Appendix 4.1: Report for Design Changes for Line 3A Phase 1

HO CHI MINH CITY PEOPLE'S COMMITTEE
MANAGEMENT AUTHORITY FOR URBAN RAILWAYS

HO CHI MINH CITY URBAN RAILWAY CONSTRUCTION PROJECT
LINE 3A PHASE 1 (BEN THANH – MIEN TAY TERMINAL)

REPORT FOR DESIGN CHANGES

May 2016

Prepared by the JICA Study Team

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1. Introduction

The JICA study team (hereinafter referred to as "JST") are assigned to review and develop Feasibility study (hereinafter referred to as "FS") for HCM Line 3A Phase 1 carried out by TEDI – South. The JST find some better options and revisions during the study considering cost, coordination with other works and actual site conditions to avoid facing any inconvenience in the future.

Hence, this report proposes better solutions compared to FS and consists of 5 sections regarding the design changes namely, 1) alignment change, 2) design concept, 3) station layouts, 4) station location and 5) Cay go station option.

2. Alignment Change

2.1. Horizontal Alignment

The route of Line 3A Phase 1, which remains unchanged from FS i.e. the Line begins at Ben Thanh Station and ends at Mien Tay Bus Station (C10) running along Pham Ngu Lao St., Pham Viet Chanh St., Hung Vuong St., Hong Bang St. and Kinh Duong Vuong St.

2.2. Vertical Alignment

Although the FS designed underground section from Ben Thanh Centre Station (C0) to Mien Tay Bus Station (C10), the JST proposes that 1) underground section is from C0 to Phu Lam Rotary Station (C8), 2) transition section is between C8 and Phu Lam Park Station (C9) and 3) elevated stations are C9 and C10.

In more details, section from C8 to C9 was designed as the underground structure as shown in Figure 2.2.1, which is revised as indicated in Figure 2.2.2, namely, transition section by cut & cover tunnel and u-shape retaining wall is designed through to the elevated section between C8 and C9.

Figure 2.2.1 Plan and Profile between C8 and C9 on FS

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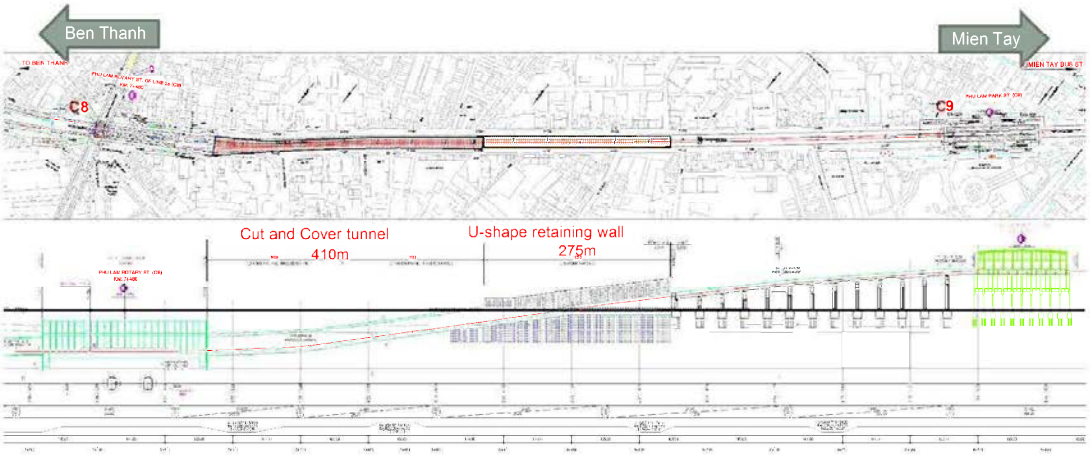

Figure 2.2.2 Plan and Profile between C8 and C9 Proposed by the JST

Originally, the transition section was located between C10 and Hi-Tech-Healthcare Park Station (C11) for Phase 2, and therefore from C10 to C11 will be the elevated sections as given in Figure 2.2.3 for the future design of Phase 2.

The alignment design of the viaduct is to maintain the concourse level and platform level of the station. Hence, after passing the station the railway level should be lower than that of the station to save the construction cost complying with the maximum gradient of 35/1000, which must be envisaged in the Phase 2 stage.

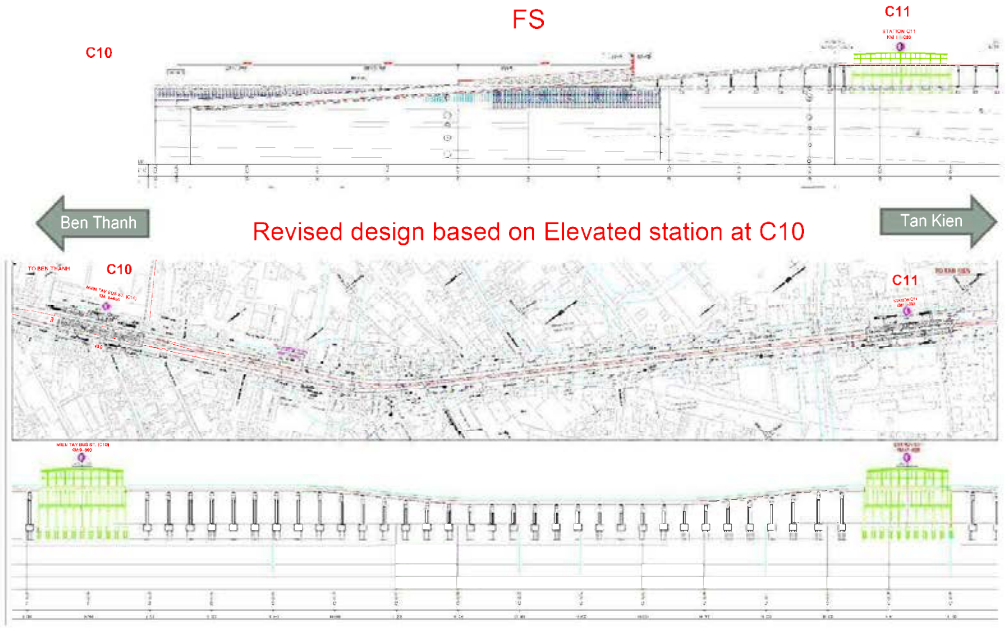

Figure 2.2.3 Comparison between FS and future Revised Design for Phase 2 from C10 to C11Elevated Stations

Due to the revision of vertical alignment, C9 and C10 are located at elevated positions as shown in Figure 2.3.1 and Figure 2.3.2.

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In more details, substructures of C9 are single piers as indicated in Figure 2.3.1 In the meantime, those of C10 are double piers considering deflection of super structure and stability of whole structure, since C10 has an island platform connecting with three tracks.

In case of side platforms, it may be possible to adopt single piers e.g. Bangkok, Thailand. However, there is no example using single piers for the island platform connecting with three tracks in urban railway projects.

C9 moved 90m toward Mien Tay bus station to close to the transport hub considering accessibility of users. However, due to the development plan of the roundabout in the future, which is highlighted in blue, all station facilities are kept outside of the development plan.

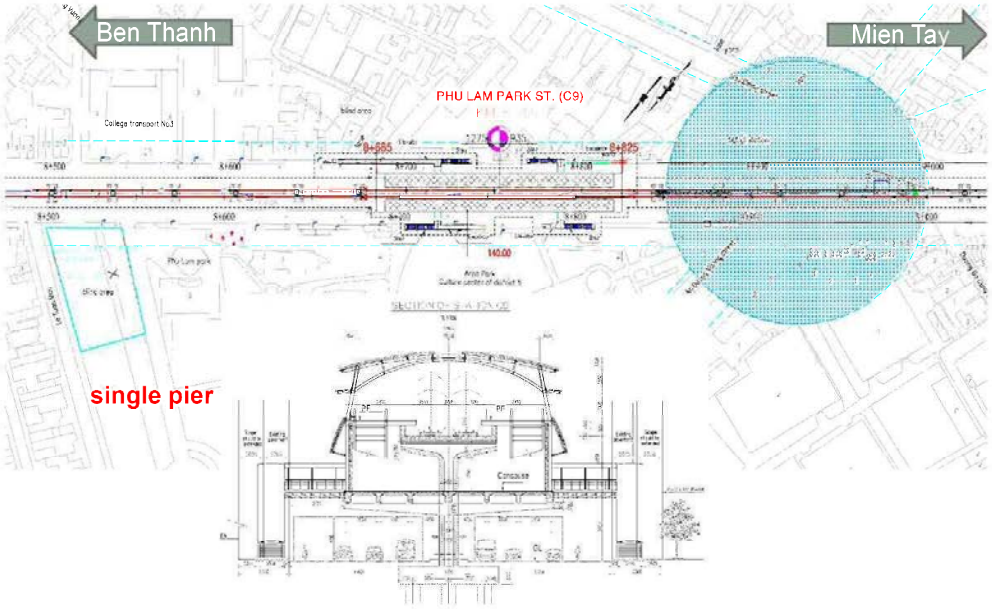

Figure 2.3.1 Plan and Profile at C9 Proposed by the JST

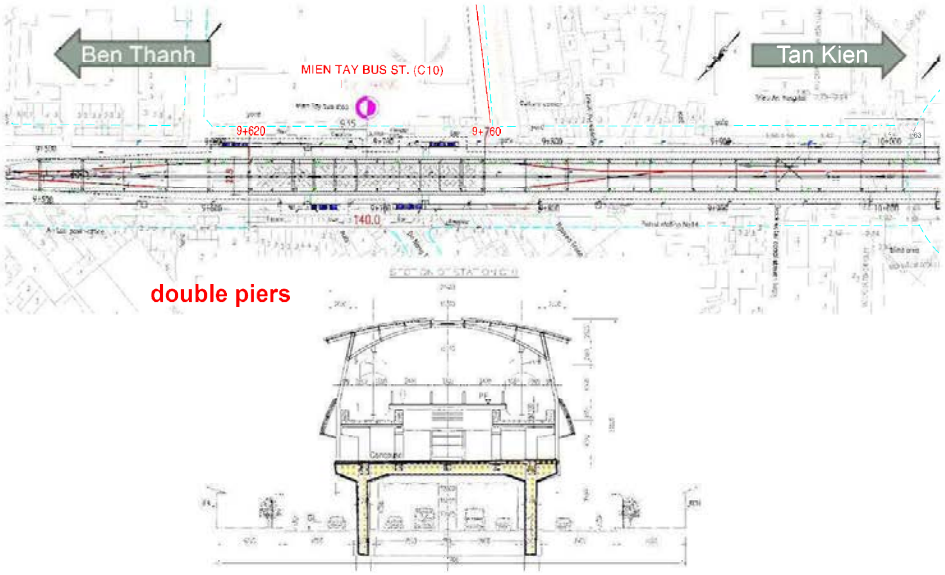

Figure 2.3.2 Plan and Profile at C10 Proposed by the JST

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2.4. Relocation of Power Cables

In order to build the elevated section, power cables needs to be relocated for about 3.6km as shown in Figure 2.4.1. According to the meeting with EVN held on 21 April 2016 where JST exhibited underground and elevated options, EVN preferred underground option based on their experiences considering safety, maintenance and adjacent impact.

The meeting concluded that power cables will be relocated to underground using HDPE pipes and protected by concrete slab referring to other projects carried out by EVN as indicated in Figure 2.4.2.

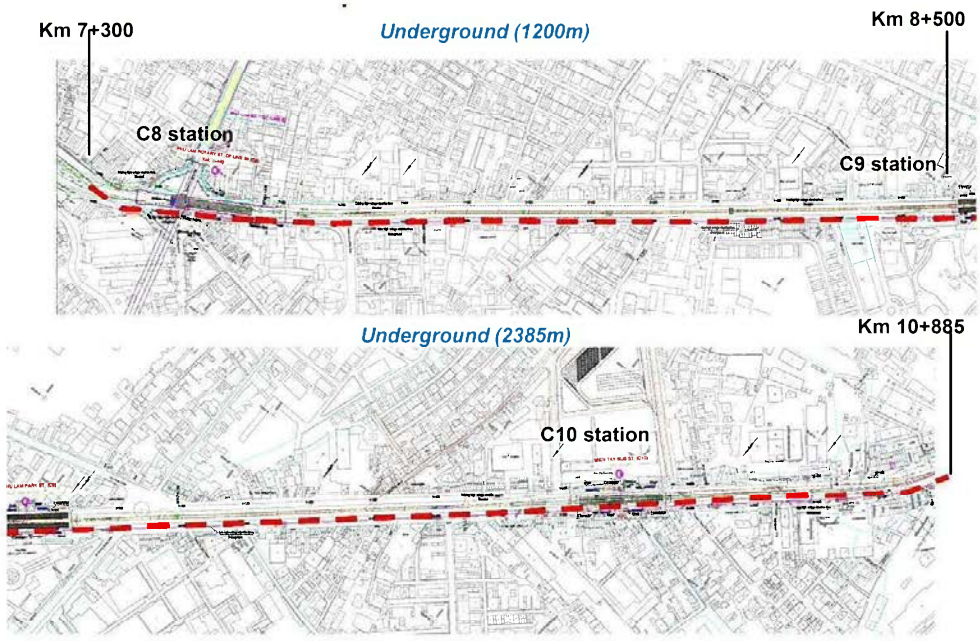

Figure 2.4.1 Plan of Relocation of Power Cables

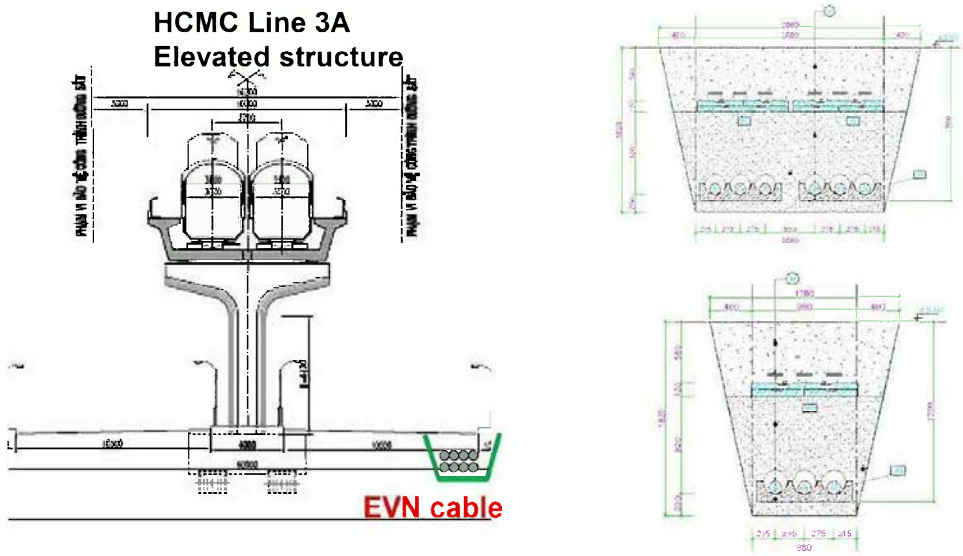

Figure 2.4.2 Section of Relocation of Power Cables

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2.5. Comparison between All Underground and Elevated Options

The comparison between all underground option proposed by the previous FS and underground & elevated (after C8) option proposed by the JST in this study is performed considering not only advantages but also disadvantages as summarised in Table 2.5.1.

The results show that all underground option got four points of advantages, while underground & elevated option acquired eight points. From this evaluation, the JST concluded that underground & elevated option is superior to all underground option.

The JST understand there is no significant environmental impacts if a proper transition section is applied from the underground section without any obstructions for the current traffic since the section from C8 to C10 area is located in suburban area as similar to the phase 2 area. As shown in Figure 2.2.2, the JST successfully accommodated the proper transition without disturbing intersections. From the discussion above, the proposal is concluded suitable.

Table 2.5.1 Comparison Table between All underground and Underground & Elevated Options

	FS All underground (UG:9.9km)	This study Elevated after C8 (UG:8.1km, Elev:1.8km)
Land acquisition	No land acquisition for main station +	No land acquisition for main station +
Power cable shifting	Power cable shifting temporally is required at station location. +	Permanent power cable shifting to underground is necessary. (EVN accepted the relocation in the meeting held on 21 Apr.)
Environmental impact	No major impact +	No major impact +
Land scape	No major impact +	No major impact under wide road space after C8 +
Construction period	Longer	Shorter +
Air conditioning and lighting at the station	Required entire area and within business hours	Only limited area and time+
Maintenance	Difficult	Easier +
Maintenance cost	Expensive	Relatively reasonable +
Direct Construction Cost	1,003 million USD* (Construction only)	834 million USD* + (Construction only)
Results	++++	++++++++ Recommend

Remarks
* As of 2015, construction cost only

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3. Design Concepts for Underground and Elevated Sections

3.1. Selection of Tunnel Construction Method

As shown in Figure 3.1.1 and Table 3.1.1, three options are compared, i.e. Option 1: Double lines of single tube by Shield Tunnel Boring Machine (TBM), Option 2: Single line of double tubes by New Austrian Tunnelling method (NATM) and Option 3: Single line of double tubes by Shield TBM.

The results show that option 3 is the most suitable method considering cost, construction schedule and neighbourhood impact. From this evaluation, the JST selected Option 3.

HCM Line 1 also adopted Option 3 for the same reasons.

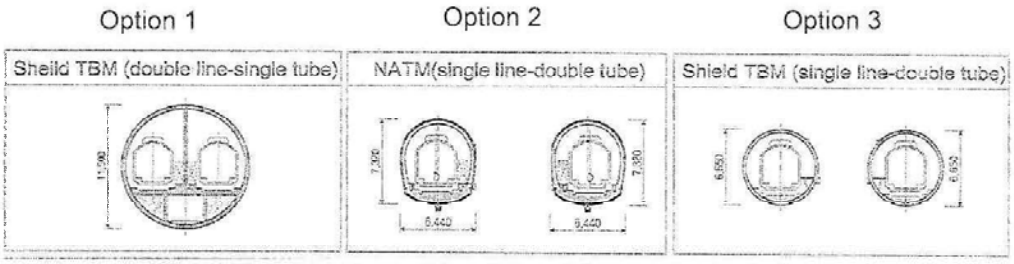

Figure 3.1.1 Comparision of Tunnel Construction Methods

Table 3.1.1 Comparison Table for Tunnel Construction Methods

Option	Cost	Schedule	Neighbourhood impact	Results
Option 1	*Highest	Medium	Medium influence	
Option 2	**Medium	Longest	***Maximum	
Option 3	Lowest	Shortest	Minimum influence	Recommend

Remarks:
* : Because larger excavation is required compared to other methods.
** : Since it requires tunnel auxiliary construction method.
*** : Due to soft soil condition, it is difficult to minimise the influence.

3.2. Selection of Superstructure for Elevated Section

As given in Figure 3.2.1 and Table 3.2.1, three options are compared for superstructure of elevated section, i.e. Option 1: Hollow slab, Option 2: PC box girder and Option 3: PC U-shape girder.

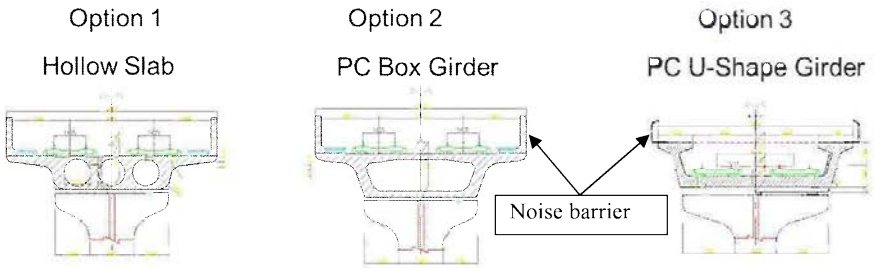

Figure 3.2.1 Comparision of Superstructures

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Table 3.2.1 Comparison Table for Superstructures

Option	Cost	Noise barrier	Rail Level	Results
Option 1	Reasonable	2.1m	High	
Option 2	Reasonable	2.1m	High	
Option 3	Reasonable	0.4m	Lowest	Recommend

Option 3 is concluded the most appropriate superstructure since it requires the lowest height of noise barrier and rail that may lead to the cheapest construction and maintenance costs for the elevated section. HCM Line 1 also adopted option 3 for the same reasons.

3.3. Ground Cover above TBM

The FS designed minimum ground cover between C1 and C2 as 1D (1x6.65m). In the meantime the JST propose 2D (2 x 6.65 = 13.3m) as shown in Figure 3.3.1 considering several factors such as settlement, possibility to hit obstructs and noise & vibration as described in 3.4 and 3.5.

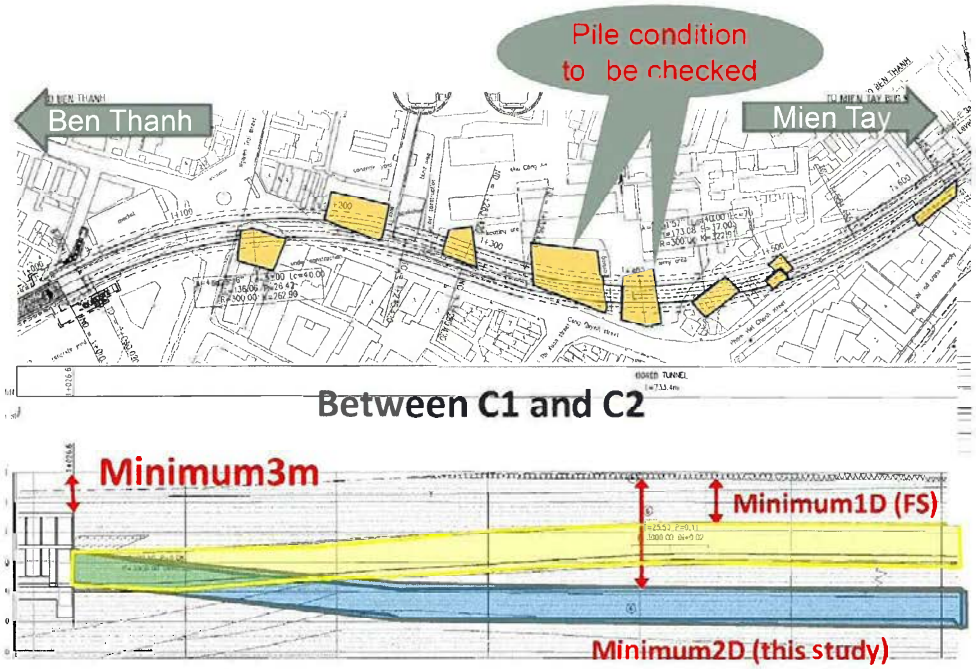

Figure 3.3.1 Comparison of Ground Cover between FS and this Study from C1 to C2

3.4. Settlement Calculation at Hanoi Line 2

In Hanoi Line 2, the settlement calculation was carried out using different ground cover from 1D to 4D for staked and level tunnels as summarised in Table 3.4.1 and Figure 3.4.1.

The result made clear that amount of settlement values shows significant reduction over 2D of ground cover. This implies that at least 2D ground cover should be kept in terms of minimising the settlement.

There is no substantial difference between stacked and level tunnels. The JST proposes level tunnels (single line of double tubes) to all alignments including Cay Go station (C7) if the existing flyover is removed as planned.

Table 3.4.1 Comparison Table for Settlement with changing Ground Cover

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Case	Maximum settlement (mm)			
	Ground cover 1D	Ground cover 2D	Ground cover 3D	Ground cover 4D
Stacked Tunnels	18.8	7.9	3.7	-
Level Tunnels	21.6	8.8	4.1	2.5

Settlement calculation for Line 3A Phase1 will be carried out during the detailed design as appropriate. However, the result is most likely to show similar tendency with the above consequence according to our experience.

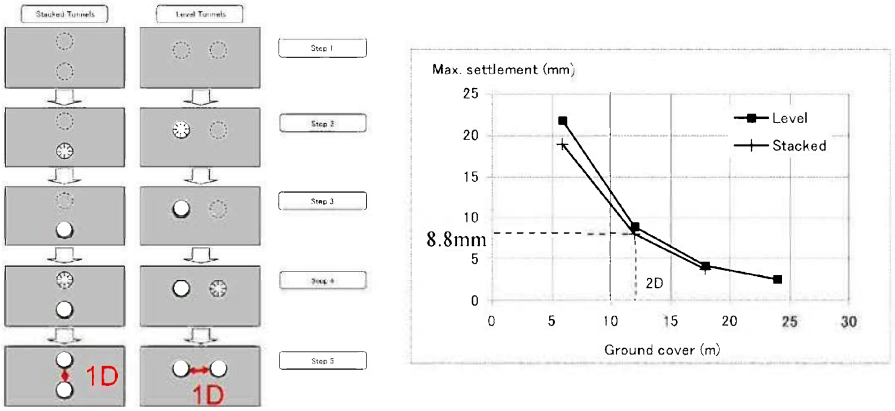

Figure 3.4.2 Comparison of Ground Cover between FS and this Study from C1 to C2

3.5. Comparison of Two Options

Two options are compared, namely, having 1D and 2D of ground cover, considering possibility to hit obstructions, land acquisition, settlement, noise & vibration and cost as indicated in Table 3.5.1.

The results show that having 2D ground cover is much superior to that of 1D ground cover. Hence, the JST recommends 2D ground cover between C1 and C2 underneath buildings.

With only 1D ground cover, noise & vibration issues will become severe during the construction and operation stage at the curve locations particularly at the section between C1 to C2. This is because trains apply brakes. We experienced the said problem in Delhi Metro.

Table 3.5.1 Comparison Table for Settlement changing Ground Cover

	FS Ground cover with 1D	This study Ground cover with 2D
Possibility to hit obstructions	Some possibility	Very low +
Land acquisition	Some possibility (It depends on the condition.)	No land acquisition +
Settlement	21.6mm	8.8mm +
Noise & Vibration during the construction	Serious based on the experience of Delhi Metro	No detect +
Cost	Reasonable + (No difference between 1D and 2D)	Reasonable + (No difference between 1D and 2D)
Results	+	+++++ Recommend

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4. Station layouts

4.1. Arrangement of E &M Area on FS

As shown in Figure 4.1.1, the FS design shows a basic station layout of 160m inside length and 17.3m inside width. This is extremely tight to accommodate both passengers and equipment. Typical metro stations have 200 to 240m in length with a similar train configuration.

Total E&M area according to the station layout of the FS design is only 1048m^2, which is significantly insufficient to accommodate necessary facilities for underground stations, such as Tunnel Ventilation and Environmental Control System.

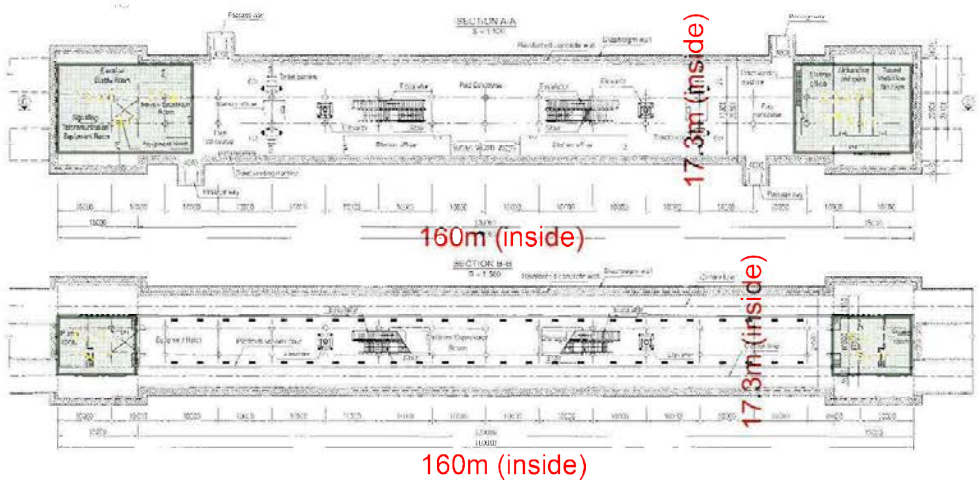

Figure 4.1.1 E & M area by the Previous FS

Given the limited time and information, assuming all the required E&M works seemed to be difficult during the FS. Station layout must be revised to equip all the necessary functions for the proper station operation.

4.2. Re-arrangement of E&M Area in This Study

The JST revised E&M area by increasing station length and width as shown in Figure 4.2.1. Inner length increased from 160m to 240m and inner width increased from 17.3m to 19.3m. Resultantly 3768m^2 of total E&M area is proposed.

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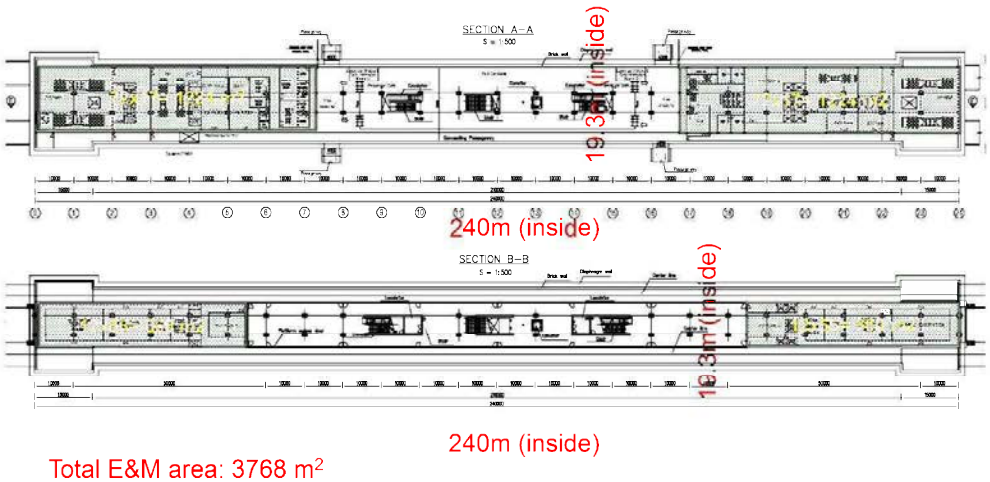

Figure 4.2.1 E & M area proposed by the JST in this Study

The above rearrangement is made based on the station layout and M&E locations of Ba Son station, Line 1, as indicated in Figure 4.2.2. The Figure shows that Ba Son station has a projection area for E&M works. This is because major land acquisition is allowed at the Ba Son station area. In the meantime, all underground stations of Line 3A, which are running under public roads, require best efforts to minimise land acquisition.

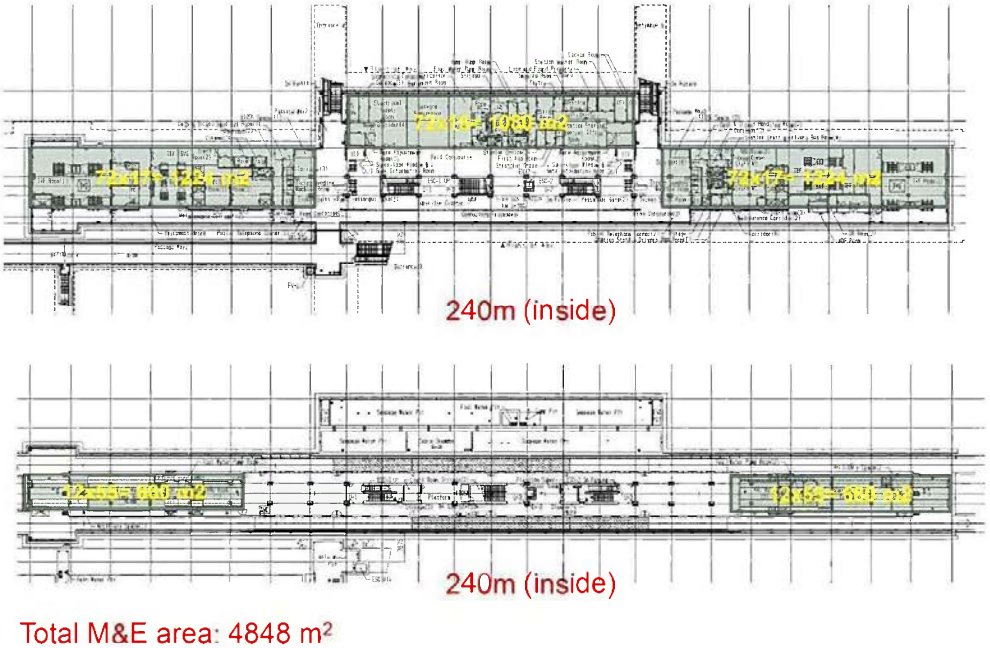

Figure 4.2.2 E & M area at Ba Son Station

The JST successfully reallocated all facilities and equipment from the projection area to other rooms at concourse and platform level. As a result, total space for M&E reduced the area by about 1000m^2 compared with that of Ba Son station.

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4.3. Comparison of E&M Area

The reasons for insufficiency of E&M area (i.e., station length and width) in the FS and comments of the JST to respective issues are summarised in Table 4.3.1.

Table 4.3.1 Comparison Table for E&M Work Area between FS and this Study

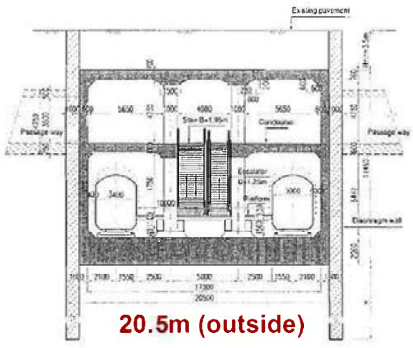
	Station Dimension (m)	E &M Area (m^2)	Reasons	Comments
FS	17.3 x 160	1048	Missing areas for TVF, TEF, ECS and AHU	Important equipment cannot be installed for TV and ECS.
This study	19.3 x 240	3768	Station is under the road, and hence minimising the area is required.	Based on the study, the area can be minimised compared to that of Ba Son station about 1000m^2.

Legend
TVF: Tunnel Ventilation Fan
TFE: Track Exhaust Fan
ECSC: Environmental Control System
AHU: Air Handling Unit
OTE: Outer Track Exhaust (it requires cut-off area on concrete slab.)
UPE: Under Platform Exhaust (it requires cut-off area on concrete slab.)
TV: Tunnel Ventilation

Some necessary facilities, such as Tunnel Ventilation and Environmental Control System, were not considered during the previous FS probably due to limited time and information. These facilities and equipment must be installed as the JST suggested.

4.4. Arrangement of Diaphragm Wall on FS

The combination of Diaphragm wall (DW) and in situ concrete was designed during the FS as indicated in Figure 4.4.1. This implies that DW was constructed at first as earth retaining wall for temporary structure, and will subsequently be used for permanent structure with in situ concrete in order to ensure water tightness. This is exactly the same design concept as HCM Line 1.



DW (1.0m)+ in situ concrete (0.6m)

Figure 4.4.1 Arrangement of Diaphragm Wall on FS

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However, our experiences reveal that the above arrangement is unlikely to effectively stop water leakage even though the Contractor is obliged to maintain water leakage to acceptance level as per the project specification. In the event of water leakage at stations, public appearance will be negative.

The JST propose Option 1: DW with drainage and brick wall and Option 2: DW with in situ concrete as illustrated in Figure 4.4.2. The advantage of Option 1 is an ability to drain water leakage (within acceptable range by the project specification) through drainage with brick coverage wall in order to maintain a good public appearance. In addition, the brick wall, having openings with a proper interval, will ease maintenance. In spite of the above advantages, the FS and HCM Line 1 selected Option 2.

For the DW thickness, the JST propose 1.2m instead of 1.0m (as in the FS) considering structure stability and reducing settlement and adjacent impact.

Having compared with five items among FS, Option1 and Option 2 as summarised in Table 4.4.1, the JST recommend Option 1 as the most suitable method. The method was, in fact, applied in Delhi Metro and Singapore Metro.

Final decision may be made during the detailed designs after careful review of the results of HCM Line 1. As the stations of Line 3A have the same outer width of 22.9m, Option 2 also remains to be a possible option even after fixing of station dimensions.

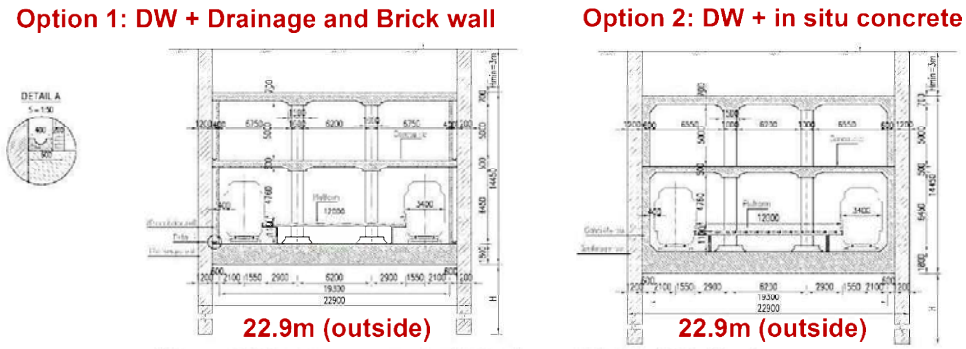

Figure 4.4.2 Arrangement of Diaphragm Wall in This Study

Table 4.4.1 Comparison Table for Diaphragm Arrangements

	FS	Option1	Option 2
Cost	Medium	Lowest +	Highest
Safety and stability	Inferior	Good +	Good +
Construction	Relatively difficult	Easy +	Relatively difficult
Maintenance	Difficult	Easy +	Difficult
Appearance	No good (if leakage is observed)	Good +	No good (if leakage is observed)
Conclusion		+++++ Recommend	+

The JST revised platform width from 10m to 12m by reference to Ba Son station (12m), Ben Thanh station (14m) and Stations of Hanoi Line 2 (11.45m). In case 10m platform width is kept, station length will become longer to accommodate E&M works. With respect to the platform width, further examination will be required during the detailed design, incorporating agreed demand forecast and fire evacuation.

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5. Station location

5.1. Thai Binh Market Station (C1)

Station length is, in general, expanded from the centre of the station associated with the change from 160m to 240m. Exceptionally in the case of C1, the station length is extended in one direction due to a curvature to Ben Thanh direction. Hence, the centre of the station is revised from Km 0+945 to Km 0+910m as shown in Figure 5.1.1.

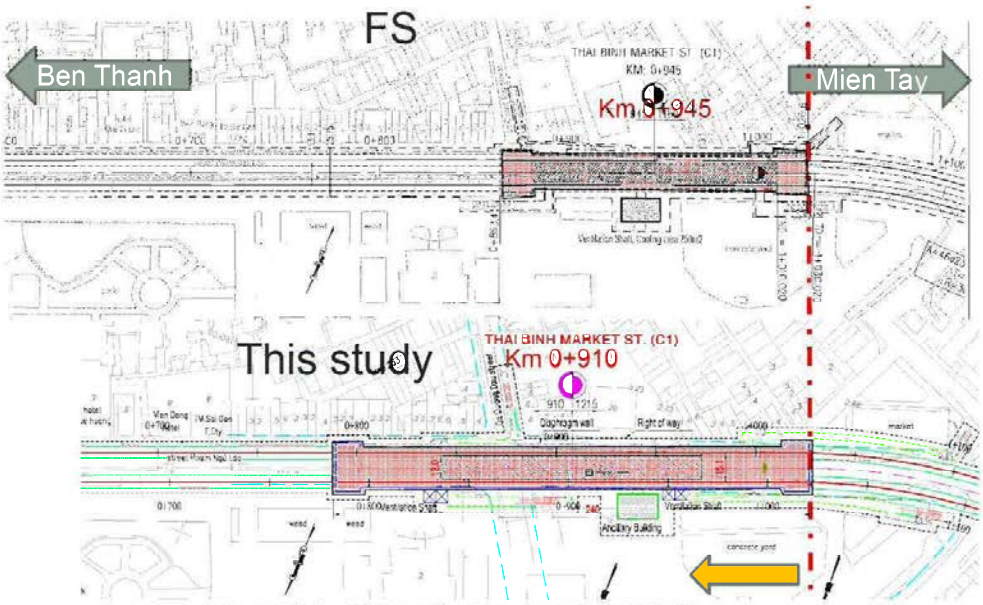

Figure 5.1.1 C1 Location between FS and this Study

5.2. Cong Hoa Six-Junction Station (C2)

The centre of the station remains unchanged, while the station and cut & cover lengths for crossing trains are revised as indicated in Figure 5.2.1.

This is because of the change in train operation and track layout of C2 as shown in Figure 5.2.2.

With regard to the track layout (see Figure 5.2.2), Line 1 and Line 3B tracks are moved outside and inside respectively to maintain connectivity with Line 3A and eventually achieve more punctual operation. With this arrangement, trains which run through from Line 1 to Line 3A and trains of Line 3B which return at C2 will not disrupt each other at turnouts on the Mien Tay side. This will help reduce the delay at the intersection.

On the contrary if trains directly run from Line 3B to Line 3A, high level of operation skills will be required.

Hence, the JST propose that all trains of Line 3B will return at C2. This means Line 3B system is operationally separated from Line 1 and Line 3A systems till operation personnel equip sufficient skills and experiences.

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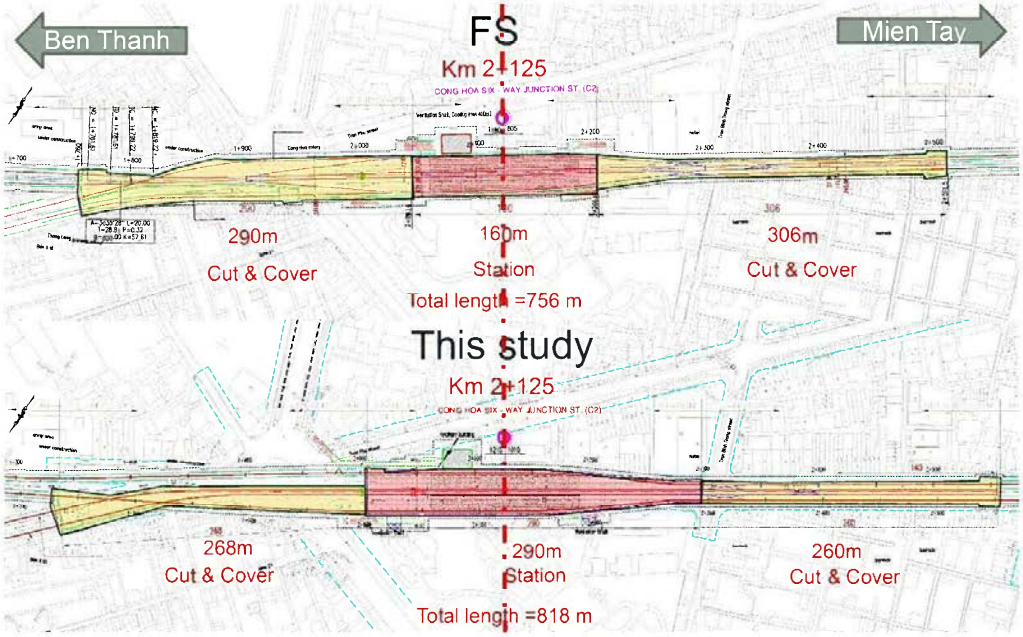

Figure 5.2.1 C2 Location between FS and this Study

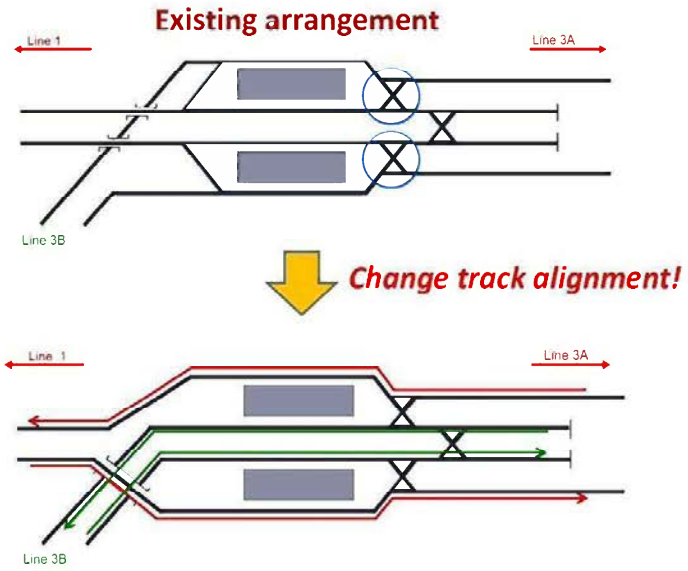

Figure 5.2.2 Track Layout at C2 between FS and this Study

5.3. Hoa Binh Park Station (C3)

C3 was originally located at Km 2 +930 as indicated in Figure 5.3.1, while Saigon Star requested alternative location (the centre of station is at Km3+205 (Option 2)) adjacent to their properties to be developed in the future, which is highlighted in yellow.

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Figure 5.3.1 C3 Location on FS

After careful review of their proposal, the JST identified even better location, which is at Km 3+135 (Option 1) with full consideration of accessibility from the neighbourhood and land acquisition as illustrated in Figure 5.3.2.

In terms of land acquisition, Option 1 is the most suitable location. The option affects the lowest numbers of houses, while the acquisition area slightly increases from the FS as summarised in Table 5.3.1.

In conclusion, the JST recommend Option 1 for three reasons in Table 5.3.2. As the difference between Option 1 and 2 is only 70m, accessibility from their properties has almost no change, while land acquisition area has great difference.

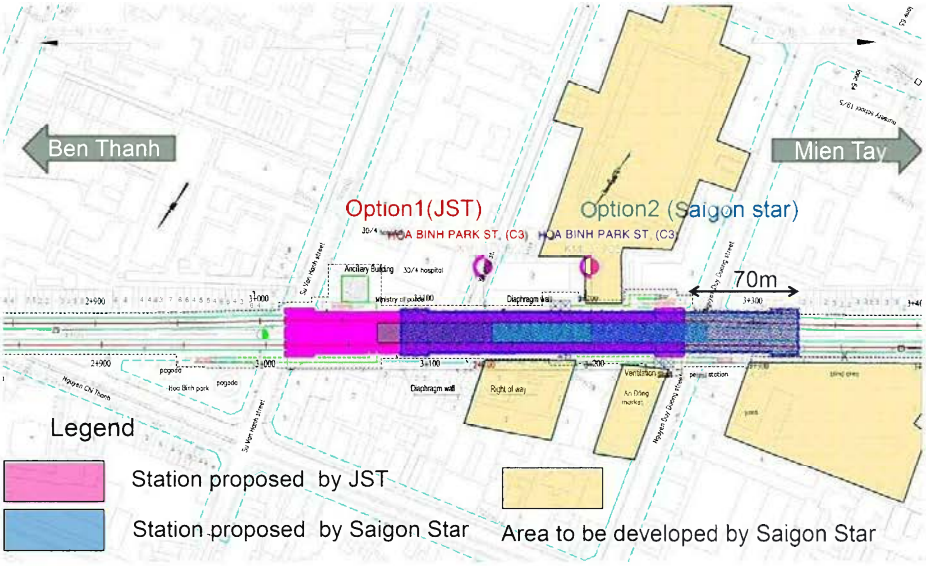

Figure 5.3.2 C3 Location between the JST and Saigon Star Proposals

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Table 5.3.1 Comparison Table for Land Acquisition

FS Km 2+930 (Original)

Number	Houses	Number of houses (right side)	Areas (m^2)	Number of houses (left side)	Areas (m^2)	Total number of houses	Total areas (m^2)
1	Temporary house	5	140	2	176	7	316
2	1 floors house	0	0	0	0	0	0
3	2 floors house	2	34	5	181	7	215
4	3 floors house	4	166	9	216	13	382
5	4 floors house	2	54	15	330	17	384
6	5 floors house	0	0	9	184	9	184
	> 6 floors house	0	0	5	168	5	168
	Total	13	394	40	1087	53	1481

The JST's Proposal Km 3+135 (Option 1)

Number	Houses	Number of houses (right side)	Areas (m^2)	Number of houses (left side)	Areas (m^2)	Total number of houses	Total areas (m^2)
1	Temporary house	3	155	6	833	9	988
2	1 floors house	2	32			2	32
3	2 floors house	4	55	1	10	5	65
4	3 floors house	5	390	1	30	6	420
5	4 floors house	1	70	0	0	1	70
6	5 floors house	0	0	0	0	0	0
	Total	15	702	8	873	23	1575

Saigon Star's Proposal Km 3+205 (Option 2)

Number	Houses	Number of houses (right side)	Areas (m^2)	Number of houses (left side)	Areas (m^2)	Total number of houses	Total areas (m^2)
1	Temporary house	3	155	11	1213	14	1368
2	1 floors house	2	32	3	115	5	147
3	2 floors house	4	55	3	10	7	65
4	3 floors house	4	330	1	48	5	378
5	4 floors house	1	70	0	0	1	70
6	5 floors house	0	0	0	0	0	0
	Total	14	642	18	1386	32	2028

Table 5.3.2 Comparison Table for C3 location

Item	Original Km 2+930	Option1 Km 3+135	Option 2 Km 3+205
Land acquisition	53nos, 1481m^2	23nos, 1575m^2 +	32nos, 2028m^2
Accessibility from neighbour hood	Good +	Good +	Good +
Distance from other stations	C2-C3 = 805m C3-C4 =1310m	C2-C3 =1010m C3-C4 =1105m +	C2-C3 =1080m C3-C4 =1035m +
Results	+	+++ Recommend	++

5.4. The University of Medicine & Pharmacy Station (C4)

In the same manner with other stations, the station length of C4 needs expansion. Taking into account the Line 5 station at Mien Tay direction, the station length is extended toward the other direction. The centre of the station is revised from Km 4+240 to Km 4+200 as shown in Figure 5.4.1.

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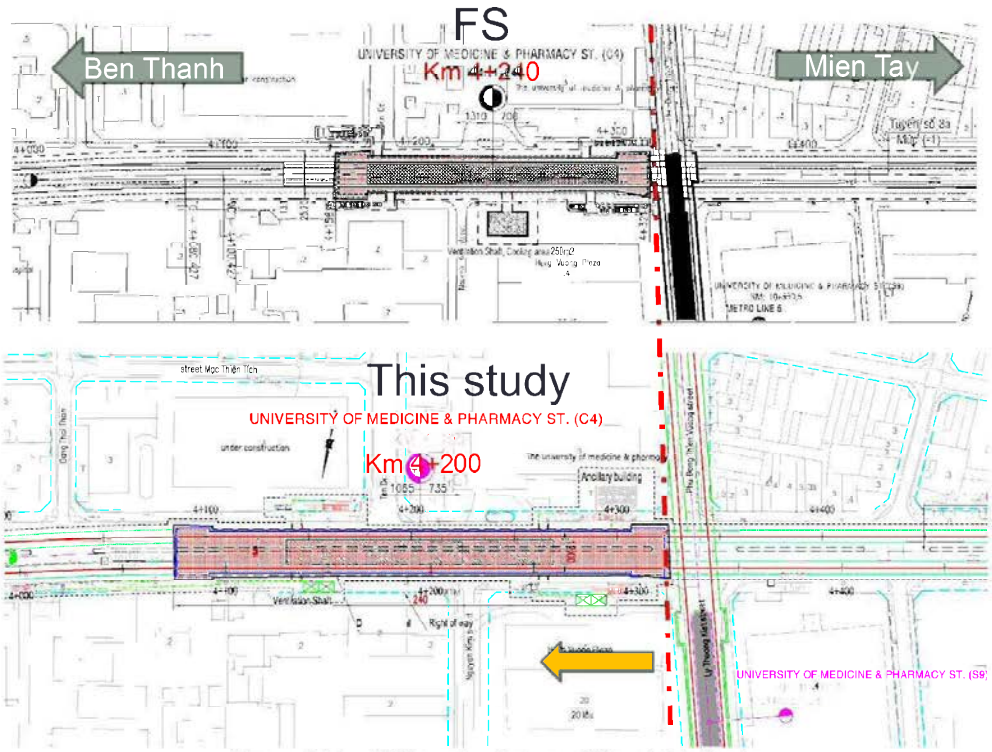

Figure 5.4.1 C4 Location between FS and this Study

5.5. Thuan Kieu Plaza Station (C5)

The centre of the station is slightly moved by 5m due to alignment change. Also, station and cut & cover lengths for crossing trains are revised as indicated in Figure 5.5.1.

The reason for the above revision is the change in track layout of C5 as shown in Figure 5.5.2. Such change in the track layout will reduce construction and maintenance cost.

After review of the latest traffic forecast and train operation, the JST concluded one turnout at C5 is sufficient to manage traffic. The remained turnout at Ben Thanh direction will be used for emergency cases such as accident. Scissors crossing seems over investment as this exceptional case occurs only few times a year according to Tokyo Metro in Japan.

Given the frequency of incident and maintenance cost, turnout is selected instead of scissors crossing.

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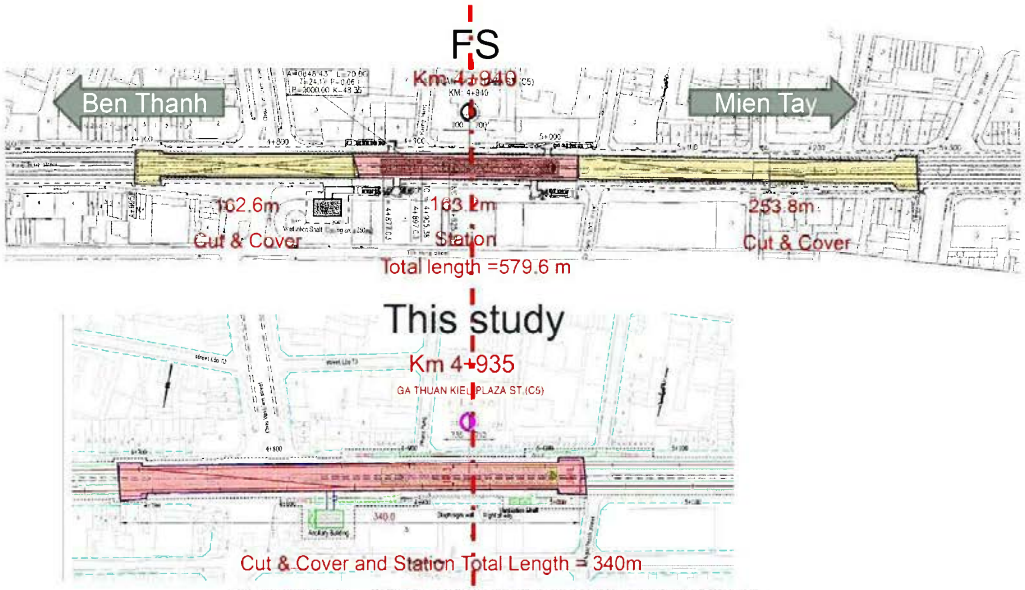

Figure 5.5.1 C5 Location between FS and this Study

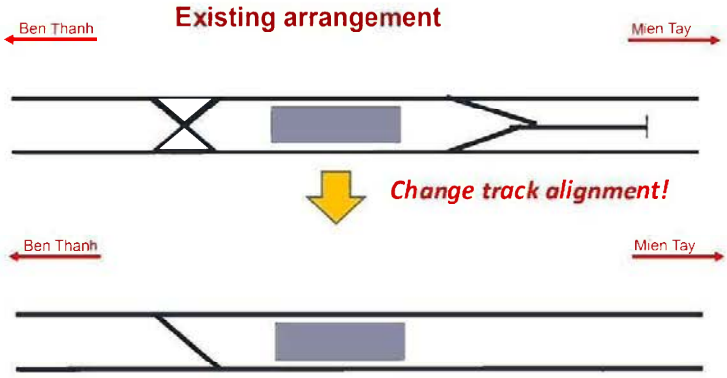

Figure 5.5.2 Track Layout at C5 between FS and this Study

5.6. Cho Lon Bus Station (C6)

The centre of the station is slightly moved by 5m from the FS due to the alignment change as shown in Figure 5.6.1.

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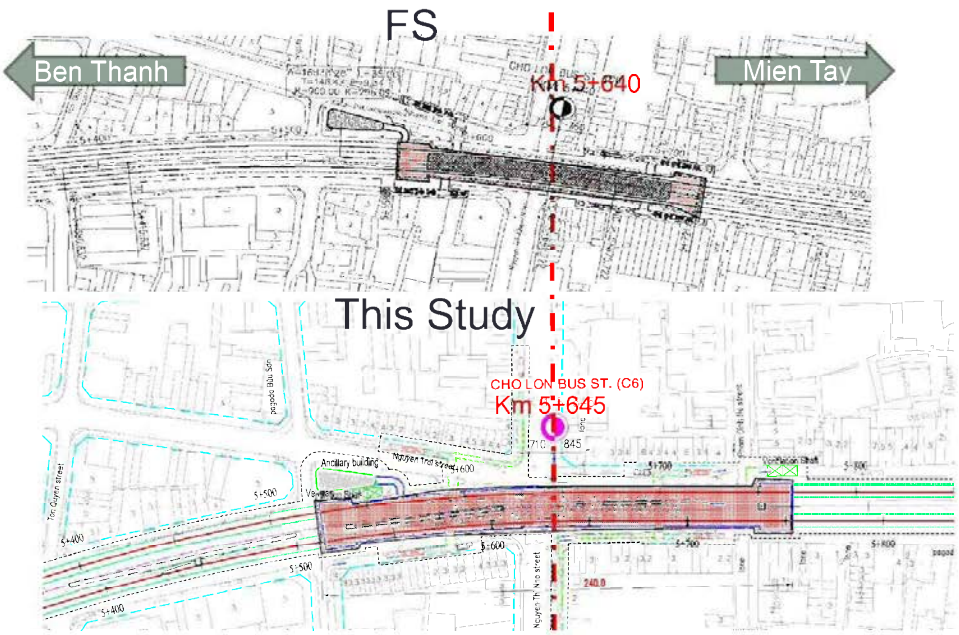

Figure 5.6.1 C6 Location between FS and this Study

5.7. Phu LAM Rotary Station (C8)

In the same manner with other stations, the station length of C8 needs expansion. Due to a curve at Ben Thanh direction, station length is extended to the other direction. The centre of the station is revised from Km 7+455 to Km 7+480 as shown in Figure 5.7.1.

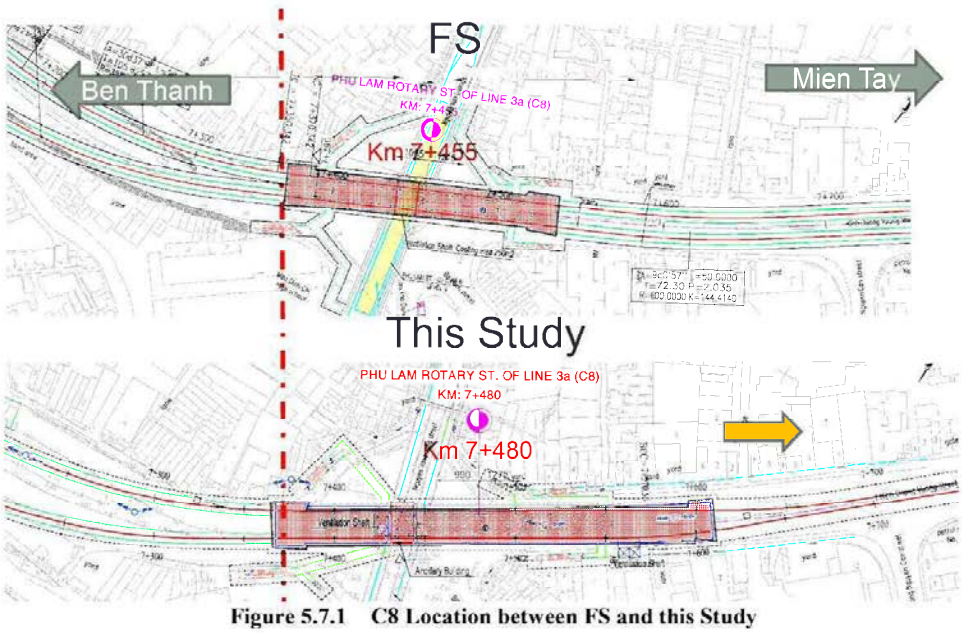

Figure 5.7.1 C8 Location between FS and this Study

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5.8. Mien Tay Bus Station (C10)

As shown in Figure 2.3.2 C10 is revised from underground to elevated station. Also, the centre of the station is revised from Km 9+700 to Km 9+ 690 due to the alignment change.

In addition, the track layout of C10 is revised considering train operation because of the following reasons (see Figure 5.8.1).

Firstly, the purpose of the revision is to reduce construction and maintenance cost.

Secondly, overnight stabling of trains at C10 is not required after Phase 2 opening.

Hence, only one additional side track is required between the two main tracks for a turn over and receiving failure trains.

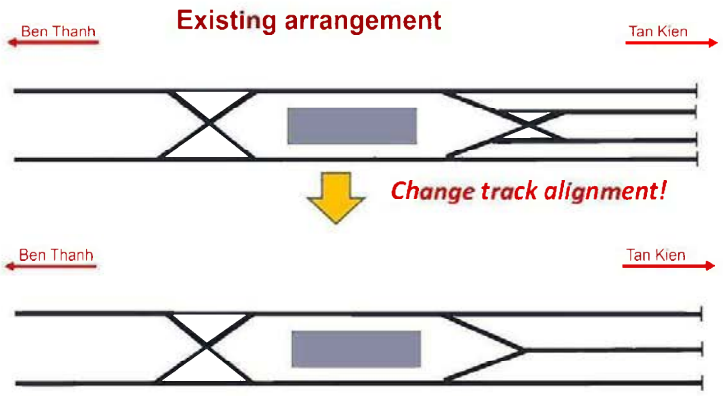

Figure 5.8.1 Track Layout at C10 between FS and this Study

5.9. Summary of Revision for the Station Location

The revision of the station locations as explained from 5.1 to 5.8 is summarised in Table 5.9.1.

Table 5.9.1 Comparison Table for Station Location between FS and this Study

No	Station	Chainage FS	Distance FS	Chainage This time	Distance This time	Reasons
C1	Thai Binh Market	0+945	945m	0+910	910m	Extension of the station length in one direction
C2	Cong Hoa Six-Way Junction	2+125	1,180m	2+125	1215m	No change
C3	Hoa Binh Park	2+930	805m	3+135	1010m	Due to the developer's suggestion
C4	The University of Medicine & Pharmacy	4+240	1,310m	4+200	1065m	Extension of the station length in one direction
C5	Thuan Kieu Plaza	4+940	700m	4+935	735m	Due to the alignment change
C6	Cho Lon Bus	5+640	700m	5+645	710m	Due to the alignment change
C7	Cay Go	6+400	760m	6+345	700m	Due to Cay go flyover
C8	Phu Lam Rotary	7+455	1,055m	7+480	1135m	Extension of the station length in one direction
C9	Phu Lam Park	8+665	1,210m	8+755	1275m	Move to closing the transport hub
C10	Mien Tay Bus	9+700	1,035m	9+690	935m	Due to the alignment change

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All stations except for C3, C7 and C9 are substantially the same locations as the FS. However, the centres of the stations are slightly moved due to the alignment change and site restriction such as existence of curves and integration with other Metros in future.

With respect to C3, the change was made in response to the suggestion from Saigon Star, the property developer.

With respect to C9, the change was made to improve access to the transport hub for convenience of users.

With respect to C7, it describes section 6.

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6. Cay Go Station (C7) Options

6.1. The Current Situation

The centre of C7 was designed at Km 6+400 by the FS as shown in Figure 6.1.1. However, it requires redesign as Cay Go flyover was constructed on the station alignment after the FS as indicated in Figure 6.1.2.

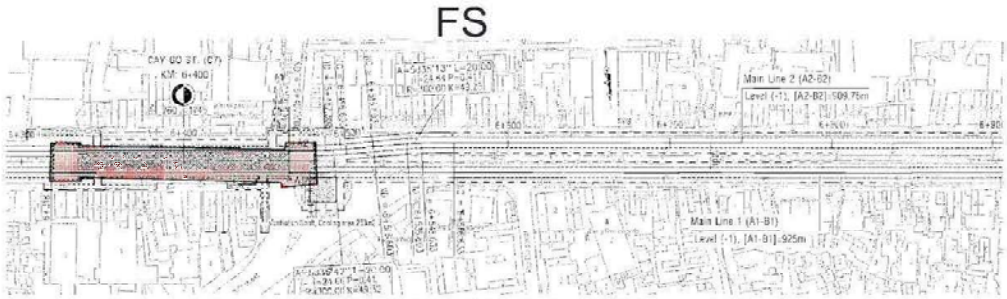

Figure 6.1.1 C7 Location on FS

Figure 6.1.2 Cay Go Flyover

6.2. Comparison of Five Options

As shown in Figure 6.2.1 five options of C7 designs are considered i.e. Option1: stacked station, Option 2: two separate stations, Option 3: parallel station with underpinning, Option 4: parallel station with demolishing and re-constructing flyover and Option 5: no construction (cancel C7).

Stacked station requires stacked tunnel alignment, the deepest section and the longest station length compared to other options.

Two separate stations require two separate station facilities beside Cay Go flyover. This option brings inconvenience to passengers, e.g. separate platforms require long distance of walking.

Parallel station with underpinning requires the most difficult construction method. The station needs to be constructed underneath Cay Go flyover using temporary jacks and piles plus monitoring thereof without making any traffic disruption on the flyover. In addition, thicker concrete slabs and walls are necessary compared to normal stations (C1 to C6 and C8), since C7 structure must receive loads from Cay Go flyover.

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Parallel station with demolishing and re-constructing flyover is the method to construct the station after demolishing Cay Go flyover and later rebuild the flyover. Although the station structure requires thicker concrete slabs and walls in the same manner with the Option 3, the construction work is much easier than that of underpinning method.

No construction option, i.e. cancellation of C7, will make distances between stations unequal. As this causes inconvenience to users, this option is no longer considered.

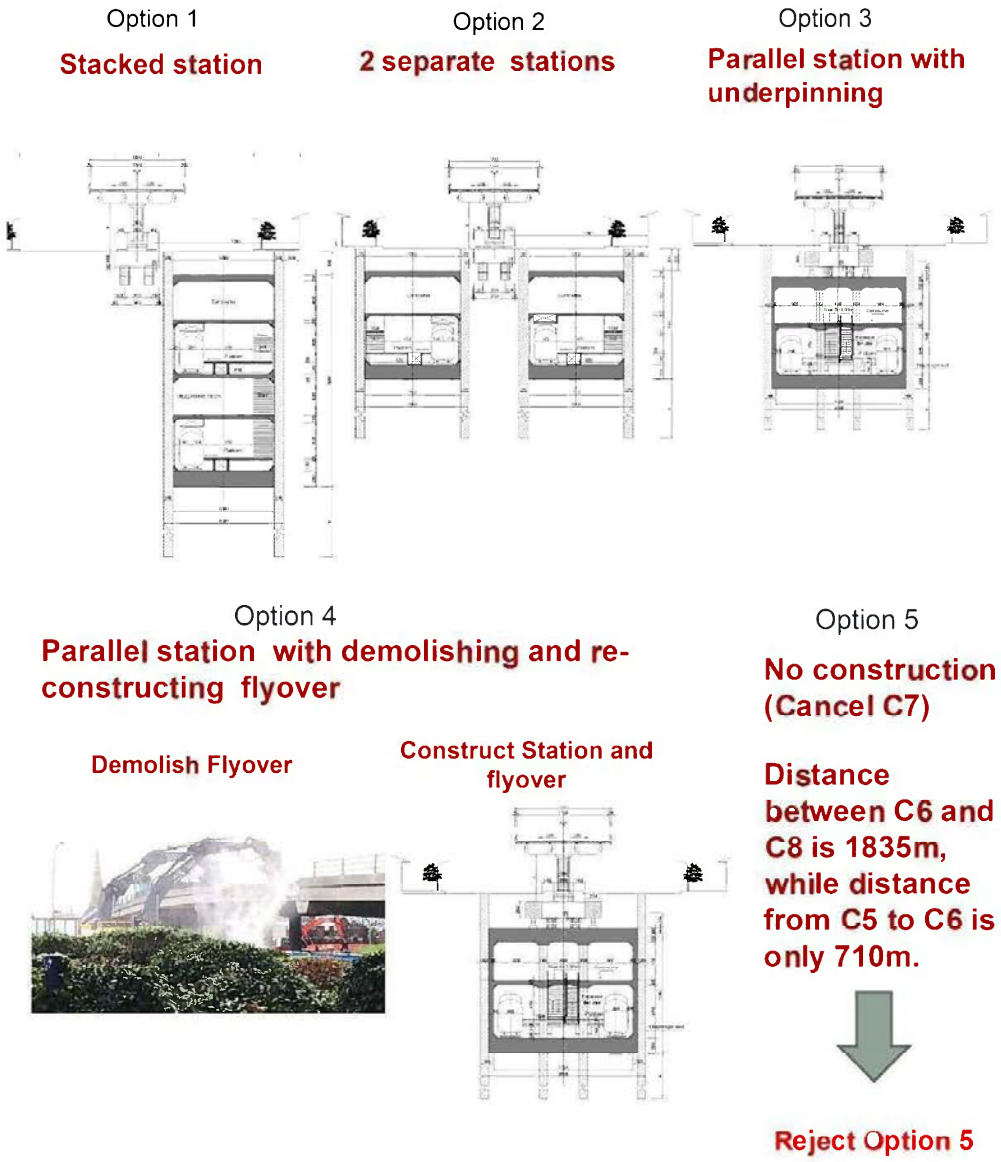

Figure 6.2.1 Five Options for a New Design of C7

6.3. Comparison of Four Options

As described in 6.2, four options are compared in Table 6.3.1. The results show that Option 4 namely, parallel station with demolishing and re-constructing flyover has the highest points considering six items. Hence, Option 4 is recommended.

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Table 6.3.1 Comparison Table for Cay Go Station Options

	Opton1 Stacked station	Option 2 2 separate stations	Option 3 Parallel station with underpinning	Option 4 Parallel station with demolishing and re-constructing flyover
Land acquisition	No land acquisition for main station +	No land acquisition for main station +	No land acquisition for main station +	No land acquisition for main station +
Traffic condition	Traffic condition will be recovered after construction. +	Traffic condition will be recovered after construction. +	Traffic condition will be recovered after construction. +	Traffic condition will be recovered after construction. +
Environmental impact	No major impact +	No major impact +	No major impact +	Major impact during demolition
Passenger convenience	Medium convenient with vertical connection of platforms	No convenient because of separate platforms with long distance	Most convenient with 1 plat form +	Most convenient with 1 plat form +
Construction	Slight difficulty	Difficulty and taking time for 2 boxes construction	Big difficulty of underpinning construction –	No difficulty +
Cost	84 Million USD * +	Slightly higher than Option 1*	Slightly higher than Option 1*	84 Million USD *+
Conclusion	++++	+++	+++	+++++ Recommend

Remarks
* As of 2015, construction cost only

6.4. C7 Location

The station location should consider the actual site conditions and reconstruction of the flyover. The centre of the station was revised from Km 6 + 640 to Km 6+345 with the following reasons.

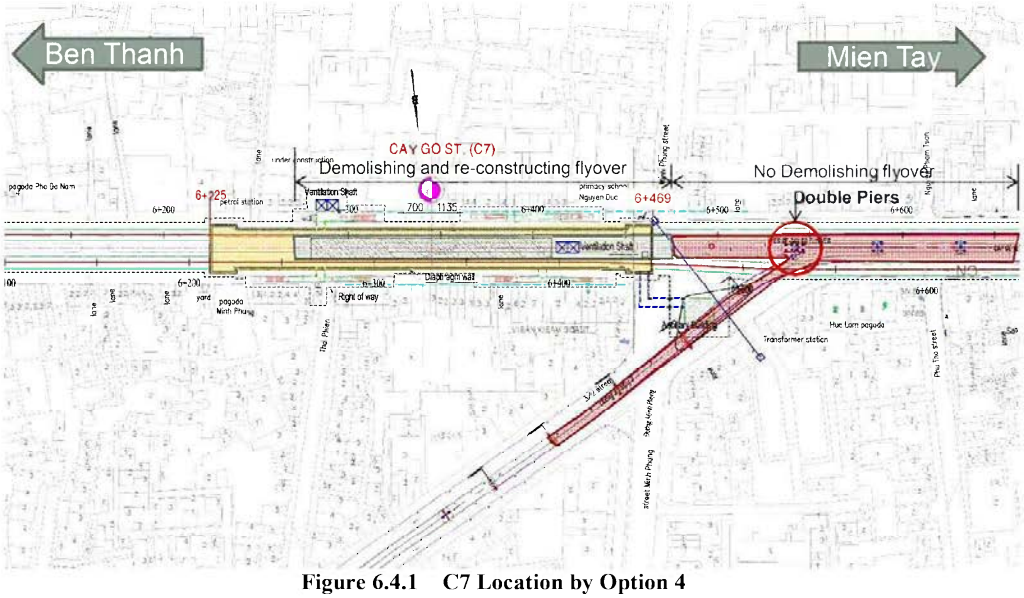

Figure 6.4.1 C7 Location by Option 4

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The Preparatory Survey on Ho Chi Minh City Urban Railway Construction Project
(Ben Thanh - Mien Tay Terminal (Line 3A Phase 1)) ***Report for Design Changes***

Firstly, a busy intersection should be kept functional during the construction because Cay Go flyover will be demolished. End of diaphragm wall of the station should not interfere with traffic flow in the intersection.

Secondly, removing and re-constructing double piers of the flyover is difficult work. Therefore, the JST propose not to remove them.

With the above considerations, about 230m of flyover will be demolished and re-constructed, while remaining part will be kept un-demolished for the traffic from 3/2 street during the construction.

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Appendix 4.2: No Objection Letter from MAUR

ỦY BAN NHÂN DÂN
THÀNH PHỐ HỒ CHÍ MINH
BAN QUẢN LÝ ĐƯỜNG SẮT ĐÔ THỊ

Số: 1350 /BQLĐSĐT-QLDA1

CỘNG HÒA XÃ HỘI CHỦ NGHĨA VIỆT NAM
Độc lập - Tự do - Hạnh phúc

Thành phố Hồ Chí Minh, ngày 17 tháng 5 năm 2016

Kính gửi: Ông **Shinya NAKAMURA**
Trưởng nhóm nghiên cứu,
Nhóm nghiên cứu JICA.

Nội dung: Về Báo cáo điều chỉnh thiết kế của tuyến metro số 3a – giai đoạn 1

Ban Quản lý Đường sắt đô thị cảm ơn Nhóm nghiên cứu JICA (JST) đã có những nỗ lực trong việc tiến hành nghiên cứu chuẩn bị dự án tuyến metro số 3a – giai đoạn 1 (Bến Thành – Bến xe Miền Tây).

Liên quan đến Công văn số JST-MAR-05-023 ngày 10 tháng 5 năm 2016 của JST về trình nộp Báo cáo điều chỉnh thiết kế của tuyến metro số 3a – giai đoạn 1, Ban Quản lý Đường sắt đô thị thông báo rằng Ban Quản lý Đường sắt đô thị không phản đối về ý tưởng thiết kế của JST, trong đó có ý tưởng: đoạn đi ngầm từ C0 đến ga Vòng xoay Phú Lâm (C8), đoạn chuyển tiếp giữa C8 và ga Công viên Phú Lâm (C9) và hai nhà ga trên cao là ga C9 và ga Bến xe Miền Tây (C10).

Ngoài ra, Ban Quản lý Đường sắt đô thị lưu ý JST một số điểm như sau:

1. Việc di dời đường dây điện cao thế:

Theo JST, Công ty lưới điện cao thế Thành phố đã chấp thuận phương án di dời theo hướng ngầm hóa bên trong các ống HDPE và được bảo vệ bằng các tấm bê tông bên trên tại cuộc họp ngày 21 tháng 04 năm 2016. Theo quan điểm của chúng tôi, tốt hơn nên có được thỏa thuận bằng văn bản từ Công ty lưới điện cao thế Thành phố hoặc Tổng Công ty Điện lực Thành phố Hồ Chí Minh.

2. Lớp đất phủ phía trên TBM:

JST đề xuất lớp đất phủ ít nhất là 2D cho đoạn giữa ga C1 và ga C2 để giảm thiểu lún (độ lún tối đa theo tính toán là 8,8mm) và để giảm tiếng ồn và độ rung trong giai đoạn thi công và vận hành. JST nên lưu ý kết hợp với kết quả khảo sát địa chất, địa hình để chuẩn bị phương án trong trường hợp độ lún cho phép vượt ra khỏi tính toán của JST. Ngoài ra, chi phí quan trắc lún cũng cần được ước tính.

3. Vị trí Ga Công viên Hòa Bình (C3):

Việc yêu cầu xem xét vị trí của ga C3 là theo đề nghị của Ủy ban nhân dân Quận 5 kèm đề xuất của Công ty Sài Gòn Star. Do đó, việc báo cáo đề cập "Công ty Sài Gòn Star mong muốn thay đổi vị trí ga sao cho tiếp giáp với các công trình được quy hoạch phát triển trong tương lai" có thể gây hiểu lầm. Đề nghị JST hiệu chỉnh nội dung này cho phù hợp.

1

4. Chuẩn bị cho buổi họp báo cáo giữa kỳ:

Để chuẩn bị cho buổi họp báo cáo giữa kỳ vào ngày 27 tháng 5 năm 2016 (dự kiến), chúng tôi đề nghị JST chuẩn bị một bảng danh mục trình bày so sánh tóm tắt những thay đổi giữa kết quả nghiên cứu của JST và FS đã phê duyệt.

Trên đây là ý kiến của Ban Quản lý Đường sắt đô thị, đề nghị JST xem xét và cập nhật.

Trân trọng./.

Nơi nhận:
- Như trên;
- PTB H.N.Cương;
- BQLDA1;
- Lưu: VT, BAH.

KT. TRƯỞNG BAN
PHÓ TRƯỞNG BAN

BAN QUẢN LÝ ĐƯỜNG SẮT ĐÔ THỊ

Hoàng Như Cương

2

HO CHI MINH CITY
PEOPLE'S COMMITTEE
MANAGEMENT AUTHORITY FOR URBAN RAILWAYS

SOCIALIST REPUBLIC OF VIET NAM
Independence - Freedom - Happiness

Ref: 1350/BQLDSDT-QLDA1

Ho Chi Minh City, 17th May 2016

To: Mr. **Shinya NAKAMURA**
Team Leader,
The JICA Study Team.

Subject: The submission of report for design changes for the metro line 3a – phase 1 (Ben Thanh – Mien Tay Terminal)

Management Authority for Urban Railways (MAUR) would like to express our gratitude to the JICA Study Team (JST) for your efforts in carrying out the preparatory survey for the metro line 3a – phase 1 (Ben Thanh – Mien Tay Terminal).

With reference to your letter ref. JST-MAUR-05-023 dated May 10th, 2016 for submission of report for design changes for the Line 3a phase 1, MAUR hereby inform you that we have no objection to your design concept, in which there is the proposal: underground section is from C0 to Phu Lam Rotary Station (C8), transition section is between C8 and Phu Lam Park Sation (C9), and C9 and Mien Tay Terminal Station (C10) are elevated stations.

Besides, MAUR would like to draw your attention to following points:

1. The relocation of power cables:

According to JST, the city high voltage power grid Company accepted the idea of relocation of power cable to underground by using HDPE pipes and protected by the concrete slab in the meeting held on April 21st, 2016. From our viewpoint, it is better to get their agreement in writing from the city high voltage power grid Company or Ho Chi Minh City EVN.

2. The ground cover above TBM:

JST proposed the minimum ground cover between C1 and C2 station was at least 2D for minimizing the settlement (the maximum settlement as your calcuatlion was 8.8mm) and reducing the noise and vibration during the stage of construction and operation. JST should take note to incorporate with the result of topographic and geotechnical survey to prepare solutions in the case the allowable settlement reaches out of the JST's calculation. In addition, the cost for monitoring settlement should be estimated.

3. The Hoa Binh park station (C3) relocation:

The request for C3 relocation is as the recommendation of People Committee of District 5 enclosed with the Saigon Star Company's proposal.

1

Therefore, the content which the report mentioned that "Saigon Star requested alternative location adjacent to their properties to be developed in the future" may lead to misunderstanding. We propose JST to revise for its appropriateness.

4. The preparation for the interim report meeting:

To prepare for the interim report meeting on May 27th, 2016 (tentative), we propose JST to prepare an index table which shows the summarized comparison of design changes between JST's study result and the approved FS.

All above are comments of MAUR, we suggest you to consider and update.

Yours faithfully./.

Attn:
- As above;
- Vice Chairman H.N.Cuong;
- PMU1;
- Save: record, BAH.

PP. CHAIRMAN
VICE CHAIRMAN

BAN QUẢN LÝ ĐƯỜNG SẮT ĐÔ THỊ

Hoang Nhu Cuong

2

Appendix 4.3: Study on Station Mechanical Systems for C2 and C5 Station and Ventilating Facilities in Ben Thanh Station for Line 3A

C_2 Machinery room Ⅱ

$\frac{17.5+34.5}{2} \times 37 = 962\ m^2$

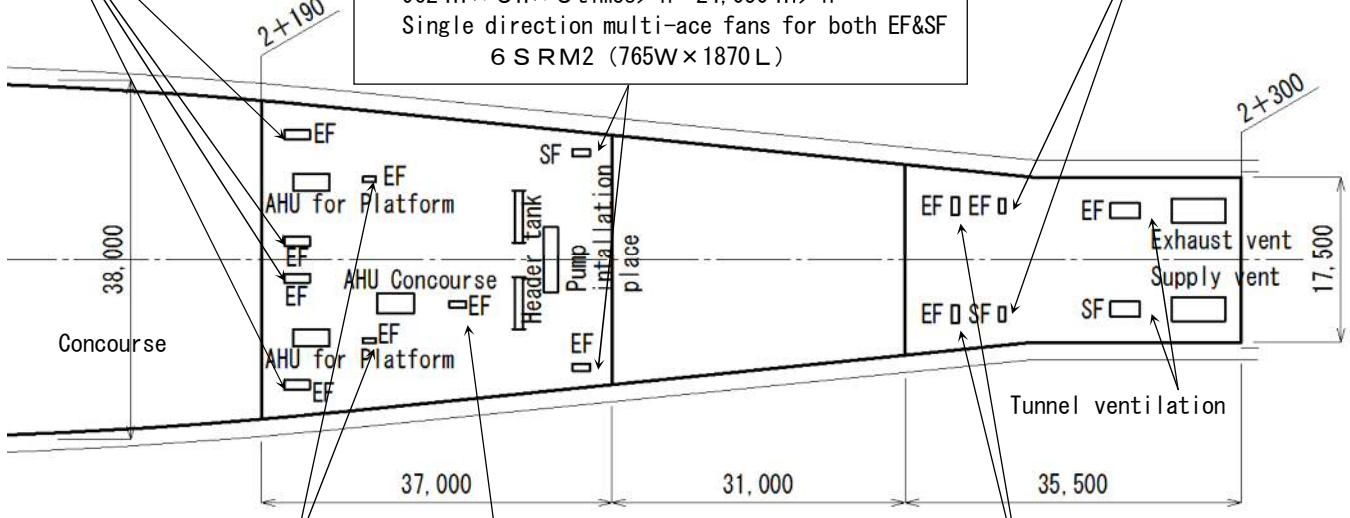
C_2 Machinery room Ⅰ

$17.5 \times 15.5 + \frac{17.5+21.0}{2} \times 20 = 652\ m^2$

Ventilation fan for Station track space
62,000 ㎥／h×４sets
Single direction multi-ace suction fan
８ＳＲＭ2（980W×2700Ｌ）

Ventilation fan for Machinery room
625 ㎡×５H×５times／h＝16,300 ㎥／h
Single direction multi-ace fans for both EF&SF
４ 1/2ＳＲＭ2（663W×1515Ｌ）

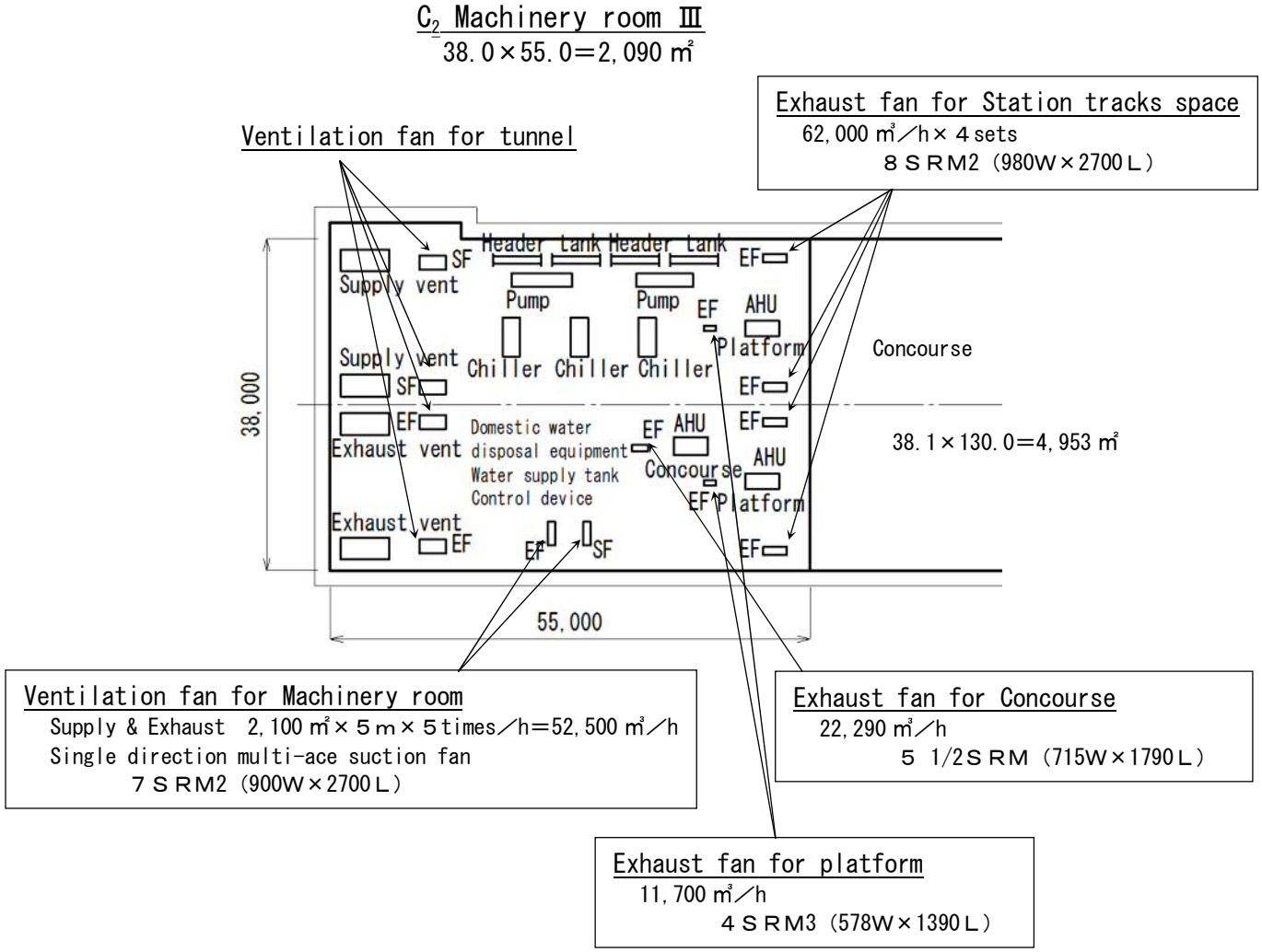
Ventilation fan for Machinery room
962 ㎡×５H×５times／h＝24,050 ㎥／h
Single direction multi-ace fans for both EF&SF
６ＳＲＭ2（765W×1870Ｌ）



Exhaust fan for platform
11,700 ㎥／h
４ＳＲＭ3（578W×1390Ｌ）

Exhaust fan for concourse
22,290 ㎥／h
５ 1/2ＳＲＭ2（715W×1790Ｌ）

Exhaust fan for Storage tracks space
Equivalent to 30% of station tracks exhaust fan capacity
（In case of no passenger on cars）
124,000 ㎥／h×30%＝37,200 ㎥h／one line
Single direction multi-ace suction fan
６ＳＲＭ2（765W×1870Ｌ）

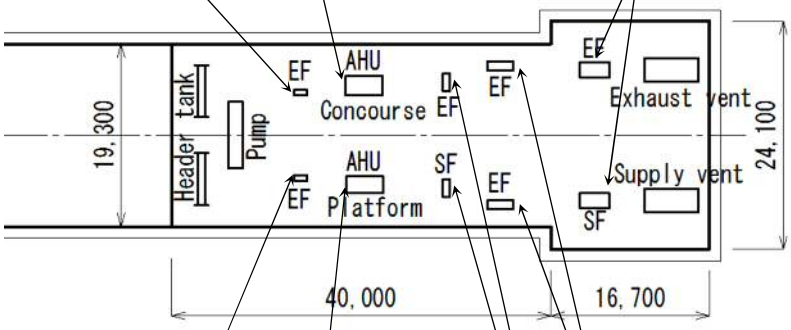

C2 Machinery room Ⅲ
38.0×55.0=2,090 ㎡
Exhaust fan for Station tracks space
62,000 ㎥／h× 4 sets
８ＳＲＭ2 (980W×2700Ｌ)
Ventilation fan for tunnel
Header tank
Header tank
SF
EF
Supply vent
Pump
Pump
EF
AHU
Platform
Concourse
Supply vent
Chiller
Chiller
Chiller
SF
EF
EF
38,000
EF
Domestic water
disposal equipment
Water supply tank
Control device
EF
AHU
Exhaust vent
Concourse
AHU
EF
Platform
Exhaust vent
EF
EF
SF
EF
38.1×130.0=4,953 ㎡
55,000
Ventilation fan for Machinery room
Supply & Exhaust 2,100 ㎥×５ｍ×５times／h=52,500 ㎥／h
Single direction multi-ace suction fan
７ＳＲＭ2 (900W×2700Ｌ)
Exhaust fan for Concourse
22,290 ㎥／h
５ 1/2ＳＲＭ (715W×1790Ｌ)
Exhaust fan for platform
11,700 ㎥／h
４ＳＲＭ3 (578W×1390Ｌ)
Platform
12.0×130=1,560 ㎡／platform × 2 platforms = 3,120 ㎡
Ceiling height of 3m(presumption) 3,120×3.0=9,360 ㎥ for 2 platforms
Station track
(2.1+2.1) ×130=546 ㎡ for two tracks
Ceiling height 6.45m(presumption) 546×6.45=3,220 ㎥ for two tracks

C_5 Machinery room I

Air Handling unit for Concourse
ＡＨ13ＦＧ（2100W×3876Ｌ）

Exhaust fan for Concourse
12,695 ㎥／h
４ＳＲＭ3（578W×1390Ｌ）

Ventilation fans for Tunnel
100,800 ㎥／h／sets
Single direction multi-ace suction fan
10ＳＲＭ2（1600W×3100Ｌ）



Exhaust fan for Platform
11,700 ㎥／h
４ＳＲＭ3（578W×1390Ｌ）

Exhaust fan for Station tracks space
62,000 ㎥／h
Single direction multi-ace suction fan
８ＳＲＭ2（980W×2700Ｌ）

Air Handling Unit for Platform
ＡＨ11ＦＧ（1800W×3876Ｌ）

Ventilation fans for Machinery room
16.7×24.1＋40.0×19.3＝1,175m
1,175m×５Ｈ×５times／h＝29,375 ㎥
Single direction multi-ace suction fan
６ＳＲＭ2（765W×1870Ｌ）

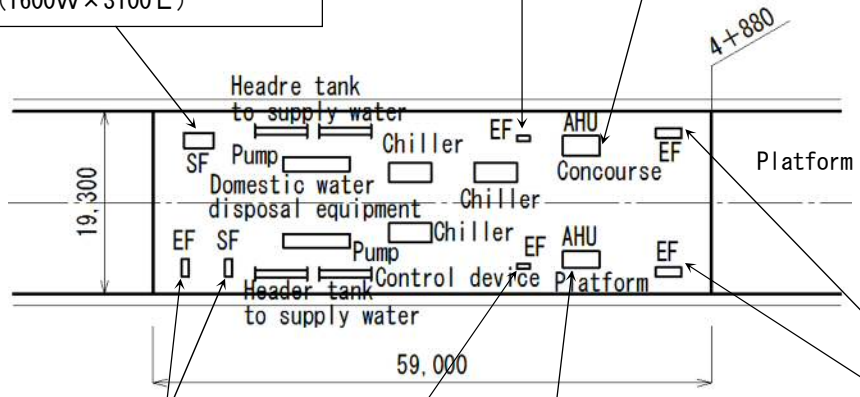
C_5 Machinery room Ⅱ

Situated on the floor over single crossover section beside Platform

Exhaust fan for Concourse
12,695 ㎥／h
４ＳＲＭ3（578W×1390Ｌ）

Supply fan for Single crossover section
19.3m×178.9m＝3,453 ㎡
3,453×6.45×５times／h＝111,359 ㎥／h
Single direction multi-ace suction fan
10ＳＲＭ2（1600W×3100Ｌ）

Air Handling Unit for Concourse
ＡＨ13ＦＧ（2100W×3876Ｌ）



Ventilation fans for Machinery room
19.3W×59.0Ｌ＝1,138 ㎡
1138.7m×５Ｈ×５times／h＝28,470 ㎥／h
Single direction multi-ace suction fan
６ＳＲＭ2（765W×1870Ｌ）

Exhaust fan Station tracks space
62,000 ㎥／h
Single direction multi-ace suction fan
８ＳＲＭ2（980W×2700Ｌ）

Exhaust fan Platform
11,700 ㎥／h
４ＳＲＭ3（578W×1390Ｌ）

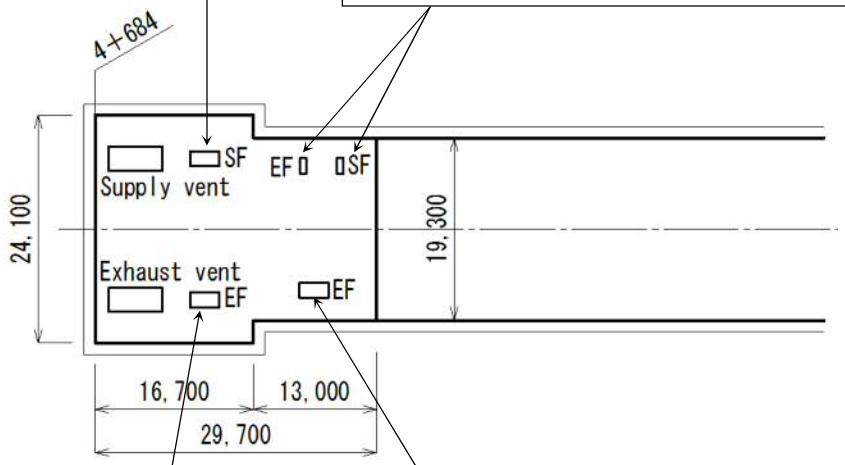
Air Handling Unit for Platform
ＡＨ11ＦＧ（1800W×3876Ｌ）

C_5 Machinery room Ⅲ

Situated on the floor over Single crossover section at the side to the starting point of the line

Supply fan for Tunnel
100,800 ㎥／h
Single direction multi-ace suction fan
10ＳＲＭ2（1600Ｗ×3100Ｌ）

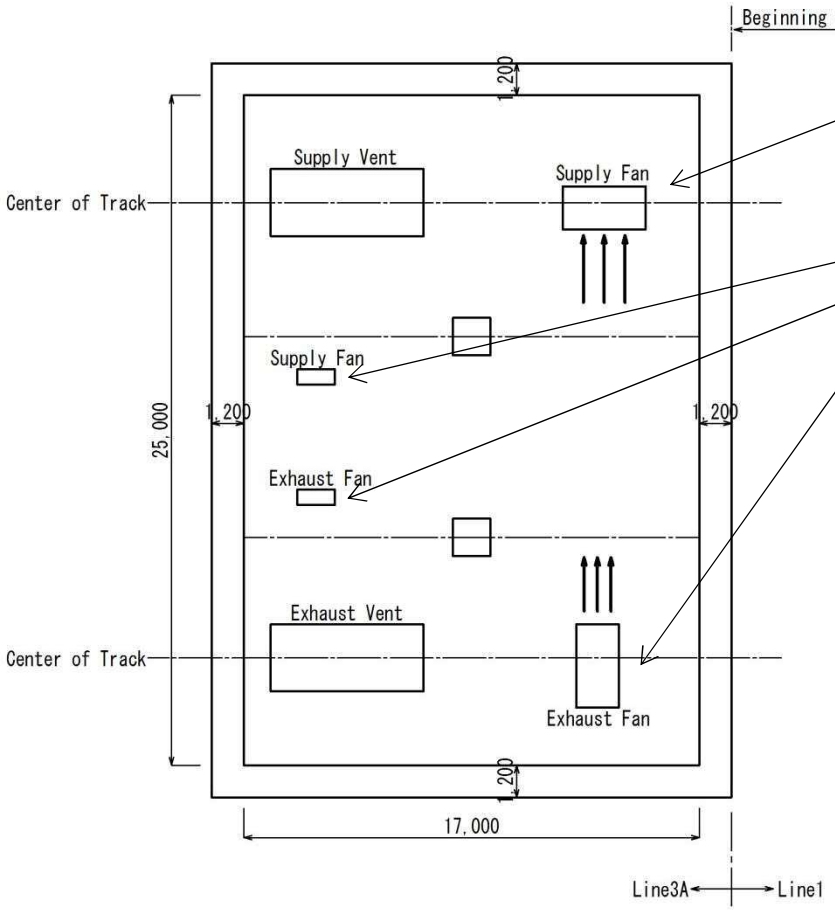
Ventilation fan for machinery room
24.1×16.7＋19.3×13.0＝653 ㎡
Ceiling height of 5m Ventilation times of 5／h
653×5.0×５＝16,325
５ＳＲＭ2（665Ｗ×1690Ｌ）



Exhaust fan for Tunnel
100,800 ㎥／h
Single direction multi-ace suction fan
10ＳＲＭ2（1600Ｗ×3100Ｌ）

Exhaust fan for Single crossover section
19.3×178.9＝3,453 ㎡
3,453 ㎡×6.45ｍ×５times／h＝111,359 ㎥／h
Single direction multi-ace suction fan
10ＳＲＭ2（1600Ｗ×3100Ｌ）

Tunnel Ventilation Shaft at Vertical Shaft, Layout Plan



Ventila tion fans for tunnel 100.800 ㎥/h・set

Single direction multi-ace suction fan

10ＳＲＭ2 (Base 1600ｍｍ×3100ｍｍ)

Ventilation fan for Machinery room

17.0ｍ×25.0ｍ＝425 ㎡

425 ㎡×6.55ｍ×5 回＝13,919≒14,000 ㎥/h

Single direction multi-ace suction fan

4ＳＲＭ3 (Base 578ｍｍ×1,390ｍｍ)

Supply air volume 100.800 ㎥/h＋14.000 ㎥/h＝114.800 ㎥/h
≒115.000 ㎥/h

Exhaust air volume 100.800 ㎥/h＋14.000 ㎥/h＝114.800 ㎥/h
≒115.000 ㎥/h

Ventilation shaft to cope with the above Supply air volume & Exhaust air volume is necessary.

Line3A dedicated shaft should be installed or not.

Otherwise, expansion of Line1 shaft is possible or not.

At B2 floor of vertical shaft, partition wall is installed between up track and down track.

Image of Supply air facilities for tunnel ventilation

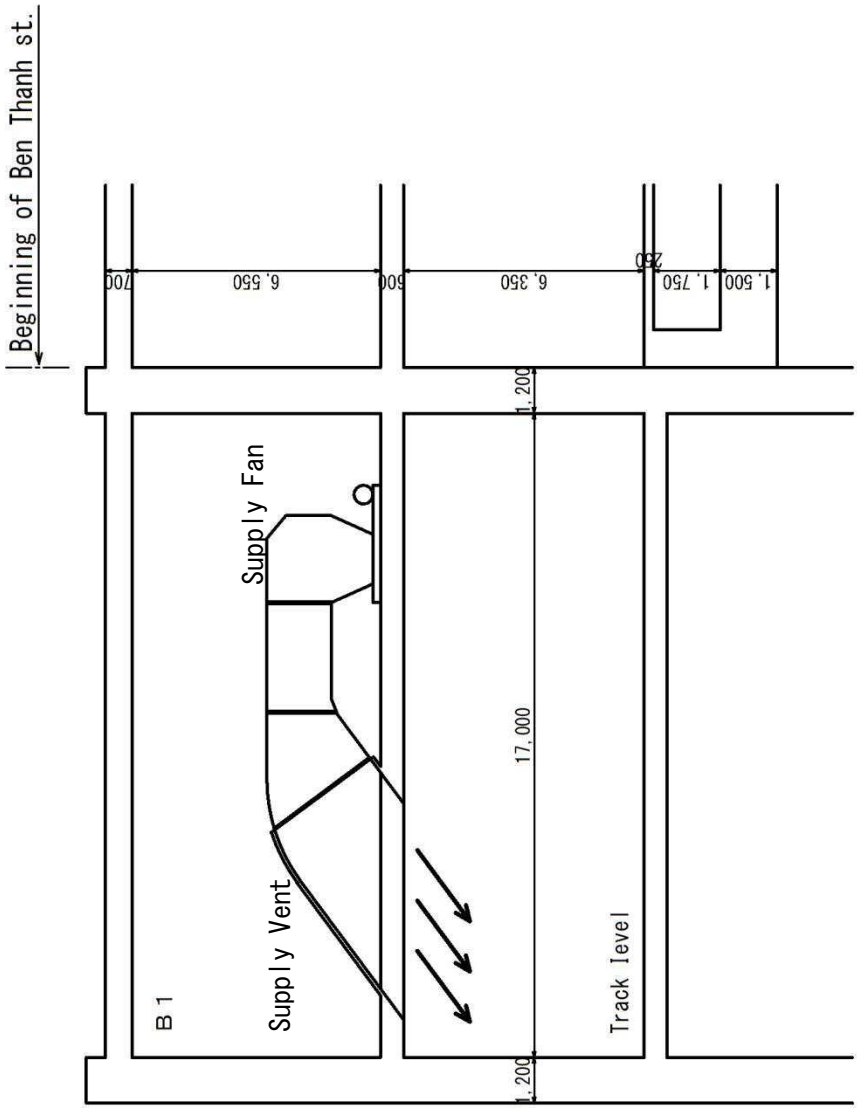
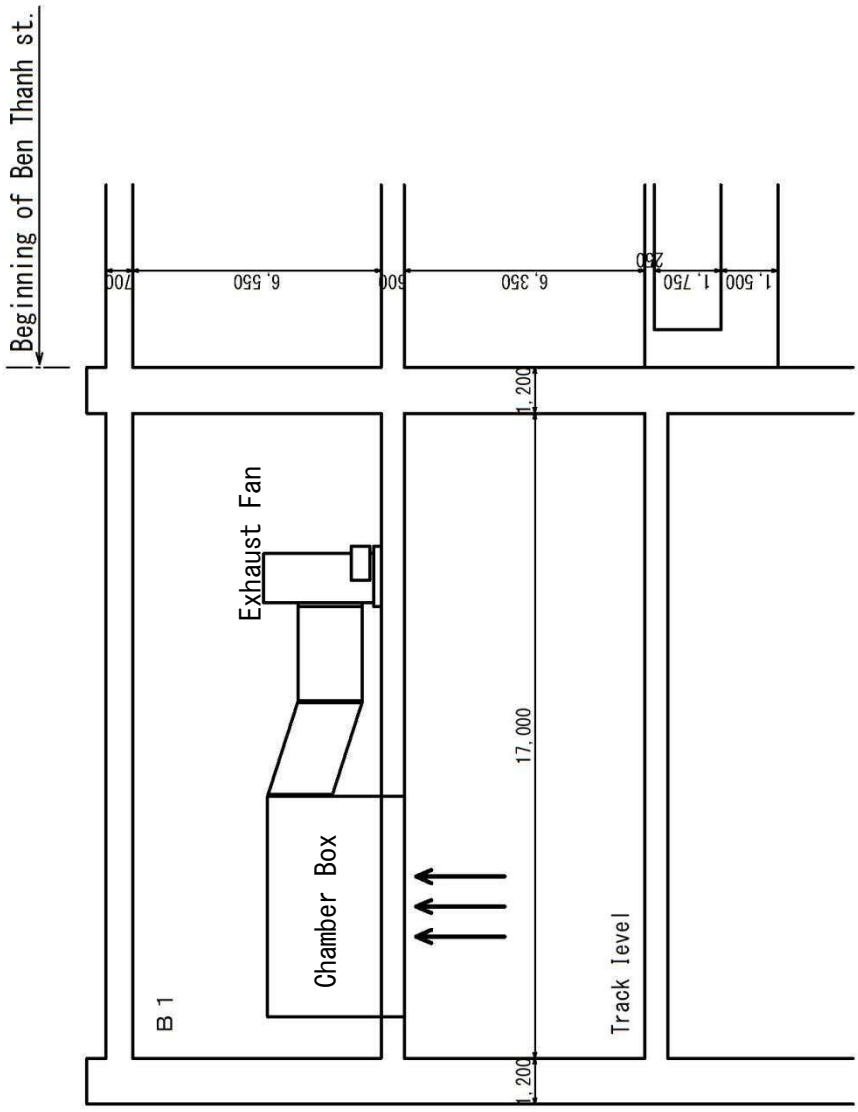
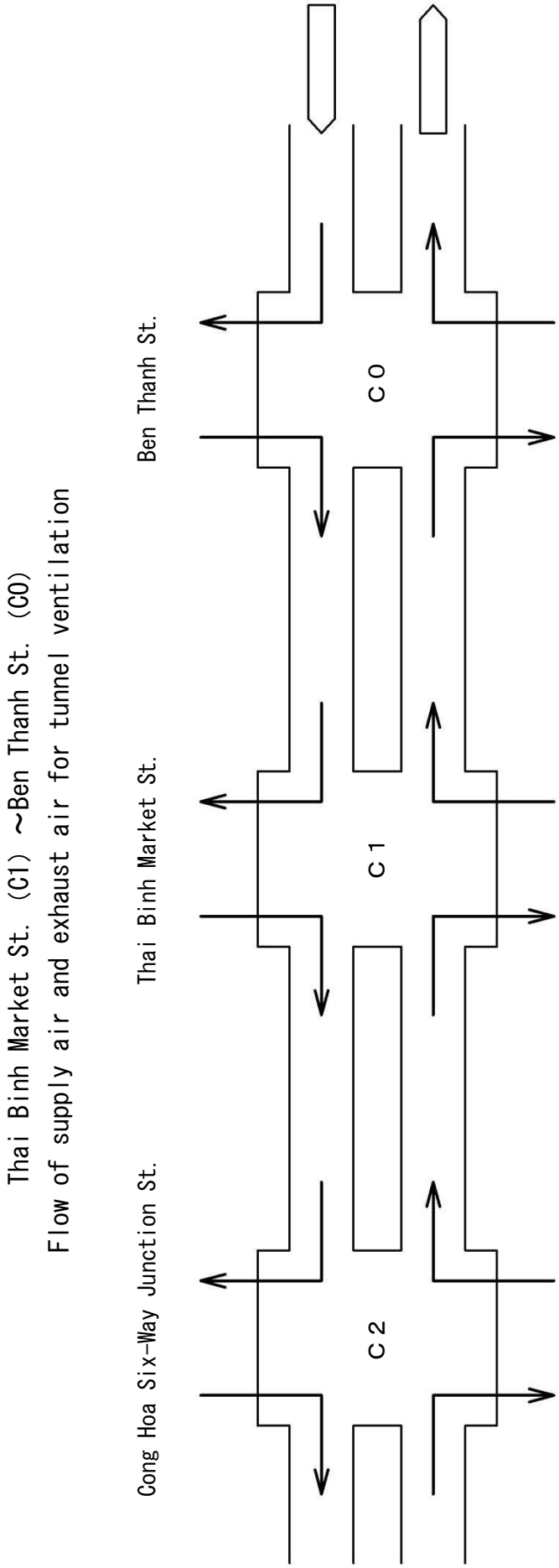


Image of Exhaust air facilities for tunnel ventilation




Thai Binh Market St. (C1) ～Ben Thanh St. (CO)
Flow of supply air and exhaust air for tunnel ventilation
Ben Thanh St.
Thai Binh Market St.
Cong Hoa Six-Way Junction St.
C O
C 1
C 2

Appendix 4.4: Signaling System Drawings

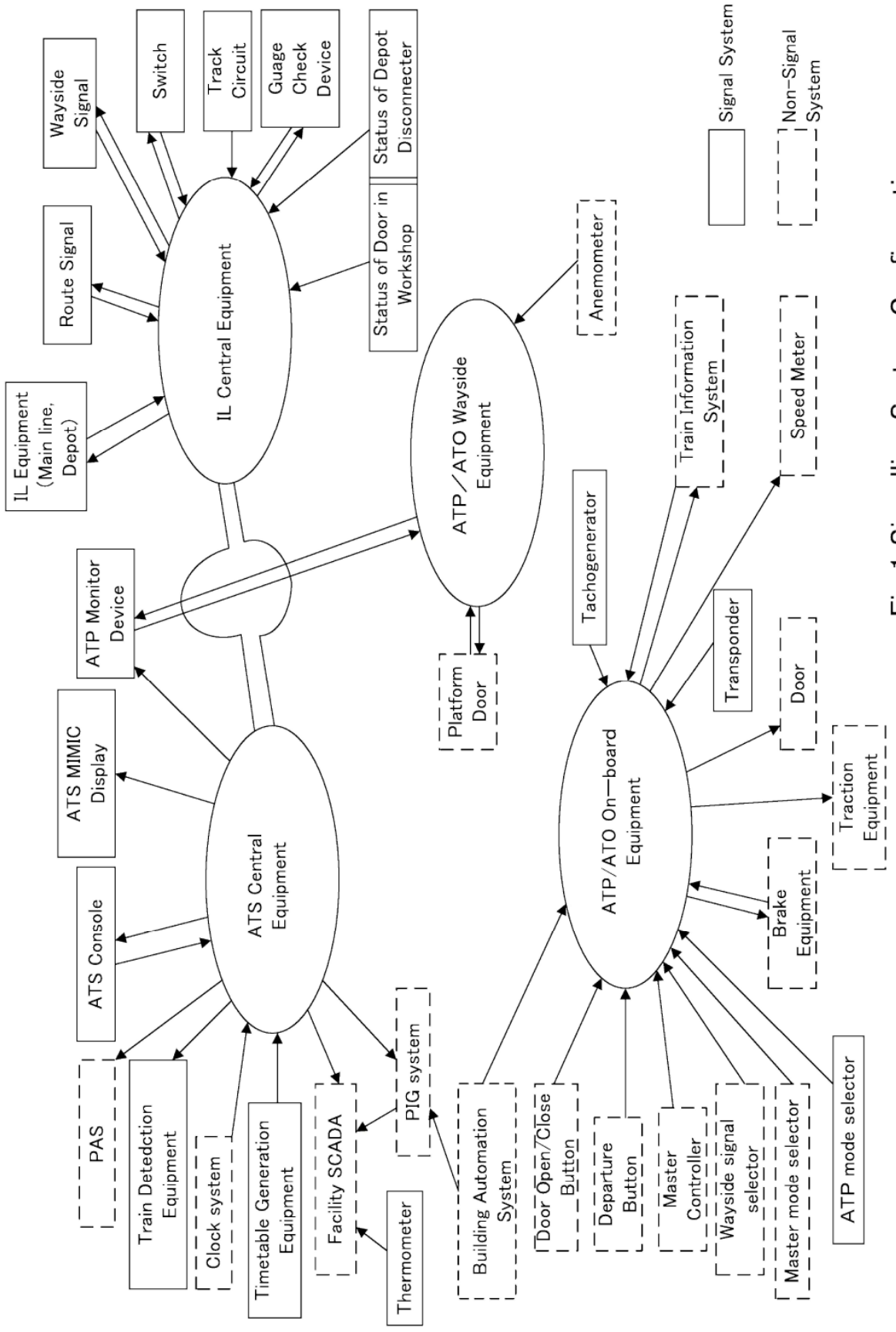


Fig 1 Signalling System Configuration

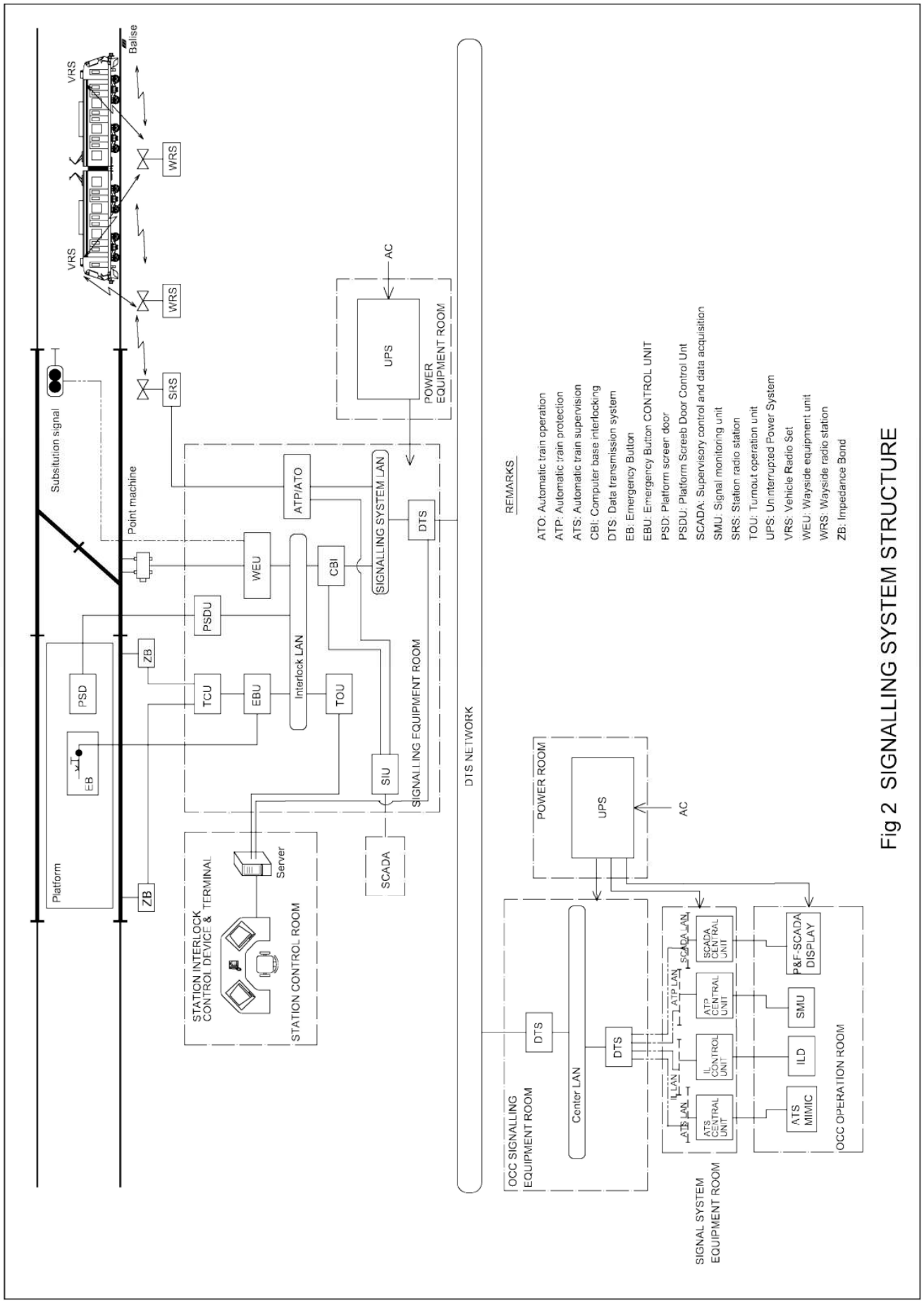


Fig 2 SIGNALLING SYSTEM STRUCTURE

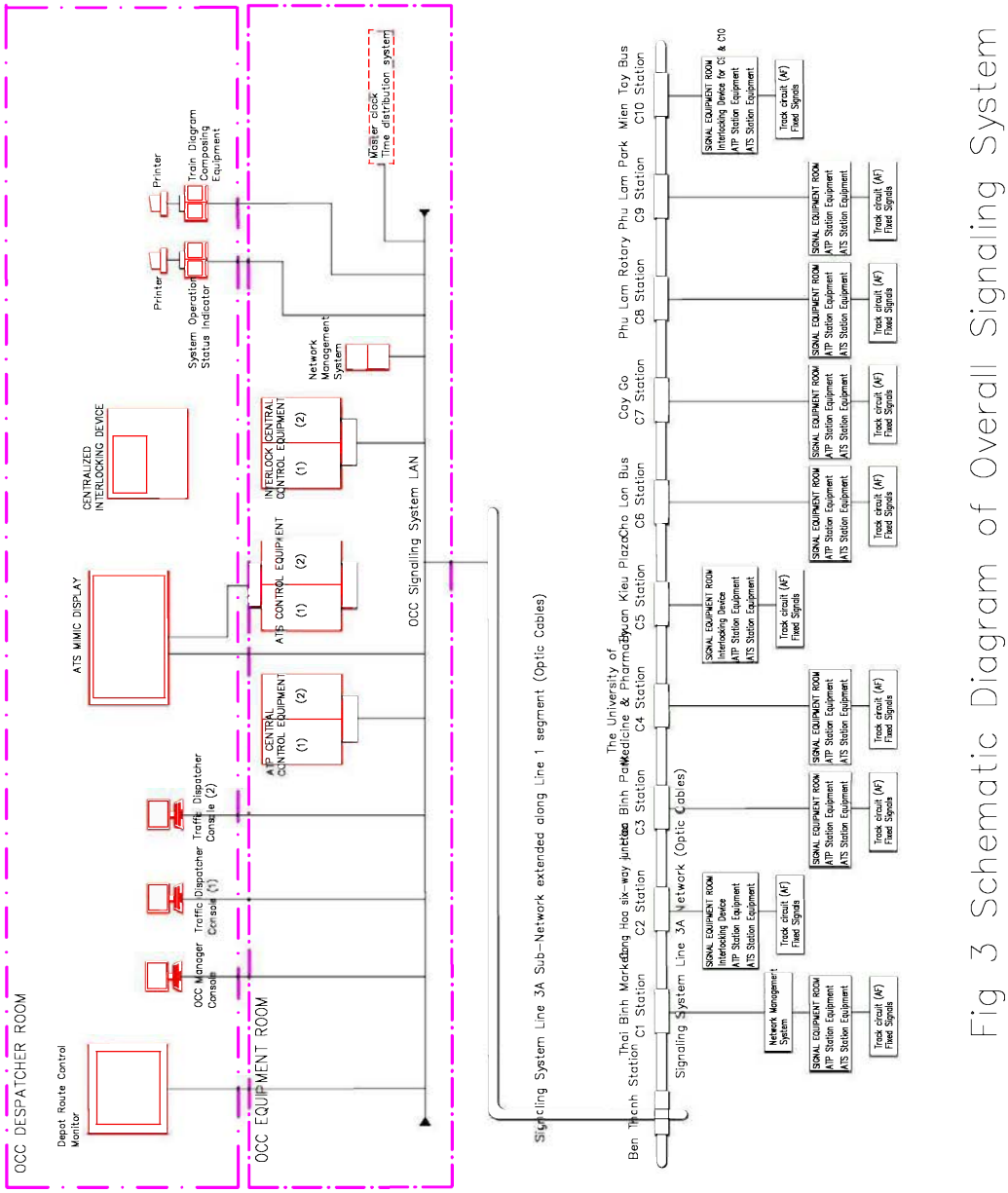


Fig 3 Schematic Diagram of Overall Signaling System

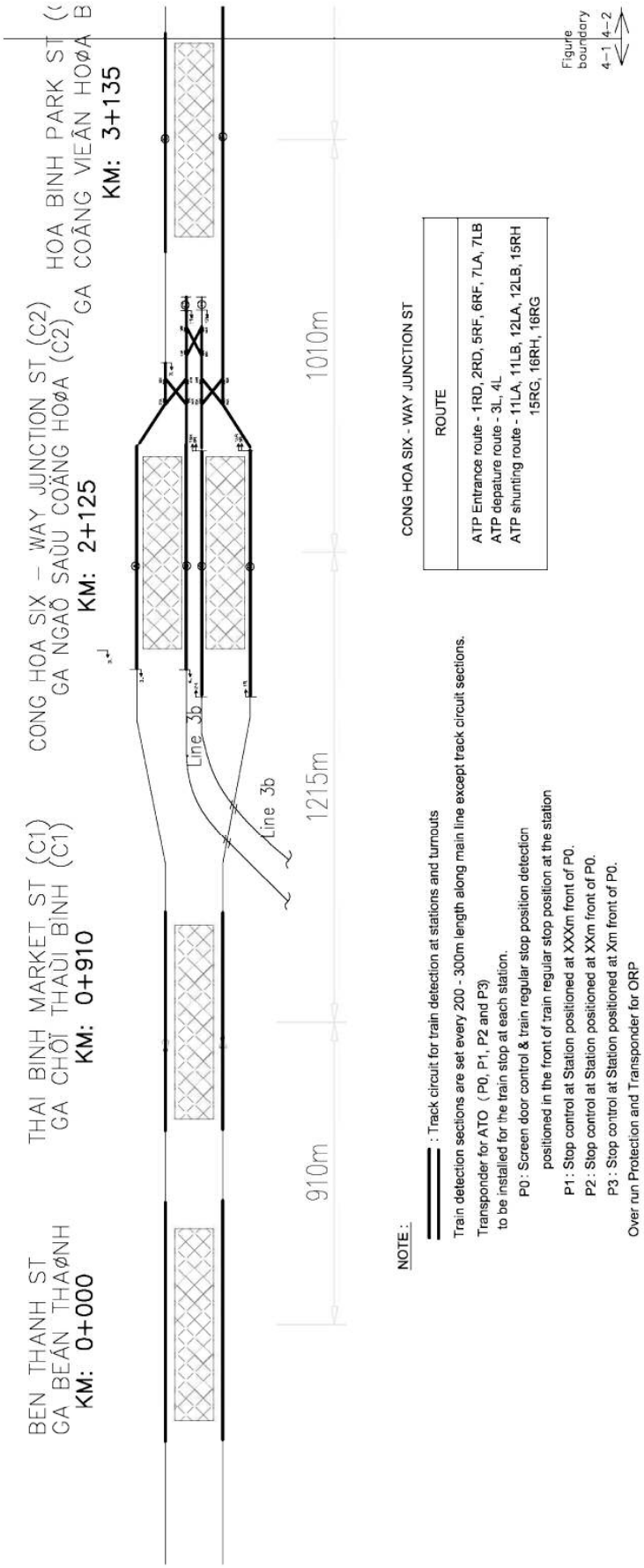


Fig. 4–1 Wayside Signal Equipment Arrangement

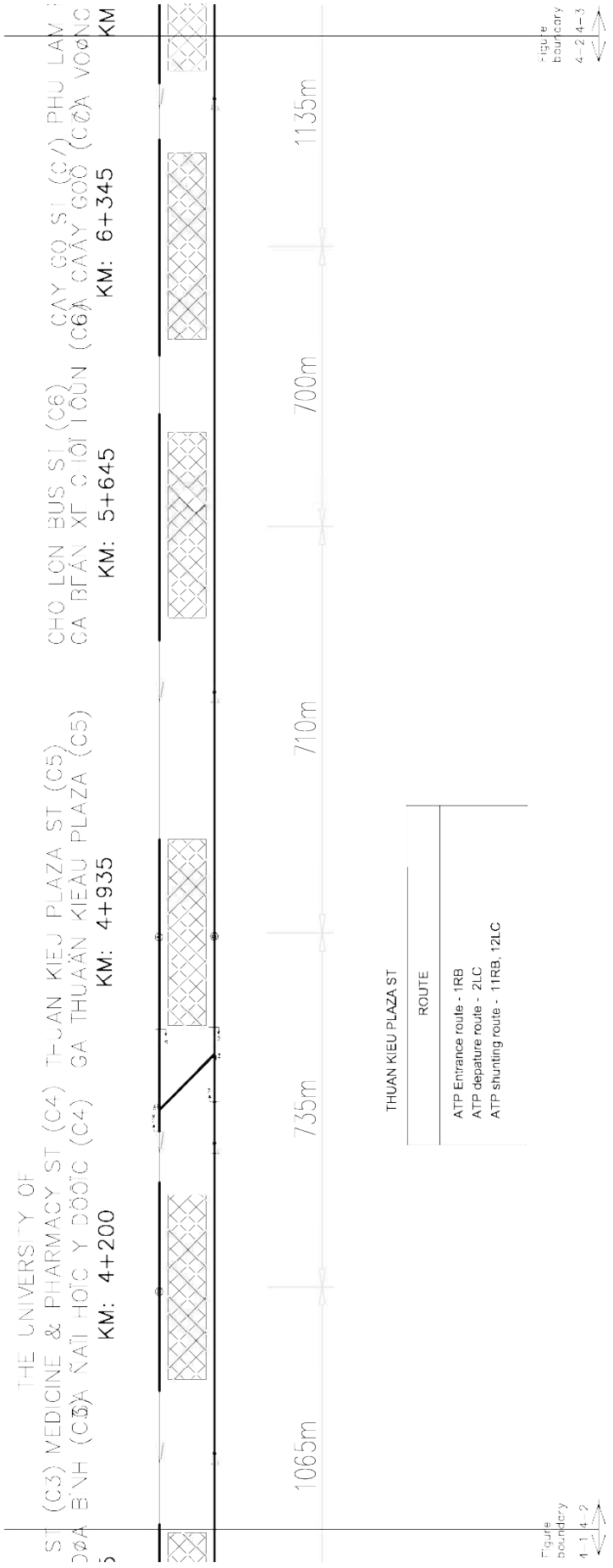


Fig. 4-2 Wayside Signal Equipment Arrangement

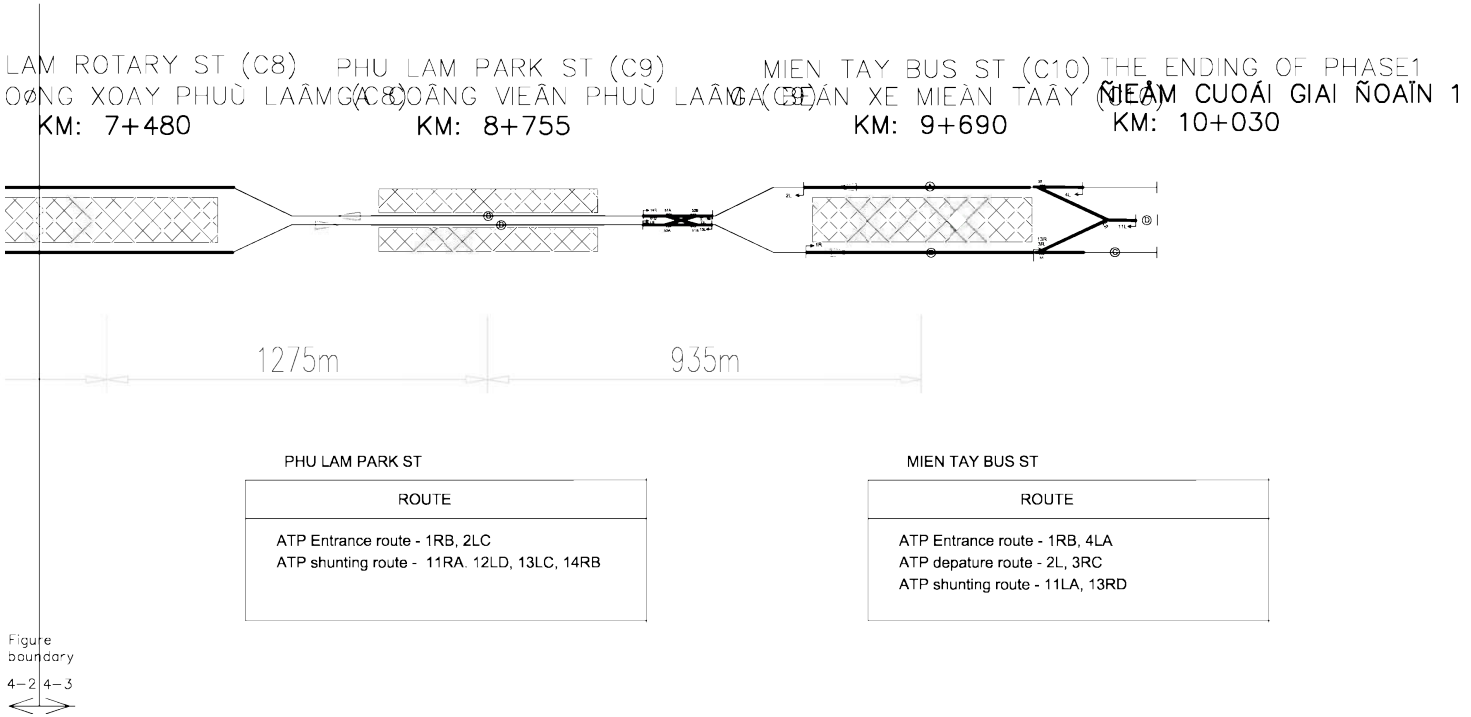


Fig. 4-3 Wayside Signal Equipment Arrangement

Appendix 4.5: Telecommunication System Drawings

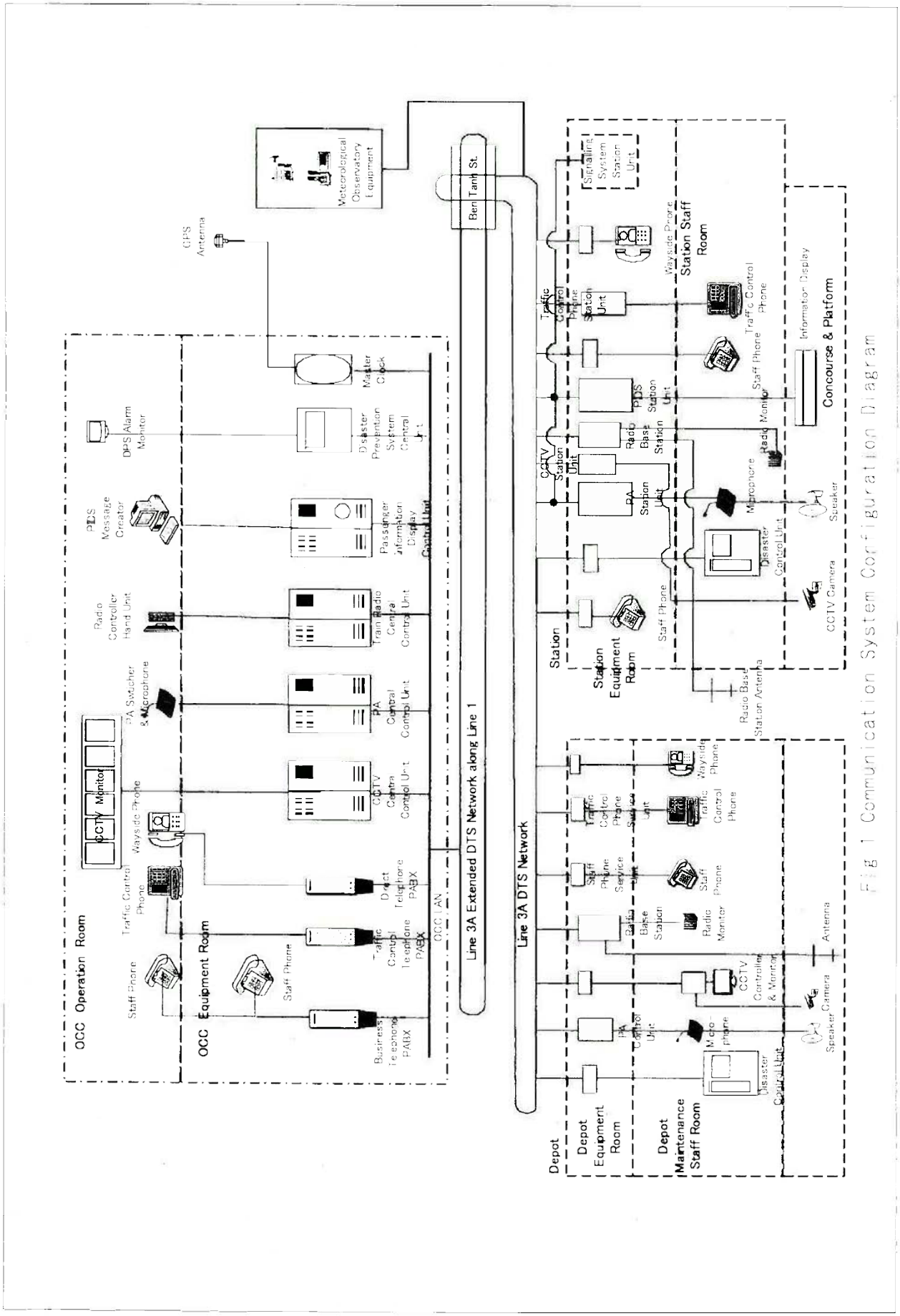


Fig 1 Communication System Configuration Diagram

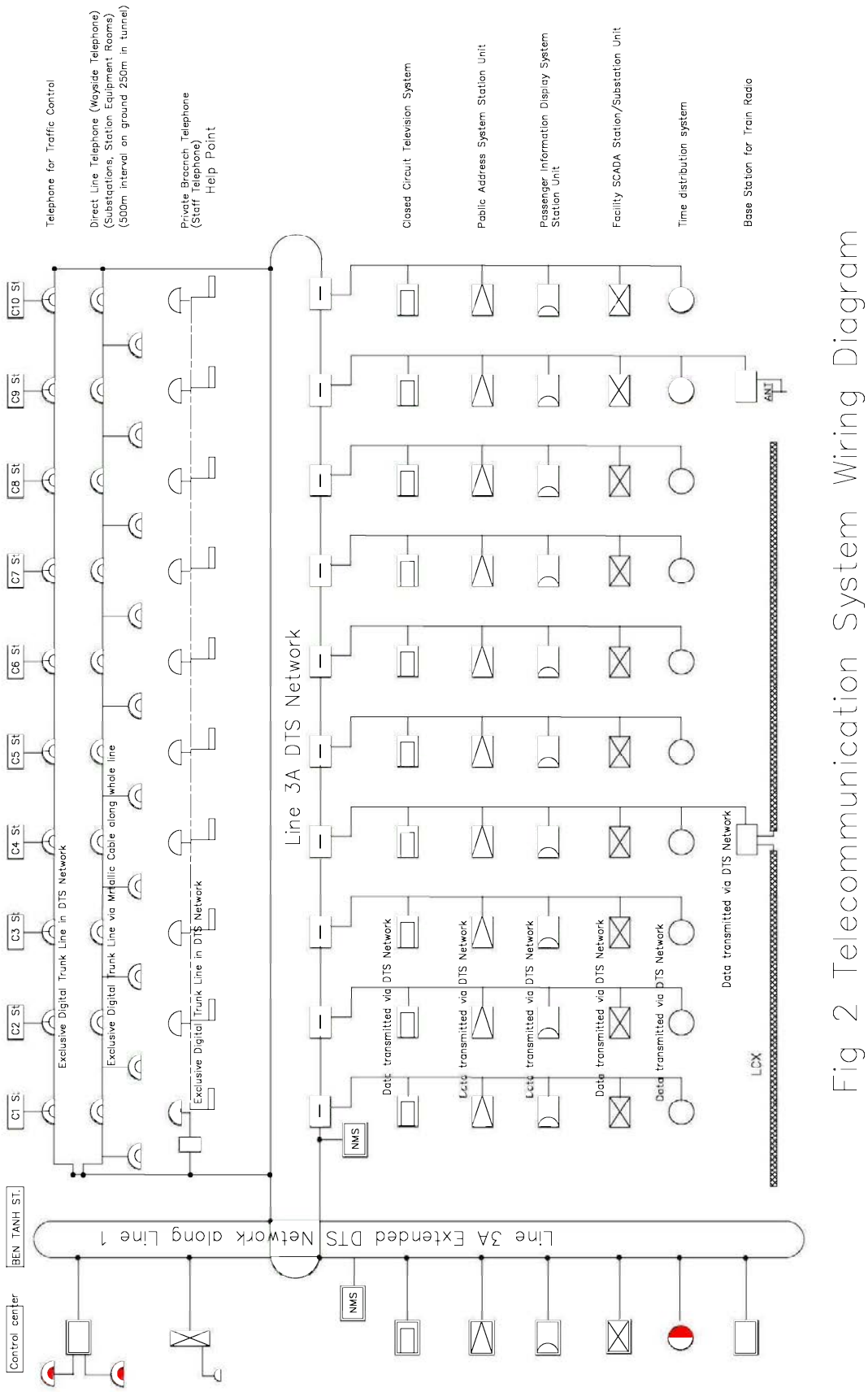
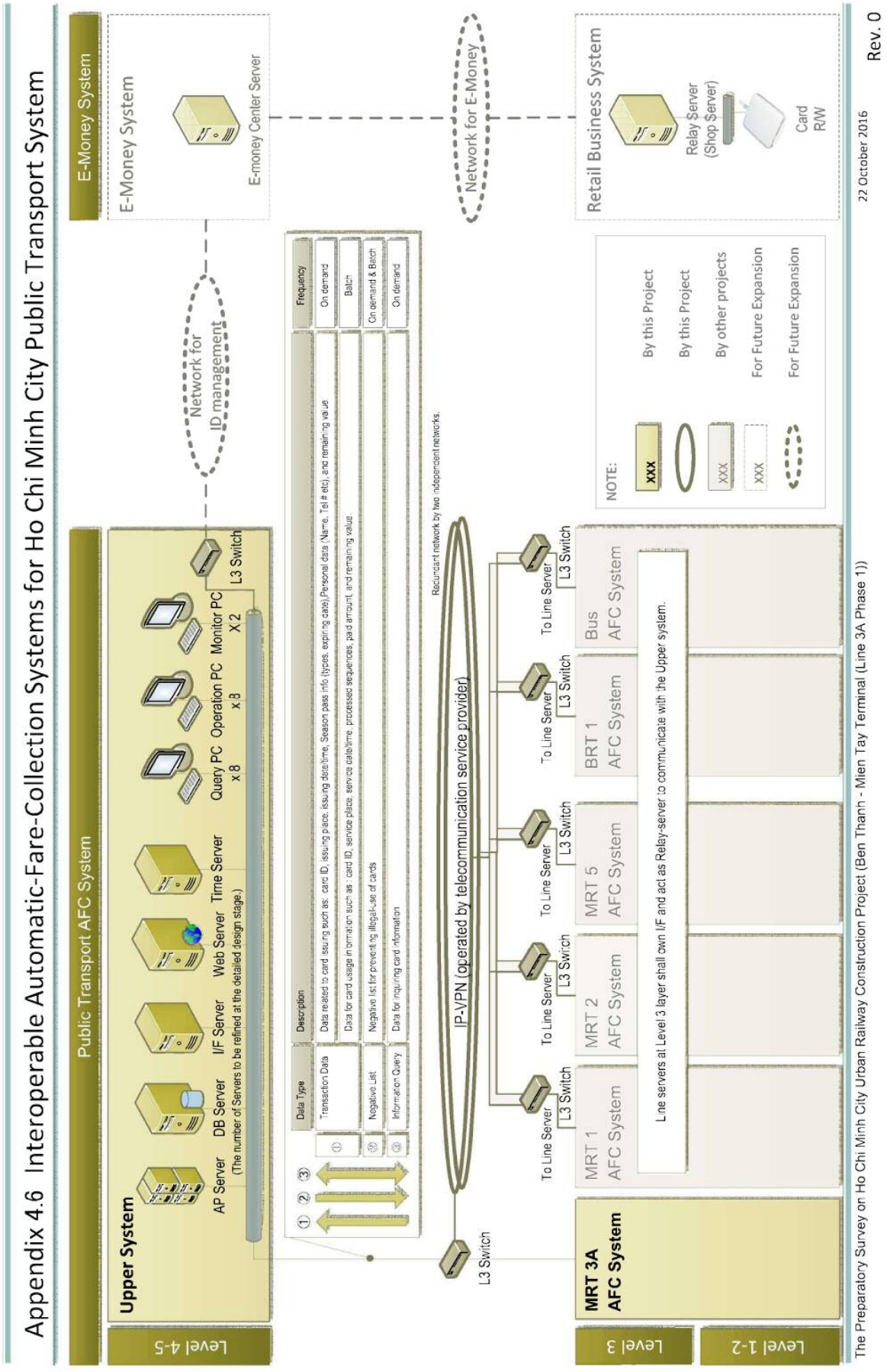


Fig 2 Telecommunication System Wiring Diagram

Appendix 4.6: Interoperable Automatic Fare Collection Systems for Ho Chi Minh City Public Transportation System


Appendix 4.6 Interoperable Automatic-Fare-Collection Systems for Ho Chi Minh City Public Transport System
E-Money System
E-Money System
E-money Center Server
Network for ID management
Network for E-Money
Retail Business System
Relay Server (Shop Server)
Card R/W
Public Transport AFC System
Upper System
AP Server
DB Server
(The number of Servers to be refined at the detailed design stage.)
I/F Server
Web Server
Time Server
Query PC x 8
Operation PC x 8
Monitor PC X 2
L3 Switch
Data Type
Description
Frequency
Transaction Data
Data related to card issuing such as: card ID, issuing place, issuing date/time, Season pass info (types, expiring date),Personal data (Name, Tel # etc), and remaining value
On demand
Data for card usage information such as : card ID, service place, service date/time, processed sequences, paid amount, and remaining value
Batch
Negative List
Negative list for preventing illegal-use of cards
On demand & Batch
Information Query
Data for inquiring card information
On demand
IP-VPN (operated by telecommunication service provider)
Redundant network by two independent networks.
L3 Switch
To Line Server
L3 Switch
MRT 1 AFC System
MRT 2 AFC System
MRT 5 AFC System
BRT 1 AFC System
Bus AFC System
Line servers at Level 3 layer shall own I/F and act as Relay-server to communicate with the Upper system.
MRT 3A AFC System
NOTE:
XXX
By this Project
By this Project
By other projects
For Future Expansion
For Future Expansion
Level 4-5
Level 3
Level 1-2
22 October 2016
Rev. 0
The Preparatory Survey on Ho Chi Minh City Urban Railway Construction Project (Ben Thanh - Mien Tay Terminal (Line 3A Phase 1))