 2.3.3.2-1). The expanded section is the section below 1,250mm from the height of the rail head. Since the expanded dimension is smaller than the structure envelope, it does not affect Vietnam's structure envelope regulations.

Distance between the height of overhead contact lines and the height of the rolling stock specified by the Vietnam's rolling stock envelope regulations is set at 300mm. This distance of 300mm is the same as the height limit for automobiles for level crossings in AC sections in Japan and as the distance to overhead contact lines. This does not interfere with the distance between overhead contact lines and the height of the rolling stock specified by Vietnam's rolling stock envelope regulations.

b) Shortening of the structure envelope
To construct raised floor platforms for urban railways, its structure envelope is shortened from regular 1,435mm (Please refer to Figure 2.3.3.2-1).The shortened section is the section below 1,100mm from the height of the rail head.

Shortened dimension is larger than the rolling stock envelope (expansion of the above described rolling stock envelope), and clearance gap from the rolling stock envelope is secured to be 100mm. For this reason, this does not affect transport by regular rolling stock specified by Vietnam's rolling stock envelope regulations.

c) Set up for overlapping of the track distance from adjacent lines and the structure envelope
In Vietnam, adjacent lines are not installed with overlapping of the structure envelope (Please refer to Figure 2.3.3.2-2). In the future, it is necessary to improve transport regulations to prepare for cases for transport of freights, and for transport by rolling stock specified by the clearance which exceed the rolling stock envelope (for an

instance, for transport by Shinkansen rolling stock etc.). Major items requiring improvement of transport regulations are as follows.

- Designations of rolling stock which can enter tracks by line and by section etc.
- Transport operating regulations for wide and large rolling stock etc.

3) Necessary technological support for sustention of vehicle performance etc.

It is necessary to support maintenance of Vietnam's first introduced Electric Multiple Unit (EMU: electric trains). Maintenance work to sustain performance of high-performance rolling stock is important to provide high quality urban railway transport. For maintenance work, technologies for inspection methods to detect possible causes for future failures etc. Specifically, education for technology transfer is necessary.

Especially, since high-pressure electricity is pressurized, improvement of manuals should be carefully conducted for safety measures for maintenance work while applying current. Improvement of these operating and maintenance manuals are described in Phase 1's detailed design Report JKT/REP/0372/E. It is desirable that VNR will consider necessity of technology transfer.

4) Changes in electrification methods

At the time of screening for the provision of the loan for this project, the electrification method was DC electrification. However, at the time of the Phase 1's basic designing (BD), it was changed to AC electrification. In general, the electrification method for exclusive lines for urban railways is DC. The Line No. 1 is not an exclusive line for urban railways. It is a line which both mid- and long-distance trains and international trains share its tracks. Since the route of the Line No. 1 is a part of the national railway network, AC electrification taking future electrification plan into consideration is desirable.

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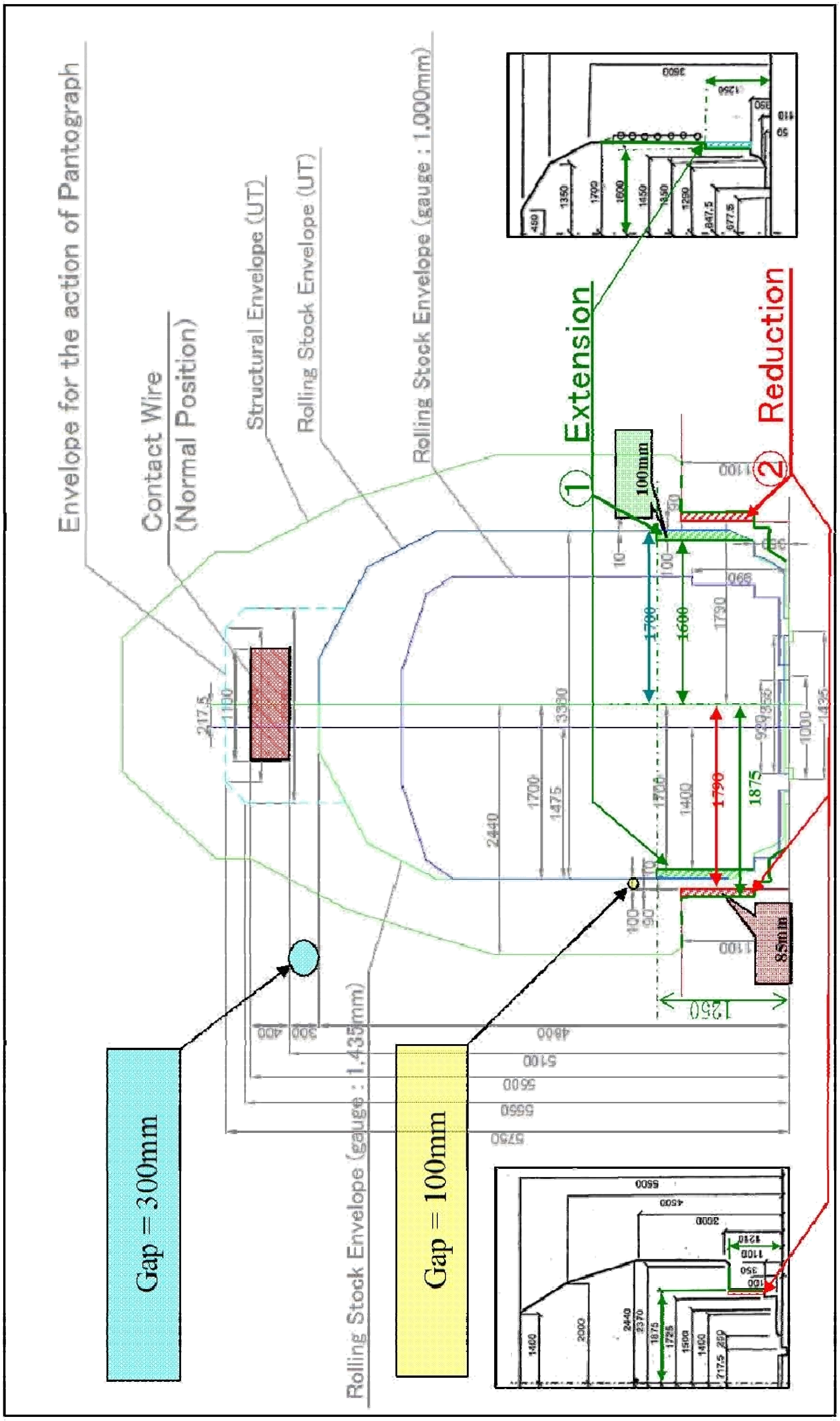
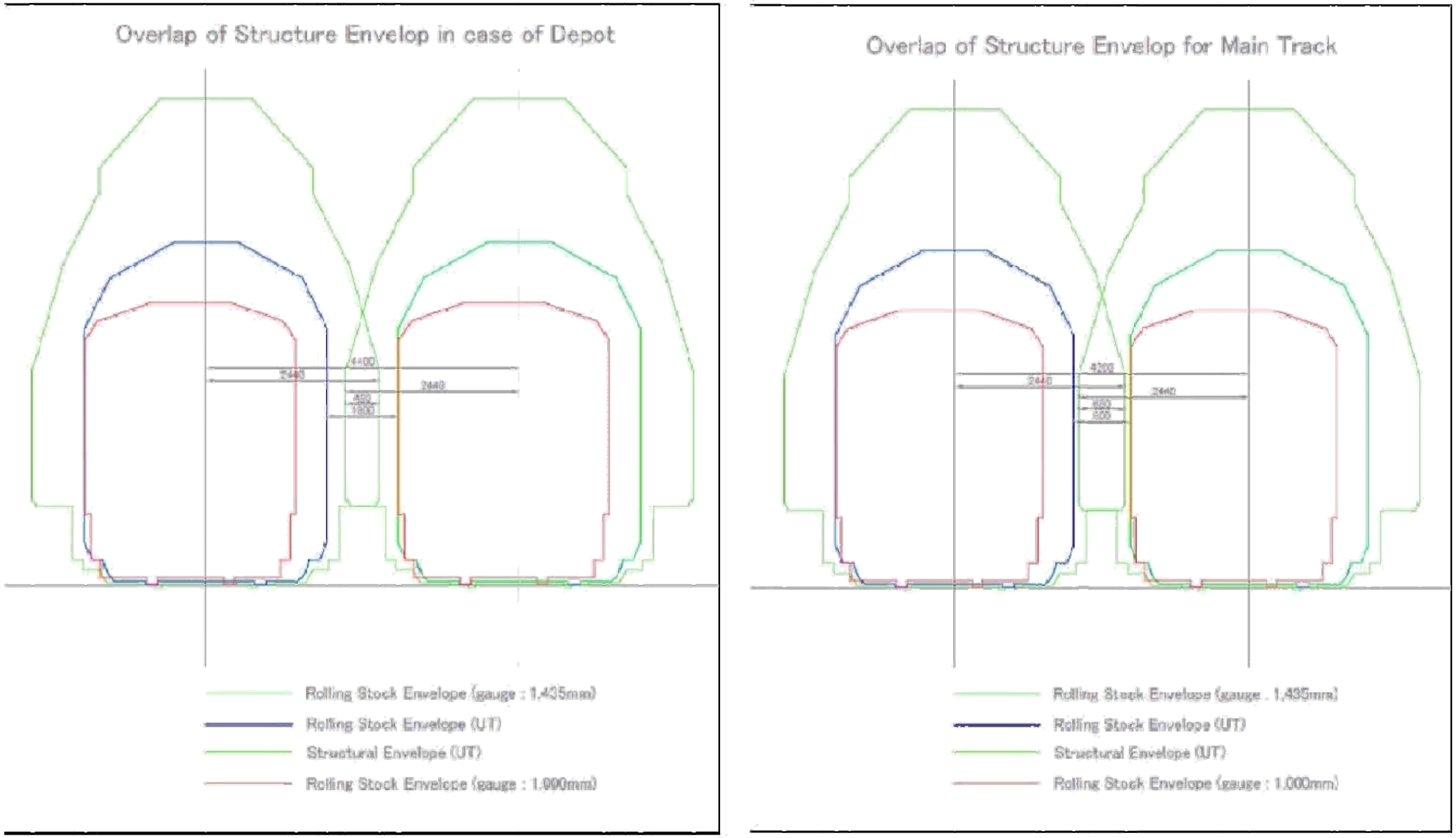


Source: JKT

Fig. 2.3.3.2-1 Shortening of structure envelope and expansion of rolling stock envelope



Source: JKT

Fig. 2.3.3.2-2 Overlapping of rolling stock envelopes for depots and the main line

2.3.3.3 Train operation plan

The validity of the train operation plan in the Phase 2a FS Report was analyzed.

1) Errors in the FS Report

As for the train operation plan in the Phase 2a FS Report, since there were divergences between the basic design (BD) in Phase 1 and the detailed design (DD) in the train operation plan, as a result of discussions with TRICC, it was found out that there were errors in descriptions. Required adjustments and corrections due to the errors are described in Annex 2.

2) The comparison of train operation plans in Phase 2a FS and Phase 1's detailed design (DD)

The comparison result of the train operation plans are indicated in Annex 2. Additionally, described blow is improvement of scheduled speeds which are considered to be required in the future.

UT's dwell time is set to be 1 min. with the request from VNR. For this reason, travelling time between Gia Lam and Ngoc Hoi is long, being 39 min. (scheduled speed: 28.5km/h). In general, scheduled speeds of urban railways are above 30km/h. Additionally, dwell time is decided for each station while taking boarding and alighting time for passengers into consideration. It is desirable to carefully examine dwell time and improve scheduled speeds before commencement of its service.

Table 2.3.3.3-1 Improvement targets of scheduled speeds

	Distance between Gia Lam and Ngoc Hoi (km)	Required time (min.)	Scheduled speed (km/h)
Time of diagrams	18.5	39	28.5
Improvement targets		35	31.7

Source: JICA Survey Team

3) Reviews of transport plans for Phase 1 + 2a

The design target year for the Phase 1 is 2030, with the planned opening of the Phase 2b by 2020. However, our team's investigation aims to evaluate Phase 1 + 2a and requires the transport plan up to 2050. Additionally, since it does not include the opening of the 2b section, the transport plan of the Basic design(BD) in Phase 1 cannot be used. Accordingly, based on the demand forecast for Phase 1 + 2a for the period between 2020 and 2050, with the prerequisites specified below, we assembled a transport plan to understand effects increases in the No. of vehicles and in the required No. of crews without increase of facilities.

- Demand forecast: Operation for Phase 1 + 2a sections only (without construction of 2b). Increase rate for the No. of passengers: increase rate for the period between 2020 and 2030 is applied to 2050.

- Ground facilities: 8 car/train set; Headway: 4 min.
- Vehicle performance: railcars for Phase 1's detailed design

Results of the reviews are indicated below.

a) Effects of facilities
The transport limit for ground facilities is up to operations with 4 min. intervals with 8- car/train-set and it was confirmed that transport up to 2050, which is the last year of the project evaluation period, is possible.

b) No. of required vehicles
No. of required vehicles is indicated in the Table below.

Table 2.3.3.3-2 No. of required railcars for simultaneous opening of Phase 1 + 2a

Year	Headway (min.)		No. of cars per train-set (car)	No. of required car (car)	Increase of No. Of car (car)
	Phase 1 section	Phase 1 section			
2020 - 2027	8	8	6	84	—
2028 - 2036	8	8	8	112	+28
2037 - 2045	6	6	8	160	+48
2046 - 2050	4	4	8	240	+80

Source: JICA Survey Team

c) No. of required crews
No. of required crews is indicated in the Table below.

Table 2.3.3.3-3 No. of required crews for the simultaneous opening of Phase 1 + 2a

Year	Headway (min.)		No. of cars per train-set (car)	No. of required drivers (person)	No. of required conductors (person)	Total No. of crews (person)
	Phase 1 section	Phase 2a section				
2020 - 2027	8	8	6	70	60	130
2028 - 2036	8	8	8	70	60	130
2037 - 2045	6	6	8	95	80	175
2046 - 2050	4	4	8	145	120	265

Source: JICA Survey Team

d) No. of trains per day and car km per day for Year 2020 and Year 2022 Calculated No. of trains per day and car km per day are indicated in the Table below.

Table 2.3.3.3-4 No. of trains per day and car km per day for 2020 and 2022

Index	Unit	Year 2020	Year 2022
No. of operating trains	No. of trains/day	242	242
Car km (km)	Car km/day	4,465×6=26,790	4,465×6=26,790
Traveling time	Time by section (min.)	Gia Lam - Ha Noi 12 min. Ha Noi - Giap Bat 12 min. Giap Bat - Ngoc Hoi 13 min.	

Source: JICA Survey Team

Methods for the acquisition of the above results are as follows.

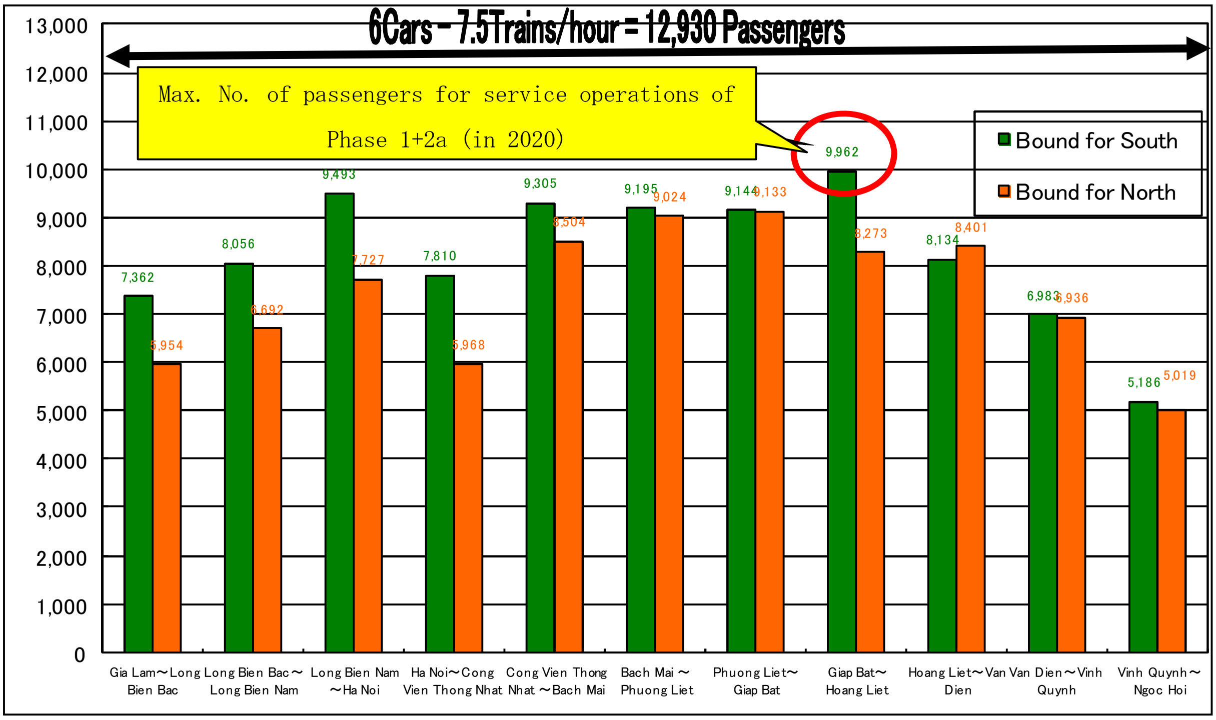
e) Assumption of the transport volume

Transport volume was calculated by the investigation team from HAIMUD's Table O-D based the following premises.

- Service operations of Phase 1 + 2a sections (without construction of 2b)
- Calculation of the No. of crews for the most congested section (between Giap Bat and Hoang Liet) for the period between 2020 and 2050
- The increase rate of 39.4% is used for the calculation for 10 years between Year 2020 and 2030.

HAIMUD's Table O-D and section traffic volume are indicated in Annex 4. The Fig. below indicated transport volume between stations for peak time zones upon the opening of Phase 1 + 2a.

6-car trainset - 8 min. intervals = 12,930 persons



Source: JKT

Fig. 2.3.3.3-1 transport volume between stations for peak time zones when opening Phase 1 + 2a

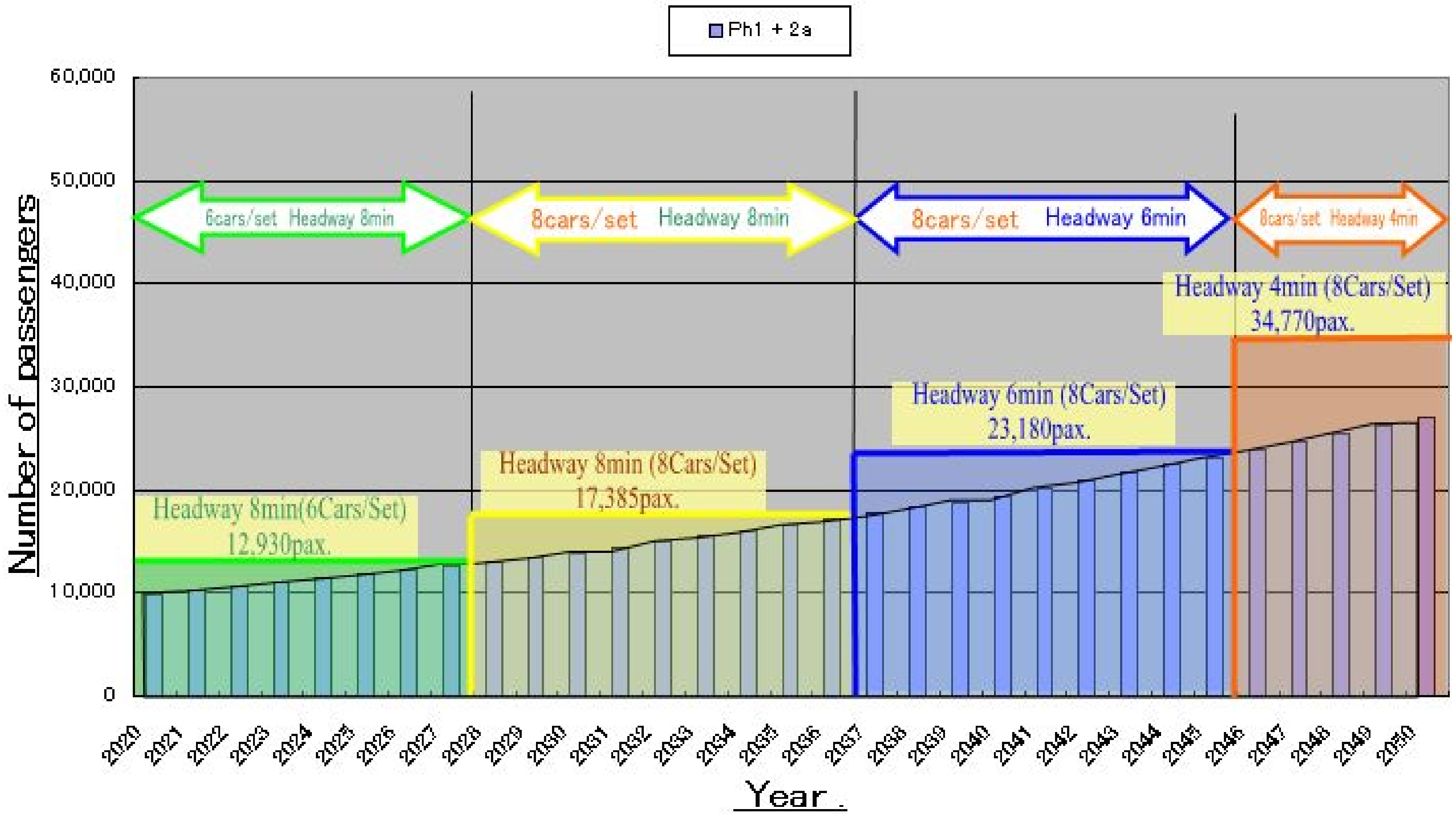
f) Required transport capacity

Calculated results for predicted No. of passengers and its required transport capacity are indicated in the Table and Figure below.

Table 2.3.3.3-5 No. of passengers and required transport capacity between Giap Bat and Hoang Liet

Year	No. of passengers during peak hours (person)	Transport capacity during peak hours
2020	9,962	6 car/train set - 8 min. interval (12,930 passengers)
2021	10,354	
2022	10,746	
2023	11,138	
2024	11,530	
2025	11,922	
2026	12,315	
2027	12.707	
2028	13,099	8 car/train set - 8 min. interval (17,385 passengers)
2029	13,491	
2030	13,883	
2031	14,430	
2032	14,977	
2033	15,524	
2034	16,071	
2035	16,618	
2036	17,165	
2037	17,712	8 car/train set - 6 min. interval (23,180 passengers)
2038	18,259	
2039	18,806	
2040	19,353	
2041	20,115	
2042	20,878	
2043	21,640	
2044	22,403	
2045	23,165	
2046	24,928	8 car/train set - 4 min. interval (34,770 passengers)
2047	24,691	
2048	25,453	
2049	26,216	
2050	26,978	

Source: JICA Survey Team



Source: JICA Survey Team

Fig. 2.3.3.3-2 No. of passengers, required trainsets, and headways for peak hours for the most congested section (between Giap Bat and Hoang Liet)

2.3.3.4 Civil facilities plan

1) General overview of the structures on the Phase 2a section

The whole Phase 2a section consists of a PC girder viaduct. However, the section that begins a bit after Van Dien station and continues until the horizontal section leading to Ngoc Hoi Complex (a downward slope until To Lich Bridge which is the end point of Phase 2a) uses a retaining wall structure because a viaduct would be too low. On the Phase 2a section there are 4 bridges and 3 intermediate stations used only by urban trains (UT). However, the platforms for UTs and other trains inside the Ngoc Hoi Complex are also included in Phase 2a. These principles are the same as those used for Phase 1 so the structures are mutually compatible.

The new viaduct will be constructed in parallel with the temporary line (during the construction of the viaduct, trains arriving at Giap Bat will run to Ngoc Hoi station for inspection and repair). The temporary line will use existing line track between Giap Bat station and Van Dien (until chainage Km9+508) and newly-laid track further along the line. Construction is kept to a minimum in order to use as little land as possible between the new line and the temporary line tracks.

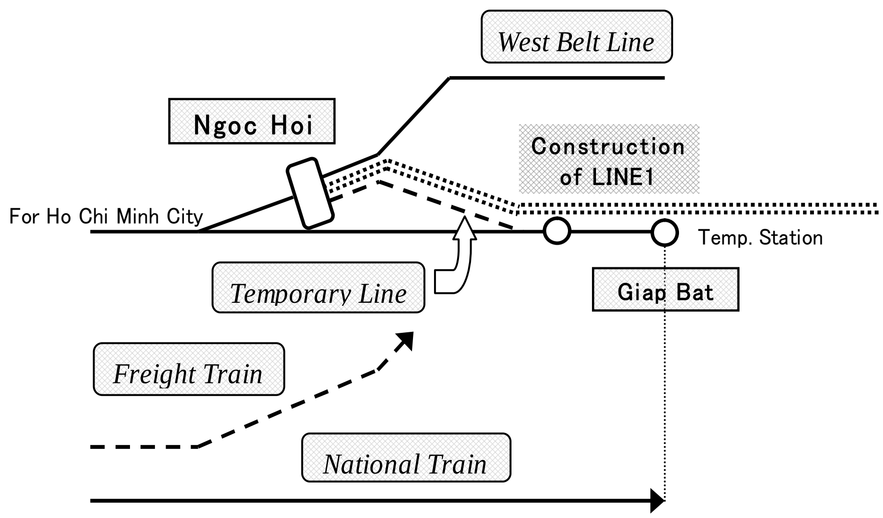


Fig. 2.3.3.4-1 Train Operation Route during Construction of Phase 1 + 2a

Because the civil facilities of Phase 2a are based on the same fundamental principles as those of Phase 1, the structures along the entire line are integrated. The profile drawings of the Phase 2a structures are shown in Annex 4.

2) Structures

a) Viaduct

The viaduct uses a girder-type structure consisting of a combination of PC girders and (single) RC piers and was chosen because of its constructability, maintainability and aesthetics. Although it would be possible to use double track 1-box, double track 2-

box as well as T-shape girders for the PC girders, double track 1-box girders were chosen because of their constructability, aesthetics and construction time. After taking the relationship with surrounding roads as well as aesthetic and economic considerations into account, the standard pier span was set at 40m.

Superstructure

- PC girders

The viaduct track surface consists of track facilities, walkways (with cable ducts underneath) and railings along the sides. The total width is 10.98m (tangent sections) and the walkways and railings extend beyond the construction gauge. The typical cross-section (L=40m) is shown in Fig. 2.3.3.4-2.

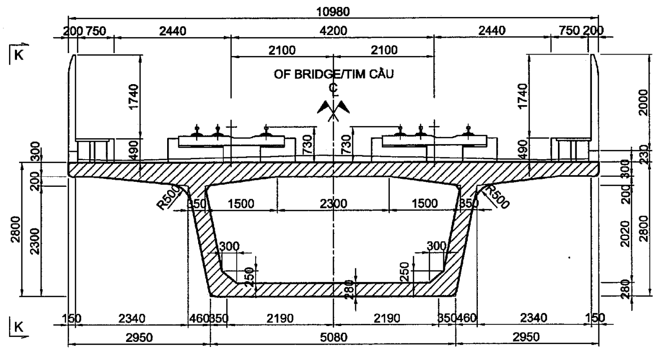


Fig. 2.3.3.4-2 Typical Cross Section of PC Girder (L=40m)

The continuous PC girders which make up the viaduct will be constructed using the precast segment construction method. In this method, the girders are divided into several concrete segments which are prefabricated at a factory or fabrication yard. The segments are then shipped to the site, aligned with each other one by one and finally assembled together. Because the segments can be fabricated already during pier construction and the next segments can be fabricated while those made previously are still being erected, it is possible to significantly shorten the construction period of the superstructure. High segment quality can also be guaranteed because the segments will be fabricated under controlled circumstances in well-

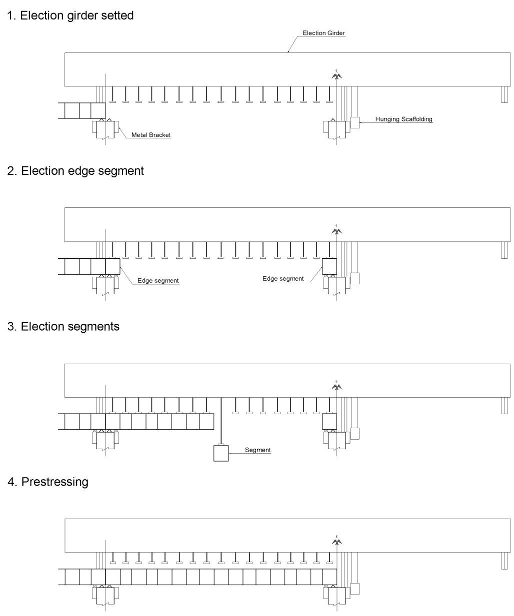


Fig. 2.3.3.4-3 Construction Method of PC Girder

maintained facilities. A summary of the precast segment construction method is shown in Fig. 2.3.3.4-3.

- Anti-noise walls

Because it is important to prevent noise pollution from affecting residential areas along the railway line, measures will be used to limit noise emitted by the structures employed for this project. Trains running on the existing line are a significant source of noise. Since the rail level of the Line 1 viaduct will be 18m above ground, even more noise can be expected from running trains in the future. Therefore, it is necessary to install anti-noise walls on both sides of the viaduct as a countermeasure.

The viaduct railings will use light-weight RC anti-noise walls especially developed for railway viaducts. These anti-noise walls are very fast and easy to install on site because they consist of factory-fabricated panels which can be attached to bolts protruding from the viaduct wheel guards. The walls consist of panels made of thin RC plates reinforced with RC ribs and are thus lighter than cast-in-place walls. Since the outer wall surfaces are rounded, flat and even, they look good also in the cityscape. Fig. 2.3.3.4-4 shows a drawing of the anti-noise wall structure.

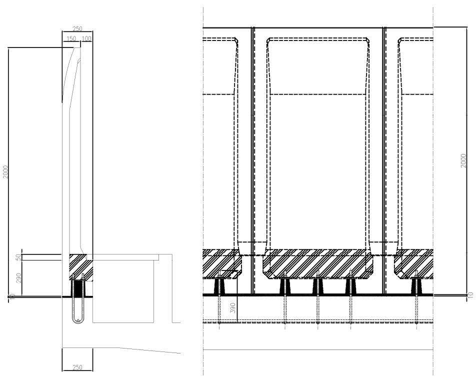


Fig. 2.3.3.4-4 Light Weight RC Anti-Noise Wall

<u>Substructure</u>

- Piers

In general, single bridge piers will be used on all sections of the Line 1 viaduct in order to enable the effective use of underlying roads for maintenance and other purposes. In order to minimize the required land acquisition, it is also advantageous to use single piers on the section south of Hanoi station that runs parallel to National Highway No. 1.

- Foundations

Cast-in-place piles will generally be used as foundation piles in urban areas in order to limit noise and vibration during construction. Reverse piles will be used for foundations and driven until the supporting soil layer (depth 30m-50m). Pile diameters between 1.2m and 1.5m will be employed. Because driven piles cause much noise and vibration and caisson foundations are difficult to construct, these two types cannot be used for foundations in urban areas.

b) Bridges

On the Phase 2a line section, there will be 3 PC girder bridges and 1 steel bridge (see section 2.3.2.1, 3) "Related projects" for the characteristics of each bridge).

- PC girders

The bridge PC girders will have the same cross-section as the PC girders of the typical viaduct. Because the bridge PC girders have long spans, they will be made from cast-in-place concrete. In general, the maximum length of simple PC girders will be 60m and steel girders will be employed for longer span lengths.

- Steel girders

Steel girders will be used for the Ring Road No. 3 Intersection. In order to minimize noise in urban areas, floors will be made from concrete slabs and the railings from light-weight RC anti-noise walls. Fig. 2.3.3.4-5 shows a cross-section of the steel girder floor system.

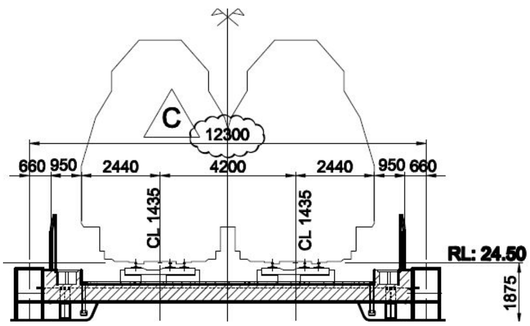


Fig. 2.3.3.4-5 Cross Section of Steel Girder

c) Retaining walls

Retaining walls will be used when the height of the viaduct is between 0 m and 5 m. The reinforced earth retaining walls will use embedded tensile reinforcement to provide soil stability and will be constructed using both retaining walls and soil. Unlike normal embankments, the walls on both sides are vertical and thus require less land. Fig. 2.3.3.4-6 shows a cross-section of the retaining wall.

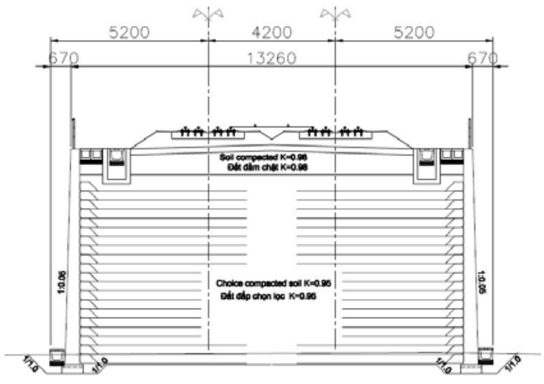


Fig. 2.3.3.4-6 Cross Section of Retaining Wall

d) Intermediate stations

The new elevated line will run in parallel with the temporary line and National Highway No. 1 between Gia Bat station and Van Dien station. Stations have platforms which increase their structural width. Hoang Liet station and Van Dien station which are located on this section both consist of two levels. Since the space between the new line and the temporary line cannot be widened, a one-pier structure will be employed with the platforms and concourse located directly over the temporary line. Fig. 2.3.3.4-7 shows a cross-section of a two-layered intermediate station.

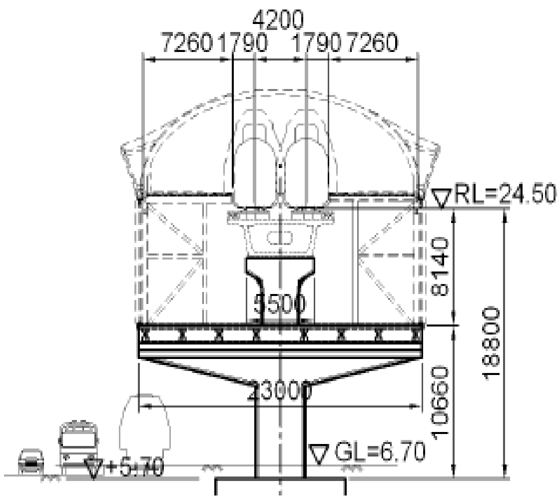


Fig. 2.3.3.4-7 Cross Section of Double-Layer Intermediate Station

Because the rail level would become low between Van Dien station and Ngoc Hoi station, Vunh Quinh station will be far separated from the temporary line and will employ a single-level, two-pier structure.

e) Track

In general, direct fixation track is used for the main line viaduct and stations. The track panels of direct fixation track are fastened to the slab and consist of sleepers with elastic material on the underside which have been fastened to the rails. Track warping is rare and the amount of maintenance work and labor can thus be reduced. The elastic material (anti-vibration rubber) used in the fastenings transfers less vibration from passing trains to structures and also helps control noise. By spreading sound absorbing ballast on top of the viaduct slab, the effect is the same as that of ordinary ballast track. The construction cost is lower compared to slab track and about the same as for ballast track.

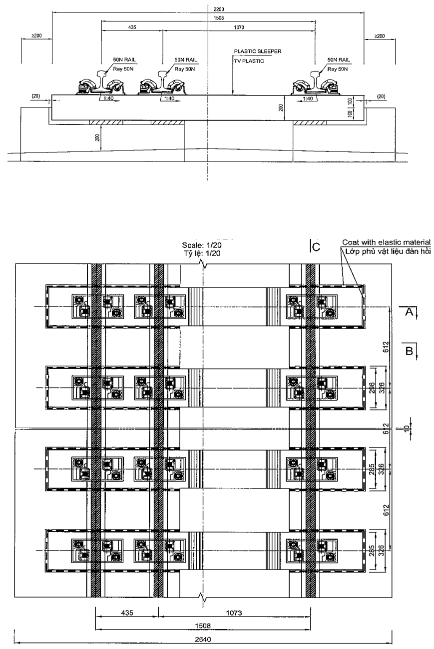


Fig. 2.3.3.4-8 Direct Fixation Track

Photo 2.3.3.4-1 Direct Fixation Track

2.3.3.5 Depot, workshop and machinery/equipment

Because the construction items of Phase 2a do not include the depot and workshop, only station machinery and equipment is reviewed in this study. The Phase 2a FS report mentions the machinery and equipment listed below.

- Automatic ticket machines: Ticket machines should be capable of handling sales of one-way tickets, one-day tickets and all types of prepaid non-contact IC cards; charging and processing refunds for prepaid IC cards; displaying information for all types of tickets and IC cards; and accepting credit cards in the future. Ticket machines should have touch panels like those used by Japanese railway companies in order to enable users to select their destination and charge IC cards.

- Fare adjustment machines: Fare adjustment machines are used to adjust the fare after overruns. Although there are no detailed descriptions of the fare adjustment machines, front and side view images of models used by Japanese railway companies are available. The machines should be able to charge the insufficient amount for one-way ticket of non-contact IC cards and prepaid cards.

- System monitoring: Monitoring of automatic ticket machines, fare adjustment machines and fare collection equipment; monitoring of IC card information; sharing of information on blacklisted cards (information storage in AFC system as well as systems to prevent use by offenders).

- Fare collection equipment: Fare collection equipment for non-contact IC cards.

- CCTV: Installation of CCTV for the monitoring of passenger safety on platforms, in elevators and escalators, and in blind spots not visible to station staff.

- Broadcasting equipment: Installation of speakers and sensors on platforms and concourses, in waiting rooms, elevators, etc. Installation of control panels in station control rooms and on station concourses. Automatic broadcasting system of Public Address (PA) system integrated with the CTC and signaling system when trains enter stations.

- Passenger guidance systems: Installation of monitors on platforms, concourses and ticket machines for the provision of information on departure times, train services and train schedules to passengers.

As shown above, the FS report for Phase 2a does not include detailed items such as air conditioning and ventilation equipment, fire protection and extinguishing equipment, emergency lighting equipment, elevators and passenger guidance systems which are all proposed in JKT's basic design. However, in order to increase passenger convenience, it is proposed that the same equipment should be used in all stations along the line. The AFC system approved in Phase 1 should also be employed for the whole line, and machinery and equipment employed for Phase 1 should also be used. Although some of the proposed systems, machinery and equipment differ from those in JKT's basic design, the same policies have still been followed. MOT has approved to use an AFC system compatible with the other planned lines in Hanoi and VNR has also agreed to this proposal.

At the time of this study, JKT had submitted the basic design for station equipment (CONCEPT DESIGN REPORT OF MECHANICAL, ELECTRICAL AND PLUMBING FOR 16 STATIONS, JKT/REP/0817/E) and the detailed design for the AFC system (Detail Design for Automatic Fare Collection System, JKT/REP/0329/E) to VNR. Equipment and facilities such as environmentally-friendly rainwater recycling and solar power generation equipment, large-scale air-conditioning units, monitor and control equipment for cooling and heating systems, fire extinguishing equipment, PA systems and surveillance monitors might seem extravagant under current conditions, but considering the remarkable economic growth in Vietnam's capital these station facilities will be suitable for when the project is completed in 2020.

2.3.3.6 Substation, OCS (Overhead Contact System), Power Distribution

1) Coordination of the phase 1 and the phase 2a

The power supply system for Phase 2a section (Km5+50~Km11+100) shall be consistent with those of Phase I in planning, design and installation. Therefore, the equipment installed on the phase 2a section of 5.6 Km including the OCS and the Power Distribution system but also the central systems (CSC) for the facilities monitoring and control in the operation control center (OCC) must be integrated to ensure consistency with one of Phase I.

2) Standby power of 22kV to Railway Power Substation, ATP and SSP

The dedicated power cables were employed and designed in the BD of the power distribution system. The reliability of 22kV power source has been increased very much. Therefore, JKT has changed the standby power of 22kV to Railway Power Substation, ATP and SSP from the external EVN power of 22kV to the internal power distribution line of 22kV. It is a reasonable change to ensure the reliability of the standby power. If the normal power grid is used, the power may be cut off due to emergency plan when there is a possibility that the electric power supply may become less than electricity demand. On the other hand, the power will not be cut off if the system uses the dedicated power line from the substation of the electric power company. For this reason, the 22-kV power supply will be kept almost ensured, and the reliability of a power supply increases.

IV.6.2.1. Page-Chapter 4-52 says "Additionally, there is the 22kV backup feeding for ATs, even for traction substation at Ngoc Hoi Railway substation." The stand-by power of the railway power substation, etc. was originally planned to receive power from the normal power grid in the power distribution basic design of JKT as the TRICC F/S-2a report of the phase-2a. However, there is no coordination between D/D report and the F/S-2a report of TRICC since it was changed in D/D.

It is better to change Fig. 2.3.3.6-1 in the TRICC F/S-2a report to make it consistent with "JKT/REP/0338/E "DETAILED DESIGN for POWER DISTRIBUTION SYSTEM ENGINEERING CONSULTING SERVICES for HANOI CITY URBAN RAILWAY CONSTRUCTION PROJECT (LINE 1), PHASE I":

3) Transmission line

IV.6.3.1.3), Page-Chapter 4-56 in the TRICC F/S-2a report recommends overhead transmission line. The route of the transmission line of 110kV to Ngoc Hoi Railway Power Substation has been changed on the phase of D/D. The route runs from the Van Dien substation of EVN to the elevated structure of HURC1 and comes down to Ngoc Hoi alongside the HURC1 structure by the power cable. Therefore IV.6.3.1.3), Page-Chapter 4-56, will be changed according to the HATEC's D/D.

4) Capacity of the Auto-Transformer

IV.6.3.2, Page-Chapter 4-56 in the TRICC F/S-2a report does not show the calculation on the capacity of AT.

IV.6.3.3.2), Page-Chapter 4-57, Table 4.6.1 in the TRICC F/S-2a report recommends 25MVAx2. In this case, electrical load of an AT becomes 25/4x120%=8MVA, line capacity. It is the reasonable if we consider the emergency case when one AT was failed. During the crowded commuting hours in the morning, trains will run with 2 km interval. Therefore, one AT supplies powers for 6 trains when the other AT on the same post were not available. Then the maximum power demand may become 6x6MVA=36MVA if all the train started simultaneously after the recovery of the power supply. In this case the required continuous rated capacity becomes 36/3=12MVA. 300% means the short time overload within 3 minutes according to the specifications. However, it could be reduced half to control the interval between trains as 4km. It also could be effective to suppress the speed of trains such as 30 km/h just after the recovery of the power supply. If the countermeasures of these items to reduce the train current were guaranteed, in this case, 8MVA is acceptable for HURC1. Otherwise, it would be better to consider other options such as 12 MVA.

5) Capacity of the main Transformer in the Ngoc Hoi Railway Power Substation

IV.6.3.3.2), Page-Chapter 4-57, Table 4.6.1 in the TRICC F/S-2a report recommends 25MVAx2. Table 4.6.1, Page-Chapter 4-58, is same as the table 3-4 -Load of HURCP Line 1 of the DD document named "JKT/REP/0337/E, DETAIL DESIGN FOR RAILWAY POWER SUBSTATION SYSTEM ENGINEERING CONSULTING SERVICES for HANOI CITY URBAN RAILWAY CONSTRUCTION PROJECT (LINE 1), PHASE I", page 17. This table says that the capacity of the feeding transformer is rated as 25x2MVA.

However, on the Basic Design named "JKT/REP/0088/E BASIC DESIGN CONCEPT & INTEGRATION DESIGN FOR ELECTRIFICATION ENGINEERING CONSULTING SERVICES for HANOI CITY URBAN RAILWAY CONSTRUCTION PROJECT (LINE 1), PHASE I", the short circuit current was studied and the electrification system has been designed on "the Item 6. FEEDING TRANSFORMER". The capacity of the feeding transformer was 22x2 MVA with 12% impedance(%Z).

Therefore the short circuit current shall be designed to be same as BD document. If the capacity of FTr is 25MVA, the %Z becomes 13.6%. This value affects the short circuit current as well as the rail potential.

6) Capacity of the main Transformer for future

IV.6.3.3.2), Page-Chapter 4-58 in the TRICC F/S-2a report says "Ensure the reliability and operation demand in the future under the estimation". The train operation in this JICA team needs the power which will be used for the train operation with 4M4T, 4 minutes head on the whole line. Therefore the TRICC F/S-2a report should mention about it because the project period of the electrification should be 30 years which means the life time of the main transformer.

Now, the capacity of the main transformer is 25MVAx2 per feeding transformer. The estimated electrical load is 21.8MVAx114%=25MVA based on the JKT/REP/ 0335 /E DETAILED DESIGN FOR ELECTRIFICATION ENGINEERING CONSULTING SERVICES for HANOI CITY URBAN RAILWAY CONSTRUCTION PROJECT (LINE 1), PHASE I.

7) ATP (Autotransformer post) and SSP (sub-sectioning post)

IV.6.6, Page-Chapter 4-89 in the TRICC F/S-2a report has listed the scope of the Phase1. This phase 1 section includes the Gia Lam ATP and Hanoi SSP. Hanoi SSP is correct. The Hanoi ATP is wrong.

8) Power consumption

The power consumption is calculated in the TRICC F/S-2a report. The electric power consumed is classified as follows:

- Traction power
- Distribution power used in the main line
- Distribution power used in Ngoc Hoi area excluding the passenger station

The traction power is studied for the phase 1+2a section. However, the railway power substation is designed to supply the feeding power on the whole section which consists of phase1, 2a, 2b. Engineer of the railway system plan (electric) analyzes the traction power used for the whole section from Yen Vien to Ngoc Hoi at first. Then the power used for the phase 1+2a is studied. The distribution power is studied regarding HURC1 passenger station. The distribution power used in Ngoc Hoi area excluding the passenger station is studied based on the assumption due to the lack of the design information.

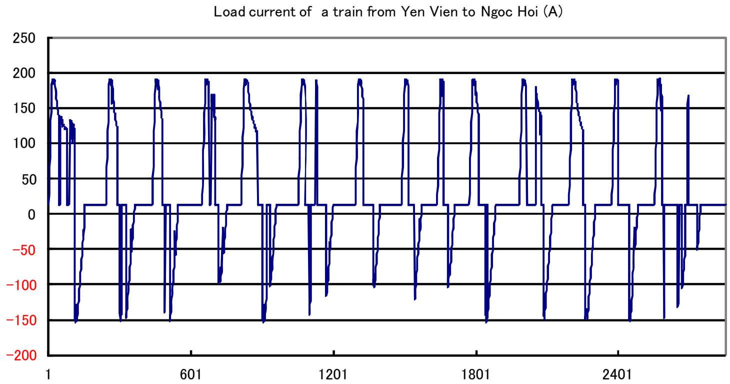
This calculation is based on the following document:

- JKT/REP/0259/E "DETAILED DESIGN, COMPOSITION OF TRAIN, ENGINEERING CONSULTING SERVICES for HANOI CITY URBAN RAILWAY CONSTRUCTION PROJECT (LINE 1), PHASE I"
- JKT/REP/0311/E "DETAILED DESIGN, TRAIN OPERATION, ENGINEERING CONSULTING SERVICES for HANOI CITY URBAN RAILWAY CONSTRUCTION PROJECT (LINE 1), PHASE I"
- Profile of Ha Noi-Ngoc Hoi and Ha Noi-Yen Vien
- Track alignment, HURC1-SW-ALG-B-2002 (Hanoi-Yen Vien)
- Track alignment, HURC1-SW-ALG-B-2001 (Hanoi-Ngoc Hoi)
- JKT/REP/0338/E "DETAILED DESIGN for POWER DISTRIBUTION SYSTEM ENGINEERING CONSULTING SERVICES for HANOI CITY URBAN RAILWAY CONSTRUCTION PROJECT (LINE 1), PHASE I"

a) Traction power used for the phase 1+2a+2b

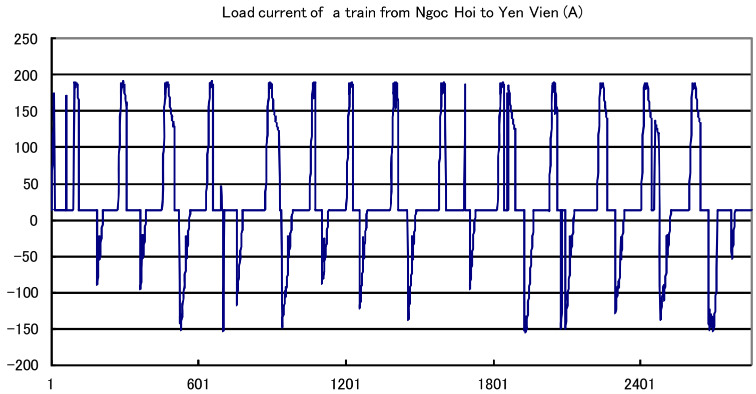
At first, motor current and auxiliary current are assumed to be added simply with no consideration of each power factor. Then the traction power can be obtained without complicated calculation and it gives simple results which will be approximately correct.
The number of trainset in the peak hour is as follows:
From Yen Vien to Ngoc Hoi is 7.5/h with 4M4T and
From Gia Lam to Giap Bat is 3.75/h with 4M4T.

A current of a train which runs from Yen Vien to Ngoc Hoi and from Ngoc Hoi to Yen Vien is shown below:



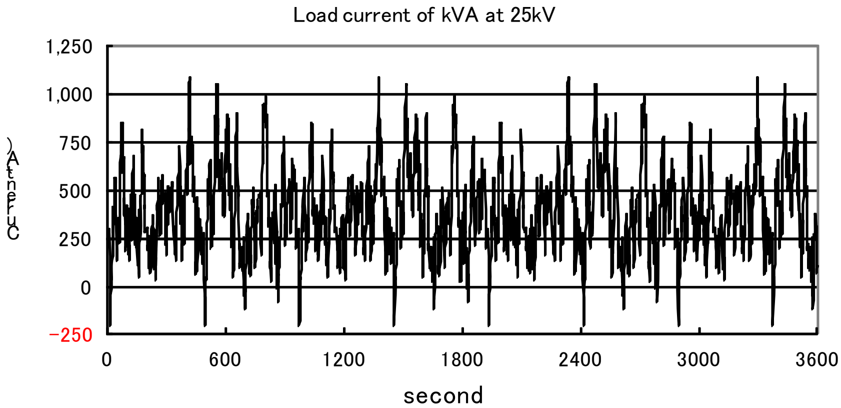
Source: JICA Survey Team

Fig. 2.3.3.6-1 Load current of a train which runs southward



Source: JICA Survey Team

Fig. 2.3.3.6-2 Load current of a train which runs northward



Source: JICA Survey Team

Fig. 2.3.3.6-3 Load current of apparent power of the railway power substation

The traction power calculated is 12763 kVArms at the feeding transformer and the traction load current is 464A at 25kV which is the nominal voltage of this system. This load includes the power consumed by 2 other trains being stabled.

The capacity of the feeding transformer is required to be decided so that it meets the power in the extension to Nhu Quynh which is far by 15km from Gia Lam. Therefore the required capacity is considered as follows:

12763 kVArms x (24.669km+15km)/ 24.669km=20524kVArms

The dead section is located KM9+200. The power factor is also considered. The results are shown below:

Table 2.3.3.6-1 Power consumption of the traction load

Section	Active power, kWh/h 1/	Lagging reactive power, kvarh/h, 2/	kVAh/h	cosφ 3/
North	8968	4006	-	-
South	1307	529	-	-
Total 4/	9939	4516	10,917	91.0

1/ Power consumed by the stabling train as well as the deadhead train are considered.
2/ Reactive power of the feeding transformer and OCS is considered.
3/ Power factor at the Incoming line of 110kV of railway power substation. The power factor shall be more than 90% according to the Circular No.12/2010/TT-BCT of April 15, 2010 Electrical transmission system regulation
4/ Total value means the value at the Incoming line of 110kV of railway power substation. Powers on North section and South section are calculated respectively.
Source: JICA team

The distance which a train set of 4M4t runs is calculated based on the train diagram which was prepared by JKT. The unit of the distance means “train-km”. The calculated value is shown below.

Table 2.3.3.6-2 Train-km in one day (phase 1+2a+2b)

Since (o'clock)	Until (o'clock)	Train-km
0	1	0
1	2	0
2	3	0
3	4	0
4	5	302
5	6	302
6	7	458
7	8	458
8	9	378
9	10	378
10	11	378
11	12	378
12	13	378
13	14	378
14	15	378
15	16	403
16	17	458
17	18	458
18	19	458
19	20	378
20	21	378
21	22	378
22	23	378
23	24	101
Total		7550

Source: JICA team

The train-km/h is 458 in the peak hour. The weight of train set of 4M4T is 448.68 ton/train. The active power in the peak hour is 9939kWh/h. Therefore, the unit power consumed by 1000ton-km is calculated as follows:

9939kWh/h / (458 train-km/h x 0.44868 (1000ton/train)) = 48.4kWh / (1000ton-km)

This is a similar value if we compared it with the power consumed by the train in YAMANOTE line in Tokyo of which power consumed is said to be 53 kWh / (1000ton-km). Therefore, 48.4kWh / (1000ton-km) can be the value used as a base to evaluate this project.

b) Traction power used for the phase 1+2a

We can calculate the train-km of the phase 1+2a with 3M3T according to the train operation document mentioned before:

- JKT/REP/0259/E "DETAILED DESIGN, COMPOSITION OF TRAIN, ENGINEERING CONSULTING SERVICES for HANOI CITY URBAN RAILWAY CONSTRUCTION PROJECT (LINE 1), Phase 1"
- JKT/REP/0311/E "DETAILED DESIGN, TRAIN OPERATION, ENGINEERING CONSULTING SERVICES for HANOI CITY URBAN RAILWAY CONSTRUCTION PROJECT (LINE 1), Phase 1"

Table 2.3.3.6-3 Train-km in one day (phase 1+2a)

Since (o'clock)	Until (o'clock)	Train-km
0	1	0
1	2	0
2	3	0
3	4	0
4	5	167
5	6	222
6	7	278
7	8	278
8	9	278
9	10	278
10	11	222
11	12	222
12	13	222
13	14	222
14	15	222
15	16	222
16	17	278
17	18	278
18	19	222
19	20	222
20	21	222
21	22	222
22	23	222
23	24	37
Total		4536

Source: JICA team

The power consumption per year is calculated as follows:
48.4kWh / (1000ton-km) x 4536 train-km x 0.33651 (1000ton/train) x 365days
=26,946,984 kWh/year

The electricity fee is calculated based on the following official gazette:
"Circular No.05/2009/TT-BCT of February 26, 2009, electricity sale prices and guiding the application thereof"

Article 11. Electricity retail prices applicable to manufacturing industries.

Table 2.3.3.6-4 Electricity fee (updated from 2012)

No.	Subjects of application prices	Electricity sale price (VND/kWh)
1	110 kV or higher	
	a/ Off-peak hours	835 x 1.05, 1/
	b/ low hours	455 x 1.05
	c/ Peak hours	1690 x 1.05

1/ The figure of 1.05 means the price increase rate of electricity fee since Dec.20 according to the newspaper "Viet Nam News" on Dec. 24th 2011.
Source: Circular No.05/2009/TT-BCT

Article 3. Consumption hour-based electricity sale price
1. Off-peak hours:
a/ From Monday to Saturday:
- From 4:00 h to 9:30 h.
- From 11:30 h to 17:00 h.
- From 20:00 h to 22:00 h.

b/ Sunday:
- From 4:00 h to 22:00 h.

2. Peak hours:
a/ From Monday to Saturday:
- From 9:30 h to 11:30 h.
- From 17:00 h to 20:00 h.

b/ Sunday:
- No peak hour.

3. Low hours:
All days from 22:00 h to 4:00 h.

Then the electricity fee becomes 30,885,684,510 VND/year for the phase 1+2a.
Then unit price is 1146 VND/kWh and 4.25 JPY/kWh when 1 JPY is 270 VND. VAT is included, 10%. It was 954VND/kWh in 1999 if I calculate by the same method. Therefore, it is 120.1% if we compare the 2012 price to 1999 price. It means that the average yearly increase rate is 1.42%.

c) Distribution power used in the main line
Power used for the phase 1+2a+2b
The power of each station and OCC are as follows:
- JKT/REP/0338/E "DETAILED DESIGN for POWER DISTRIBUTION SYSTEM ENGINEERING CONSULTING SERVICES for HANOI CITY URBAN RAILWAY CONSTRUCTION PROJECT (LINE 1), Phase 1"

Table 2.3.3.6-5 Maximum demand (phase 1+2a+2b)

Phase	Station and OCC	Maximum demand (kVA)
IIb	Yen Vien	1,350
IIb	Yen Vien Depot	500
IIb	Cau Duong	510
IIb	Duc Giang	510
I	Gia Lam	1,450
I	Gia Lam Depot	700
I	Long Bien Bac	510
I	Long Bien Nam	510
I	Hanoi	1,750
I	OCC	530
I	Cong Vien Thong Nhat	510
I	Bach Mai	510
I	Phuong Liet	510
I	Giap Bat	1,400
IIa	Hoang Liet	510
IIa	Van Dien	510
IIa	Vinh Quynh	510
I	Ngoc Hoi	1,350
Total		14,130

Source: JICA team

Power used for the phase 1+2a

The power of each station and OCC which does not include the section of 2b are as follows:

Table 2.3.3.6-6 Maximum demand (phase 1+2a)

Phase	Station and OCC	Maximum demand (kVA)
I	Gia Lam	1,450
I	Gia Lam Depot	700
I	Long Bien Bac	510
I	Long Bien Nam	510
I	Hanoi	1,750
I	OCC	530
I	Cong Vien Thong Nhat	510
I	Bach Mai	510
I	Phuong Liet	510
I	Giap Bat	1,400
IIa	Hoang Liet	510
IIa	Van Dien	510
IIa	Vinh Quynh	510
I	Ngoc Hoi	1,350
Total		11,260

Source: JICA team

These loads will be operated by 20 hours per day. Average power factor is assumed to be 90% using the adequate power capacitor. The load factor is assumed to be about 40%. Therefore, the consumed power becomes as follows:

11260kVA x 0.9 x 0.40 x 20h x 365days = 29,591,280kWh/year

The voltage of the incoming line of the electric room in Hanoi, Gia Lam, Giap Bap is 22 kV. The consumed power is 22,022,640kWh/year. The electricity fee is based on the same article 11. Electricity retail prices applicable to manufacturing industries are in the official gazette mentioned before.

Table 2.3.3.6-7 Electricity fee

No.	Subjects of application prices	Electricity sale price (VND/kWh)
1	Between 22kV and under 110 kV	
	a/ Off-peak hours	870 x 1.05
	b/ low hours	475 x 1.05
	c/ Peak hours	1755 x 1.05

Source: Circular No.05/2009/TT-BCT

The consumed power is assumed to be constant. Then the electricity fee becomes 25,448,344,614 VND/year for the 22kV section of phase 1+2a. Then unit price is 1156 VND/kWh and 4.28 JPY/ kWh when 1 JPY is 270 VND. VAT included is 10%.

The voltage of the incoming line of the railway power substation in Ngoc Hoi is 110 kV. The consumed distribution power is 7,568,640kWh/year. The consumed power is assumed to be constant. Then the electricity fee becomes 8,403,454,382 VND/year for the 110kV section of phase 1+2a. Then unit price is 1110 VND/kWh and 4.11 JPY/ kWh when 1 JPY is 270 VND. VAT is included, 10%.

d) Power used in Ngoc Hoi area excluding the passenger station

Power used in Ngoc Hoi area excluding the passenger station is not shown in the JKT's design document. Then I estimated it and calculated as follows.

Table 2.3.3.6-8 Electricity fee for Ngoc Hoi Depot

No.	Area	Capacity of transformer (kVA) 1/	Load Factor 2/	Working time(h) 3/	kWh/year	VND/year
1	UT Depot	2,500	48% (12%)	8 (20) 2/	4,513,206	5,343,580,839
2	DL Depot	2,000	77%	8	5,016,743	6,254,392,117
3	PC Depot	4,000	75%	8	9,769,617	12,179,819,454
4	FC Depot	3,000	79%	8	7,701,026	9,600,898,029
5	Freight Station	750	40%	20	1,861,500	2,066,821,824
6	Common facilities	500	55%	20	1,706,375	1,894,586,672
Sum		12,750			30,568,467	37,340,098,935

1/ The Capacity of transformer is being estimated.

2/ The load factor is reduced based on the consumed traction power of phase 1+2 compared to the phase 1+2a+2b. 48%of UT Depot is the load factor for the 8 hours daily work in a day. 12% is applied to the working time of the earlier morning as well as later night.

3/ The main working time is 8 hours. 20 hours is estimated for daily inspection work.

Source: JICA team

The total capacity of the transformer is estimated to be 12,750kVA. Therefore, the capacity of the distribution transformer in Ngoc Hoi railway power substation is:

DTr capacity = 12,750kVA (depot) + 2,880kVA (passenger station of HURC1)

= about 16,000kVA

e) Power used for the phase 1+2a

<u>Power used for the phase 1+2a including facilities not used for HURC1.</u>

The total power is calculated as follows. The unit electricity fee is the current price on the beginning of 2012:

Table 2.3.3.6-9 Electricity fee for the phase 1+2a

No.	Item	kWh/year	VND/year
1	Traction	26,946,984	30,885,684,510
2	HURC1 Stations(22kV)	14,782,360	17,081,811,960
3	HURC1 Stations(110kV)	5,080,334	5,640,690,181
4	Ngoc Hoi Depot	30,568,467	37,340,098,935
Sum		77,378,144	90,948,285,586

Source: JICA team

Power used for the phase 1+2a, HURC1 only

The total power calculated for the facility of the urban train is shown below. The result in No.4 in the table below does not include the depot such as DL, PC, FC and FS. The common electricity fee of UT depot is also reduced proportionally to the consumed kWh in the facilities. Power consumption in 2020 is calculated as follows based on the 6-rolling-stock (3M3T) with 8 min. head. The unit electricity fee is the current price on the beginning of 2012:

Table 2.3.3.6-10 Electricity fee for the phase 1+2a of HURC1

No.	Item	kWh/year	VND/year
1	Traction	26,946,984	30,885,684,510
2	HURC1 Stations(22kV)	14,782,360	17,081,811,960
3	HURC1 Stations(110kV)	5,080,334	5,640,690,181
4	Ngoc Hoi Depot(HURC1)	4,765,140	5,623,302,440
Sum		51,574,817	59,231,489,090

Source: JICA team

2.3.3.7 Signaling and telecommunications

1) Scope of work of signaling and telecommunications for Phase 2a

Signaling and telecommunication equipment for Phase 2a section (Km5+50~Km11+100) shall be consistent with those of Phase I in planning, design and installation. The urban trains and existing trains (e.g. national trains and international trains) will be operated on the same line concurrently. Much consideration in design must be taken for both trains to operate on the same line safely. Accordingly, not only local equipment for the phase 2a section of 5.6 Km including the stations of Hoang Liet, Van Dien and Vinh Quynh, but also the central systems (CTC, PRC, CMS) for train operation and facilities monitoring and control in the operation control center (OCC) must be upgraded to ensure consistency with Signaling and telecommunication systems for Phase I. In addition, the Centralized Monitoring System (CMS) to be installed in the maintenance depots for signaling and telecommunication equipment must be upgraded.

a) Required signaling systems or equipment for Phase 2a
- Automatic Block System (ABS)
- Automatic Train Protection System (ATP)
- Train Detection System (TDS)
- Train Identification System (TIS)
- Centralized Traffic Control System (CTC)
- Programmed Route Control System (PRC)
- Centralized Monitoring System (CMS)
- Traffic Information Display System (TID)
- Signaling Cables
- Power Supply Equipment for Signaling Systems

b) Required telecommunication systems or equipment for Phase 2a
- Synchronous Digital Hierarchy (SDH)

- Telecommunication Cables
- Optical Fiber cables
- Automatic Telephone System
- Dispatcher Telephone System
- Way-side Telephone System
- Passenger Information System (PIS)
- Centralized Monitoring System (CMS)
- Clock system
- Public Address system (PA)
- Closed Circuit Television System (CCTV)
- Power Supply Equipment for Telecommunication Systems
- Lightning Protection and Grounding System

2) CBTC

CBTC (Communication Based Train Control) is used as a word meaning a various kind of train control systems using wireless telecommunication between ground and on-board equipment. ETCS (European Train Control System) is listed up as an example. Furthermore, CBCT has been mainly introduced to urban railways such as New York Subway, BART in San Francisco and other urban railways. In Japan, CBTC called ATACS has been introduced on the Senseki Line of JR East Co. In addition, some Japanese signal makers have supplied CBTC systems called SPARCS, etc.

CBTC has characteristics using wireless telecommunication between ground and on-board equipment, and its unique train detection system. Its overview is as follows.

Wireless telecommunication between ground and on-board equipment used on CBTC

Main systems are as follows.

- Space - wave radio (Wave bands of 2.4 GHZ, 900MHz, 400MHz etc are used.)
- Leaky Coaxial Cable (LCX)

Train Detection System used on CBTC

Main systems are as follows.

- Tachometer generator + ground equipment (called as transponder or balise)
- Track circuit + transponder
- Method measuring propagation time of space - wave radio
  (due to its margin of error, used with other methods)
- Method using GPS (due to its margin of error, used with other methods)

a) Overview of CBTC equipment

The following shows overview of ground and on-board equipment of CBTC system in case of using space-wave radio (2.4GHz) as wireless telecommunication between ground and on-board equipment, and tachometer generator + ground equipment (transponder) as a train detection system.

- Ground equipment

Fixed signals and track circuits are not necessary on CBTC system. However, tachometer generators on board and transponders on track side are required to improve accuracy of train location detection. Spacing of transponder installation is required to be 500~1,000m long. Antennas and radio equipment are required to be installed per about 300m along the railway. In addition, ordinarily, block systems between stations, interlocking systems per station and operating control system in the OCC are required to be installed.

- On-board equipment

All the possible trains to enter a CBTC section are required to be equipped with on-board equipment for CBTC system. Ordinarily, the first car or locomotive and the last end car are required to be equipped with on-board equipment for CBTC system to detect separation of train and improve its reliability.

b) Signaling system to be adopted in HURCP line 1

<u>Fundamental conditions of train operation required on HURCP Line 1</u>

The following shows fundamental conditions of train operation required on HURCP Line 1.

- Mixed operations of urban and existing trains

Namely, urban train (Electric Multiple Unit, 1,435mm gauge), national train (Diesel Locomotive traction, 1,000mm gauge) and international train (Diesel Locomotive traction, 1,435mm gauge) are required to operate concurrently on the HURCP Line 1. Therefore, 3-rail dual gauge track (1,435mm and 1,000mm gauge) is employed.

- Design maximum speed: 120km/h, minimum operational headway: 4 minutes

<u>Alternative 1: To adopt only CBTC system on the HURCP Line 1</u>

Urban trains, as well as, all the possible national and international trains to enter HURCP Line 1 are required to be equipped with on-board equipment for CBTC system on the first car or locomotive and the last end car of them. It needs substantial amounts of costs for all the possible existing trains to enter the line. In addition, the number of cars which Diesel Locomotive pulls varies on its train so as not to specify the last end car of the train. Therefore, it is not realistic for all the possible last end cars to be equipped with on-board equipment for CBTC system.

And, the operational performances of the urban trains and the existing DL traction trains are much different so that the effect of a moving block system due to CBTC system is extremely limited.

<u>Alternative 2: To adopt both CBTC system and fixed signal system (Track Circuit + ATP) on the HURCP Line 1</u>

CBTC system for urban trains and fixed signal system (Track Circuit + ATP) for the existing trains are not recommended due to the following reasons.(ATP: Automatic Train Protection System)

- Ground equipment needs double costs of CBTC system and fixed signal system.
- In case of adopting two different independent signaling safety systems of CBTC system and fixed signal system, the train operation safety is not always ensured

on principle. The train operation safety in the double systems must be verified and validated adequately.

Alternative 3: To adopt fixed signal system (Track Circuit + ATP) on the HURCP Line 1 (JKT system)

JKT system adopts fixed signal system using track circuits for train detection and ATP for preventing train drivers from making operational errors. ATP generates an operational pattern for each train and a train is able to approach a preceding train within the limit of the operational pattern. Therefore, the ATP system has the effects to improve train operational safety and high density train operation.

The JKT system ensures the followings.

- Mixed operations of urban and existing trains in safety
- Design maximum speed: 120km/h, minimum operational headway: 4 minutes

c) Summary

If only the urban trains operate on the HURCP Line 1, CBTC system is recommendable. However, if urban and existing trains operate on the HURCP Line 1 concurrently, the JKT system is recommended. If it is planned to adopt CBTC system on condition of mixed operation of the urban trains (EMU) and the existing trains (Locomotive train) on the HURCP Line 1, it is desirable for a third party to previously verify and validate the safety and transportation efficiency of the signaling systems and total costs of the systems including ground and on-board equipment quantitatively and in a comprehensive way.

2.3.3.8 Certification System for Scope of Works (Criteria・Standard・Specification) in Vietnam

1) Design Framework

In Vietnam, criteria, standard, etc. applied for the operation are listed in the report "Design Framework" created by design consultants and the approval from MOT is needed.

According to the report of FS 2a, the technical standard・stipulation applied for Phase 1 are the same as the ones applied for Phase 2a, 2b. For this reason, "Design Framework" for the whole construction area has been registered to be approved due to the approval of the report "Design Framework" created・submitted for the current detailed design service of JKT.

In regard to the detailed design of Phase 1, the report "Design Framework" was submitted to VNR/MOT and partially approved in November 2011 (No.2520/QD-BGTVT). The reason only a part of the report was approved is that there was not the English translation for Japanese criteria・standard and VNR and MOT couldn't confirm. Although there is no formal English translation for JIS, design standard, etc. of Japan applied for this project, it might lead to a copy right infringement problem if JKT creates and submits the English translation.

If "Design Framework" is not approved, the approval of the whole project might be delayed. Accordingly, the conference between the certification authorities that are MOT, VNR and JKT is expected to solve the problem based on the submission of overview explanation of the technical criteria・standard.

2) Approval of Special Stipulation

Besides the "Design Framework" mentioned above, Vietnamese as well as international criteria・standard can't be applied directly. In the case of applying new standards, the approval from Ministry of Science and Technology is necessary following "Law Concerning Standard and Technology Approval No.68/2006/QH11". The approval procedure for new criteria・standard is as follows. Seminars in regard to the draft for new criteria・standard are hold and the draft will be completed based on the public comments received in a period of not less than 60 days. The content of the draft will be adjusted in coordination with relevant departments and agencies and submitted to Ministry of Science and Technology for deliberation. The Ministry of Science and Technology will deliberate on the draft and give the notice of acceptance in 60 days after receiving. The official announcement will come in less than 30 days after the acceptance.

The application of new standard in regard to "Signal Principle・Signal System・Signal Display" as well as "Construction・Rolling Stock Limitation" for Line 1 Construction Project needs to be approved following the decree mentioned above. At the present, this new standard has been proposed to VNR with the report explaining the overview.

The approval of the 2 new criteria・standards mentioned above requires at least 5 months. Therefore, it is necessary to accelerate the early approval in order to place construction order at an early date.

2.3.3.9 Universal design

Because the FS report for Phase 2a does not include any sections on universal design, the following measures are proposed.

1) Universal design facilities

Line 1 uses the principles of universal design to ensure the security, safety and comfort of all railway facility users including the elderly and disabled. Discussions have been held with both general users and disabled people and the design reflects their opinions and wishes. Below are some examples of facilities that employ universal design principles.

a) Passenger flow inside station buildings
To enable a smooth passenger flow, station concourses will be flat and without stairs and ramps. However, as a countermeasure against flooding, ground level elevator entrances at intermediate stations will be elevated by 1m and sloped. Stations will be equipped with stairs as well as wheelchair-accessible elevators and escalators for movement between different levels. All passenger flow lines leading from entrances and concourses to ticket gates and platforms will have tactile paving on the floor. Detectable warning tiles will be installed at stairs, ends of platforms and other dangerous places. Picture 2.3.3.9-1 shows an example of tactile paving.

Photo 2.3.3.9-1 Detectable Warning Tiles

b) Automatic ticket machines, chargers and automatic ticket gates
Enough space will be provided for automatic ticket machines and chargers and their screens will be designed to be easily readable also for children and wheelchair users.

Automatic ticket gates will be used at entrances and all stations will have at least one wide gate for wheelchair-bound passengers. Picture 2.3.3.9-2 shows an example of automatic ticket machines and chargers.

Photo 2.3.3.9-2 Automatic Ticket Machine and Charger

c) Multipurpose toilets

All stations will have at least one multipurpose toilet accessible to wheelchairs and easy to use for elderly and disabled people. Fig. 2.3.3.9-1 shows a multipurpose toilet which will be installed at stations, and Picture 2.3.3.9-3 shows an actual example.

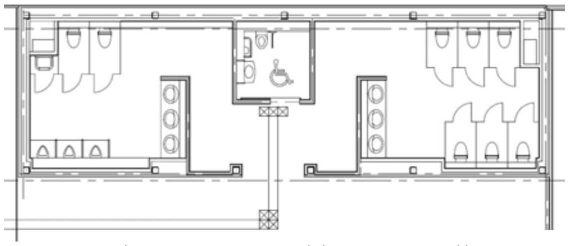


Fig. 2.3.3.9-1 Multipurpose Toilet

Photo 2.3.3.9-3 Multipurpose Toilet

d) Difference in level between platform and train floor
To enable elderly people and wheelchair users to easily get on and off trains, the difference in level between the platform and train floor will be made as small as possible.

e) Guidance
Train departure times will be announced in multiple languages in an easy to understand way and shown on electronic displays. Braille panels will be provided for visually impaired people. Guide signs will have pictograms in accordance with international standards and will be written both in Vietnamese and English. Picture 2.3.3.9-4 shows an example of a guide map inside a station.

Photo 2.3.3.9-4 Guidance Board in Station

2) Location of universal design facilities inside stations

Universal design facilities will be located optimally with regard to passenger flow inside stations.

2.3.3.10 Station Facility Scale Confirmation

Since these are the first urban railway stations built in Vietnam, there is no standard for scale calculation. The station scale in Phase 2a FS report was designed referring to urban railway stations of other countries. In order to avoid planning station scale using various standards in the same line, the calculation of every station of Phase 2a is also based on the standard applied for JKT’s detailed design. The station dimension of JKT’s detailed design is set by platform width・length as well the number of track. All the stations located in the section of Phase 2a are urban railway ones and only double track is planned. Since no train outruns trains ahead at the section between Ngoc Hoi station and Giap Bat station and thus, side track is not planned. This plan is considered to be reasonable.

The station scale in JKT’s detailed design was based on the estimated value of user number in 2030 at every station calculated in HAIMUD’s survey. The scale of platform, concourse, lifting and lowering facilities, walkway, toilet, etc. were calculated using this value estimated for 2030 and based on “JR relevant standards and so on”. The number of automatic fare collection equipment as well as fare adjustment machine is also set based on the following estimated value. As for automatic fare collection equipment, the place in consideration of the proliferation in the future is secured. Calculation result of equipment scale for every station at Phase 2a is shown below.

Table 2.3.3.10-1 Station Equipment Scale

Station Name	Platform Width (m)		Stair Width (m)		Number of Automatic Fare Collection Equipment		Number of Fare Adjustment Machine for Official Use	Number of Fare Adjustment Machine for Passenger
	Calculated Value	Using Value	Calculated Value	Using Value	General	Wide		
Hoang Liet	4.57	6.5	1.5	2x2.5	6	1	3	3
Van Dien	4.31	6.5	1.5	2x2.5	5	1	3	3
Vinh Quynh	5.13	6.0	1.5	2x2.5	6	1	4	3

Source: JKT

2.3.3.11 Relocation of Buried Objects and Overhead Wire

In FS Phase 2a, relocation of interfering objects during construction period were not mentioned. In detailed design stage of Line 1, some local consultants are hired to handle relocation plan of telecommunication cable, electricity cable as well as water supply and sewerage facilities. The selected local consultants are well known and familiar with telecommunication company, electricity company and water supply company.

However, comparing with the schedule of inauguration of this Project, relocation work of electricity cable and water supply & sewerage facilities is delayed. According to information form JKT, these delays were caused by decision of station location and Red Line Boundary is delayed. In detailed design of Phase 2a, these problems are estimated to be solved and relocation works could be smoothly executed.

Actually, this relocation work is shall be borne by HPC. However, VNR requested yen loan to cover relocation of 10 locations of high-voltage line (110kV and 22kV) which crossing the Line 1 because this relocation work is expensive. Since delay of this relocation work will influence overall schedule of this Project, financing of this relocation work by yen loan is desirable.