5.2 Civil Structure and Track

5.2.1 Structures between Stations

(1) Type of Structures

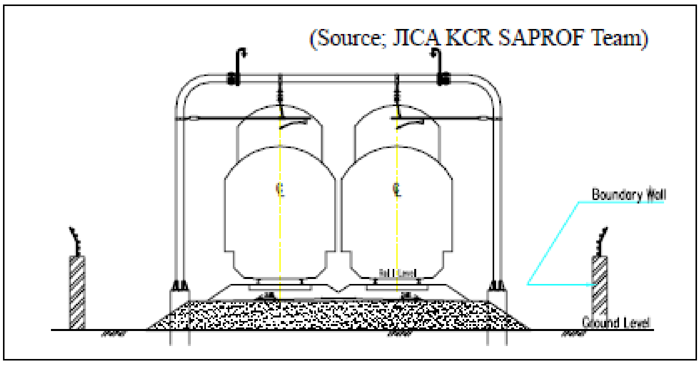
Typical structure between stations is classified into three categories in the previous study SAPROF (I) as follows.

1) **On-ground structure**
2) **Elevated structure**
3) **Culvert structure**

To eliminate all the existing level crossing along the KCR route was one of basic concept in SAPROF (I). Decision on dimensions of above-mentioned civil structures is a crucial matter in this study, especially width of structure because of requirement for avoiding additional land acquisition and resettlement.

1) On-ground structure

On-ground structure was adopted in the section where there was no level crossing with road, and the standard cross section was as shown in Figure 5.2.1.



Source: JICA Study Team

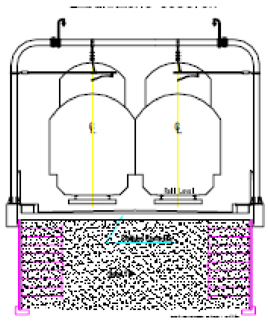
Figure 5.2.1 Standard Cross Section of On-ground Structure

JICA Study Team proposes that on-ground structure is also adopted in the same way because of economical construction cost and then further reviewed taking account of the finalized ROW of KCR and design criteria and specification for KCR.

2) Elevated Structure

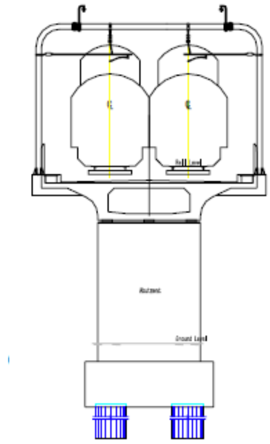
Elevated structure is divided into two types in the previous study, embankment and bridge as shown in Figure 5.2.2 and Figure 5.2.3.

In the SAPROF (I) embankment as elevated structure was recommended because of effect for preventing encroachment on railway land. Consequently bridge type was planned only at the place of over-crossing roads and rivers.



Source: JICA Study Team

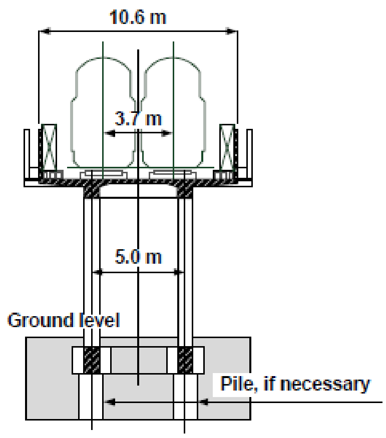
Figure 5.2.2 Cross Section of Embankment



Source: JICA Study Team

Figure 5.2.3 Cross Section of Bridge

In addition to above two structure types of elevated structure, beam-slab rigid-frame viaduct shown in the figure below is recommended in this review because space under viaduct is recognized as the importance for effective use, such as commercial development areas.

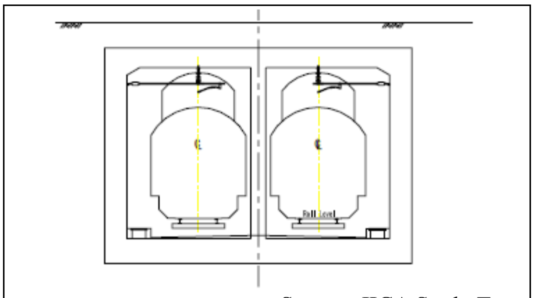


Source: JICA Study Team

Figure 5.2.4 Beam-slab Rigid-frame Viaduct

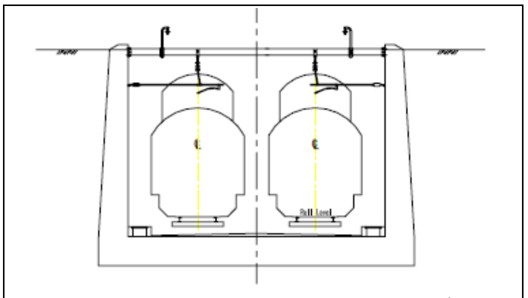
3) Culvert Structure

Culvert structure was adopted in trench section and classified into two types in previous study, box culvert and U-shape culvert as shown in Figure 5.2.5 and Figure 5.2.6.



Source: JICA Study Team

Figure 5.2.5 Cross Section of Box Culvert



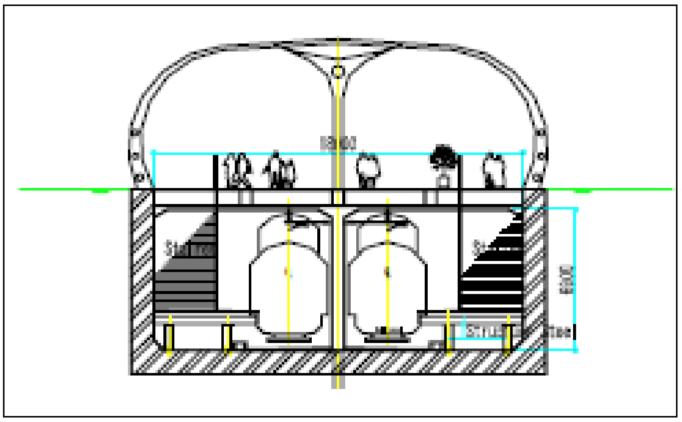
Source: JICA Study Team

Figure 5.2.6 Cross Section of U-shape Culvert

SAPROF (I) recommended adopting box culvert structure in trench section because of countermeasure for rainwater and protection against throwing of garbage.

In addition selection of station structure in trench section is also important issue. SAPROF (I) proposed open culvert structure station as shown in Figure 5.2.7.

JICA study team will select most adequate structure type between box culvert and U-shape retaining wall including station structure taking into account not only site condition, necessary countermeasure for rainwater and throwing garbage, but also effect for using space on the top slab of box culvert.



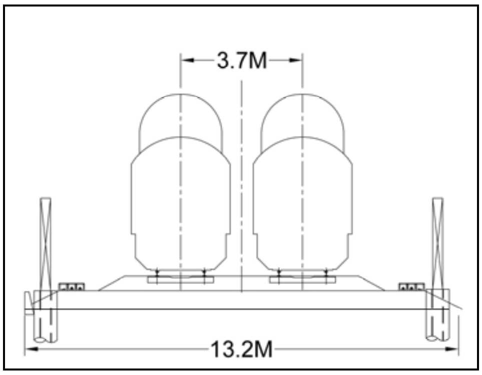
Source: JICA Study Team

Figure 5.2.7 Cross Section of Station in Trench Section

(2) On-ground Structure

On-ground structure consists of double railway track and haul road at both side along the KCR route as shown in Figure 5.2.8.

Width of Right of Way for on-ground structure is 13.2 m to be finalized based on review of Technical Standard (See Section 4.1).



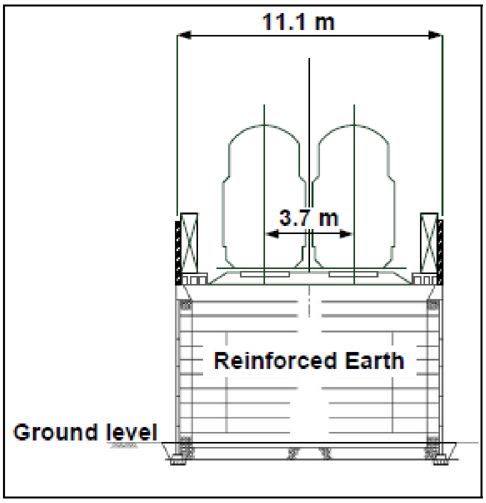
Source: JICA Study Team

Figure 5.2.8 On-ground Structure

(3) Reinforced Embankment

SAPROF (I) recommended adopting embankment structures outside stations as much as site conditions permit because of effect for preventing encroachment on railway land.

This embankment is steel bar reinforced earth-fill retained by concrete panel. The cost of this construction method is lower about 40% than viaduct. It can also reduce the time for construction. Furthermore, it can also be easy constructing method for local construction companies, because fortunately this type embankment has been constructed in many flyover projects in Karachi.



Source: JICA Study Team

Figure 5.2.9 Cross Section of Reinforced Embankment

Width of embankment structure is 11.1 m to be finalized based on review of Technical Standard as shown in Figure 5.2.9. (See Section 4.1)

Space under viaduct is recognized as the important space for effective use, such as commercial development areas. However, the embankment structures will unable to use space under the railway. As a result of discussions between KUTC and JICA Study Team, it was agreed that the embankment structure was not adopted for the KCR so as to maintain the opportunity for developing the available land.

(4) Elevated Structure

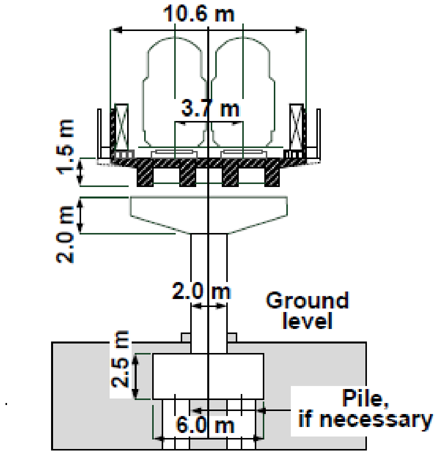
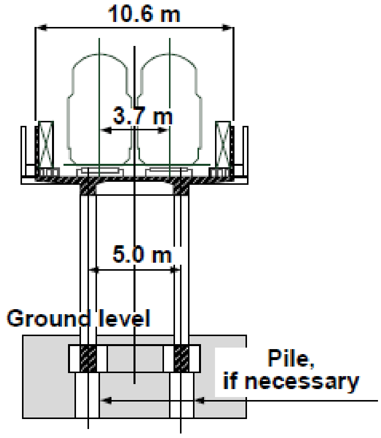
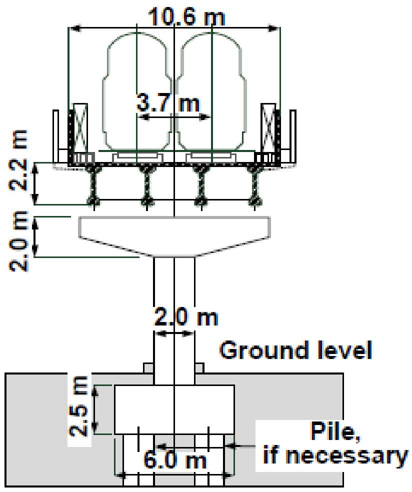
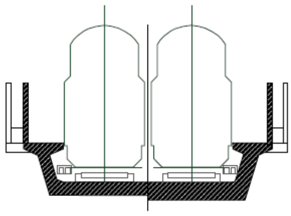
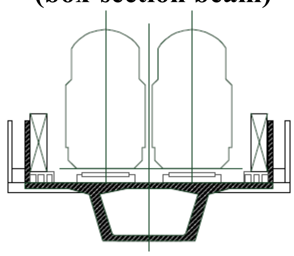
Elevated structure between stations is classified into the following three types:

1) Reinforced concrete girder viaduct
2) Prestressed concrete girder viaduct
3) Beam-slab rigid-frame viaduct

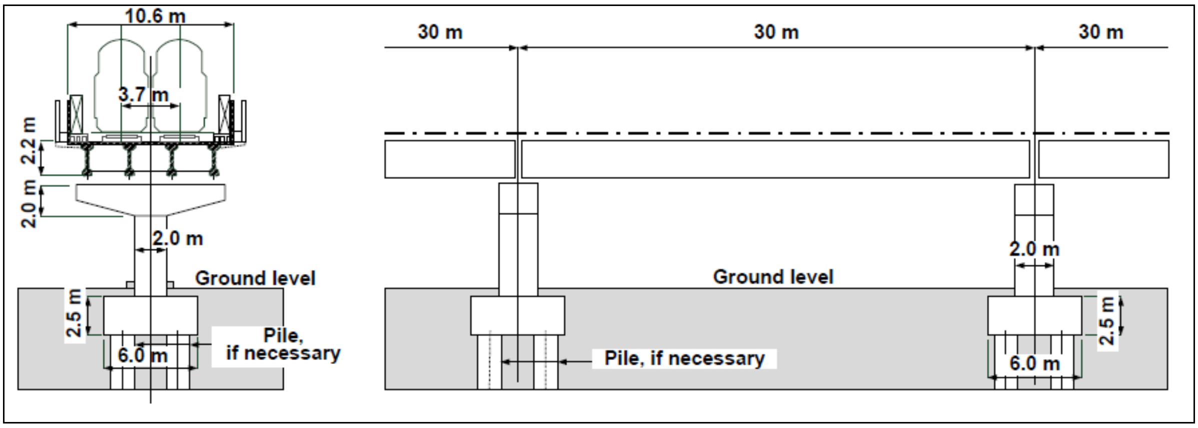
Characteristics of above-mentioned elevated structures are shown in Table 5.2.1. The typical design of the bridge type structure and the rigid-flame type structure are shown in Figure 5.2.10, Figure 5.2.11 and Figure 5.2.12.

The prestressed concrete bridge will be used for the sections along the existing PR line due to limited ground space available for the KCR structures, where beam shape and type will be determined in the next basic design stage. In other elevated sections, the prestressed concrete girder viaduct or beam-slab rigid-frame viaduct will be adopted taking into account the required span, available construction area and suitableness for commercial use of spaces under the viaduct.

Table 5.2.1 Characteristics of Elevated Structures

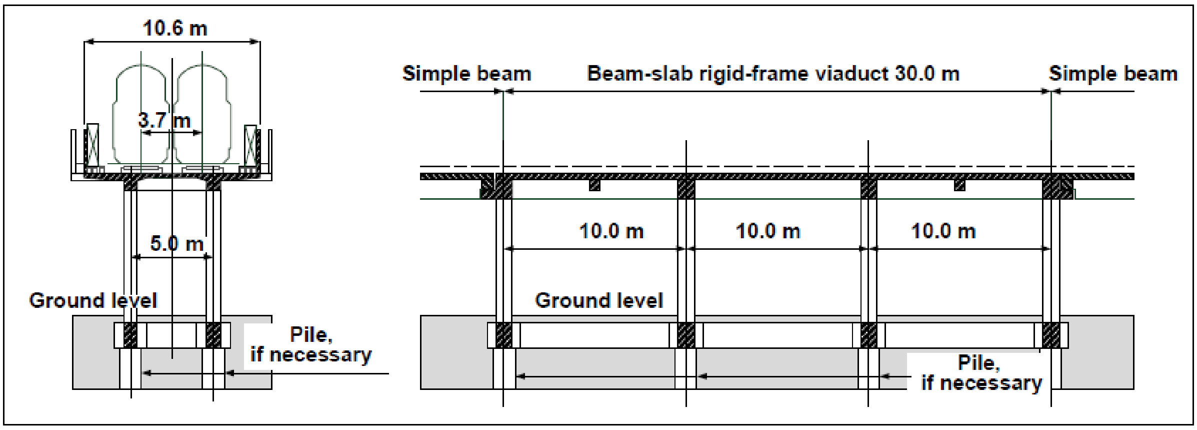
Reinforced concrete girder viaduct  Applicable span length; less than 20 m Construction is easy. Rich experience in flyover in Pakistan	**Beam-slab rigid-frame viaduct**  Applicable total length; less than 30 m Construction is easy. Rare experience in Pakistan
Prestressed concrete girder viaduct (I-section beam)  Applicable span length; less than 30 m Construction is easy Rich experience in flyover in Pakistan	**Prestressed concrete girder viaduct (U-shape beam)**  Applicable span length; less than 50 m Rare experience in Pakistan **Prestressed concrete girder viaduct (box-section beam)**  Applicable span length; less than 50 m A few experience in Pakistan

Source: JICA Study Team



Source: JICA Study Team

Figure 5.2.10 Girder Type Structure



Source: JICA Study Team

Figure 5.2.11 Rigid-Flame Type Structure

Source: JICA Study Team

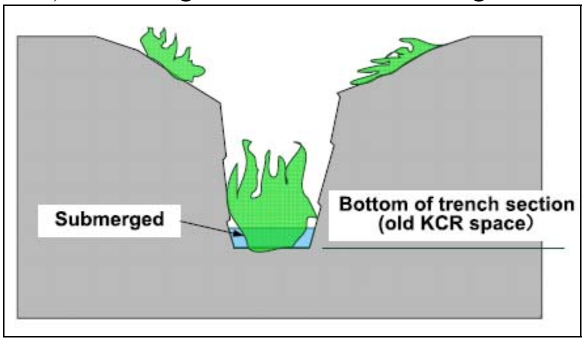
Figure 5.2.12 Actual Construction Photography

(5) Culvert Structure in Trench Section

1) Present condition through site inspection

Characteristics of present condition in trench section are as follows.

a) Width of trench is narrow and depth is deep as shown in Figure 5.2.13. Bottom width is about 6 m and depth is about 10 m near Alladin Park Station.
b) Though steep slope seems firm ground like soft rock (not soil), falling rocks are also found here and there.
c) Submerged area is covered with grown weeds as shown in Figure 5.2.14.



Source: JICA Study Team

Figure 5.2.13 Schematic Cross Section

Source: JICA Study Team

Figure 5.2.14 Photograph of Site

2) Countermeasure for submergence

The water in the submerged area is assumed to originate in the following sources:

・Inflow of miscellaneous household waste water
・Damage of sewerage or water supply pipe
・Influence of underground water

Countermeasure against the above-mentioned factors is divided broadly into two stages, before construction commencement and after railway operation.

a) Countermeasure before construction commencement
Necessary countermeasure before construction commencement will be to pump out submerged water from submerged site to existing main sewage or to existing river.
Discharging point will be selected between river and existing sewage taking into account Environmental Standards for Water Quality in Karachi.
Necessary facilities for pumping out submergence water are described in Section 2.2.
b) Countermeasure during railway operation period
In the case that submergence is caused by inflow of miscellaneous household waste water, construction of new sewerage from submergence area to existing main sewage is required.
In the case that submergence is caused by damage of utilities, making repairs on sewage or water pipes is necessary.
New sewerage and repaired utilities should be laid underground at outer side of railway land, because a governing body for these utilities maintenance is different from Railway Company (KUTC).
When underground water is one of submergence factors, the following two countermeasures should be considered.
・ To drain out groundwater through side drainages
・ To resist hydrostatic uplift by dead weight of base slab

3) Selection of civil structure in trench section

Although SAPROF (I) recommended adopting box culvert structure in trench section because of countermeasure for rainwater and protection against throwing of garbage, JICA Study Team additionally takes account of following characteristics.

a) Though excavation will be necessary for construction of railway structure in trench section, temporary retaining wall will be unnecessary because of high stability for excavation in soft rock. Consequently construction cost will be economical in comparison with cut & cover method.
b) Other requirement is to select economical structure type for maintenance cost.
c) In addition countermeasure for rainwater in rainy season is another important issue.
d) Agreements between KUTC and local community resident in the past, such as depth of railway track and countermeasure for noise and vibration, if any.

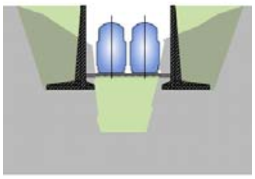
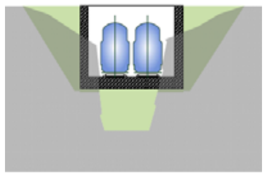
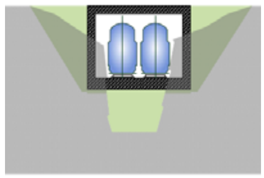
The following three kinds of structure are conceivable for culvert type in trench section.

a) Retaining wall
b) U- shape culvert
c) Box culvert

Optimum railway structure should be selected taking into account not only the above-mentioned requirements, but also depth of railway track based on vertical railway alignment plan.

Comparison of structure type is shown in Table 5.2.2

Table 5.2.2 Comparison of Structure Type in Trench Section

Item	Retaining wall	U-shape culvert	Box culvert
Outline Cross section			
Countermeasure for underground water	Facility is necessary to keep continually pumping out groundwater		
	Difficulty to resist hydrostatic uplift	Another easy measurement is to resist hydrostatic uplift by dead weight of structure	
Countermeasure for rainwater	Pumping out facility is necessary for rainwater		Not applicable
Protection against throwing garbage	In addition to handrail on-ground, setting up protection net on upper space , if necessary		Not applicable
Environmental issue	Noise and vibration		Not applicable
Other requirement issue	Not applicable		Smoke-extraction & ventilation facility, if necessary
Construction cost	Lowest	Fair	Highest
Maintenance cost	Pumping out cost is main issue		Firefighting facility cost is main issue, if necessary
Evaluation	Only in case of unnecessary countermeasure for groundwater	Most suitable type	In case of effective using plan on top slab

Source: JICA Study Team

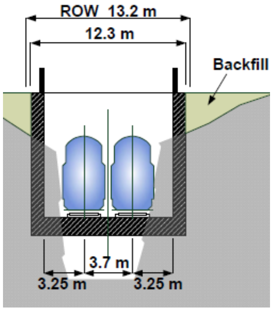
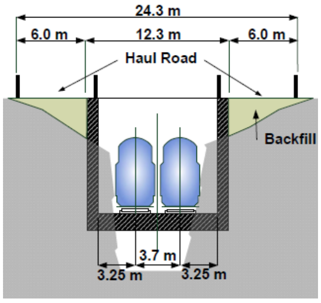
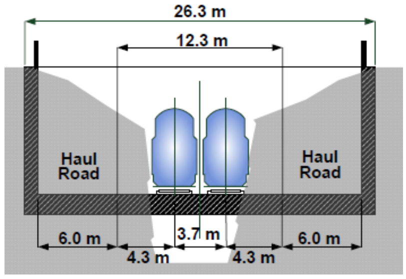
JICA Study Team recommends U-shape culvert is most suitable type because of construction cost and maintenance cost.

In addition to aforesaid structural issue, setting up of haul road for maintenance of railway is another important issue. Haul road is also in use when rescue passengers from emergency accident is necessary. There are two type of space for haul road along the railway route as follows.

a) At ground
b) In culvert

Comparison of space for haul road in trench section is shown in Table 5.2.3.

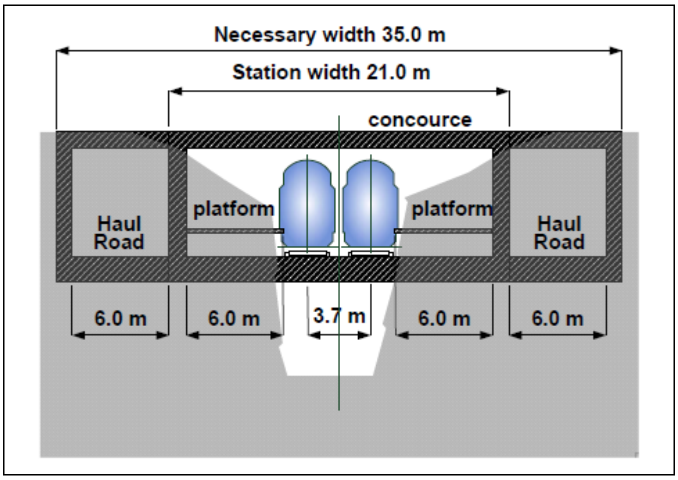
Table 5.2.3 Comparison of Space for Haul Road

Item	Without haul road	At ground	In culvert
Outline			
ROW width	13.2 m	24.3 m	26.3 m
Construction cost ratio	1.0	1.0 Except land issue	About 2.0
Convenience	Necessity of another countermeasure	Less convenient due to difference of elevation	Most convenient

Source: JICA Study Team

JICA Study Team recommends that basically haul road should be planned at ground both side of culvert because of construction cost.

Furthermore construction cost of station including haul road is clearly highest as shown in Figure 5.2.15.



Source: JICA Study Team

Figure 5.2.15 Cross section of Station with haul road

In addition, in the case of lack in land for haul road, maintenance bases should be arranged for supply with materials and side track of machine.

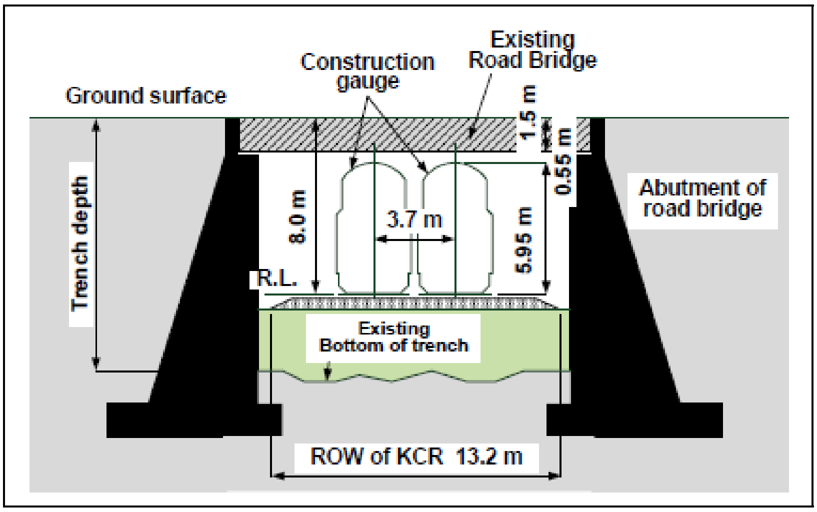
4) Introducing space for KCR Line in trench section

KCR Line should be planned under existing crossing road-bridge in trench section based on the concept that KCR Line is planned to avoid level crossing with road in entire KCR route.

Rail level of KCR should be at least 8.0 m depth under the ground level at crossing road as shown in Figure 5.2.16.

This minimum depth of KCR is decided due to following bases.

- Height of road bridge; 1.5m
- Clearance; 0.55m (including overhead catenary space for AC2x25kV)
- Construction gauge; 5.95m
- Minimum depth 8.0m



Source: JICA Study Team

Figure 5.2.16 Minimum Depth of KCR

5) Standard section of culvert between stations

Required inner space of culvert structure is designed in accordance with the same concept as viaduct standard section described in Section 4.1.

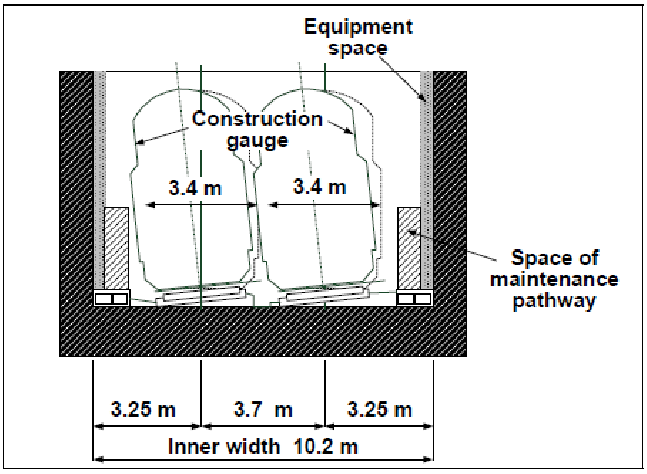
Main determining factors of inner space required in culvert structure are shown in Table 5.2.4.

Table 5.2.4 Required Inner Width of Culvert Section

Item of breakdown	Required inner width of culvert
Distance between track centers	3.7 m
Basic width of construction gauge	3.4 m
Over-throw in curve	0.122 x 2 = 0.244 m
Lean of car in curve	0.352 x 2 = 0.704 m
Space of maintenance pathway	0.7 x 2 = 1.4 m
Space for fixing equipment on both wall	0.35 x 2 = 0.7 m
Total	10.148 m
Applied inner width of culvert	10.2 m

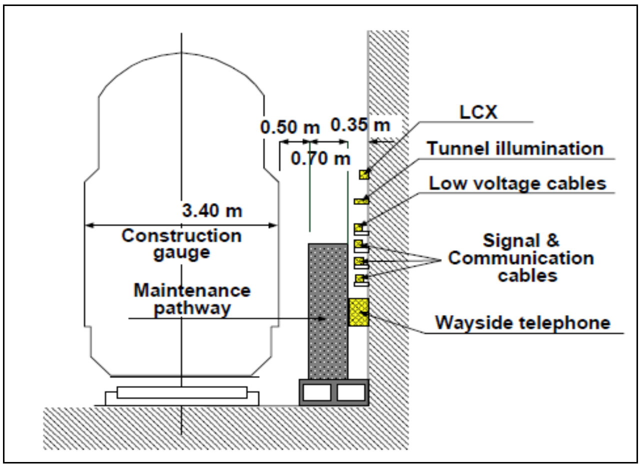
Source: JICA Study Team

Standard culvert section is shown in Figure 5.2.17 and example of equipment on wall is shown in Figure 5.2.18.



Source: JICA Study Team

Figure 5.2.17 Standard Section of Culvert



Source: JICA Study Team

Figure 5.2.18 Example of Equipment on Both Wall

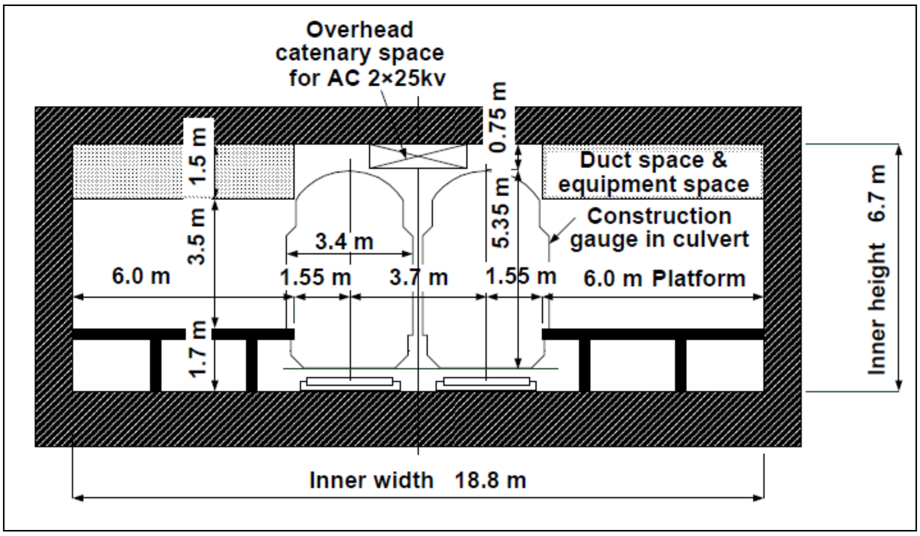
6) Standard station of box-culvert structure

Required station facilities constructed by culvert type are mainly as follows.

a) Platform story (inner space of box-culvert)
- Track space
- Platform (width of platform is 6 m in the case of side type described in Section 4.1)
- Escalator, elevator and stairs connecting platform and concourse of station
- Duct space and equipment space on ceiling
- Over head catenary space for AC 2x25kV
- Drainage pump facility room

b) Station concourse story (space on top slab of box-culvert)
- Office room and ticketing system room
- Ticketing facility
- Entrance and exit (access facility to road from station concourse)
- Electricity-related facility room
- Signal-telecommunication facility room
- Ventilation and smoke-exhaustion facility room, if necessary.

Standard cross section of culvert station is shown in Figure 5.2.19 taking into account above-mentioned necessary facility.



Source: JICA Study Team

Figure 5.2.19 Standard Station of Culvert Structure

7) Other issue concerning culvert structure

Other important issues concerning culvert structure are pointed out as follows.

a) Drainage pumping facility
b) Other countermeasure for fire-fighting

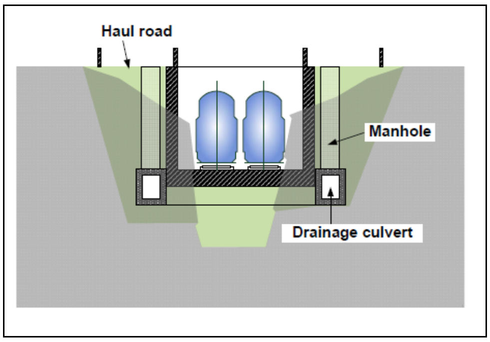
a) Drainage pumping facility

Drainage pumping facility is necessary in railway station because of not only rainwater drainage from outside of stations along open culvert line but also wastewater disposal from toilet, station office and cleaning of floors.

In addition countermeasure for groundwater might be necessary between Alladin Park Station and Johar Station. The groundwater is considered to flow from Nipa to Drigh Road.

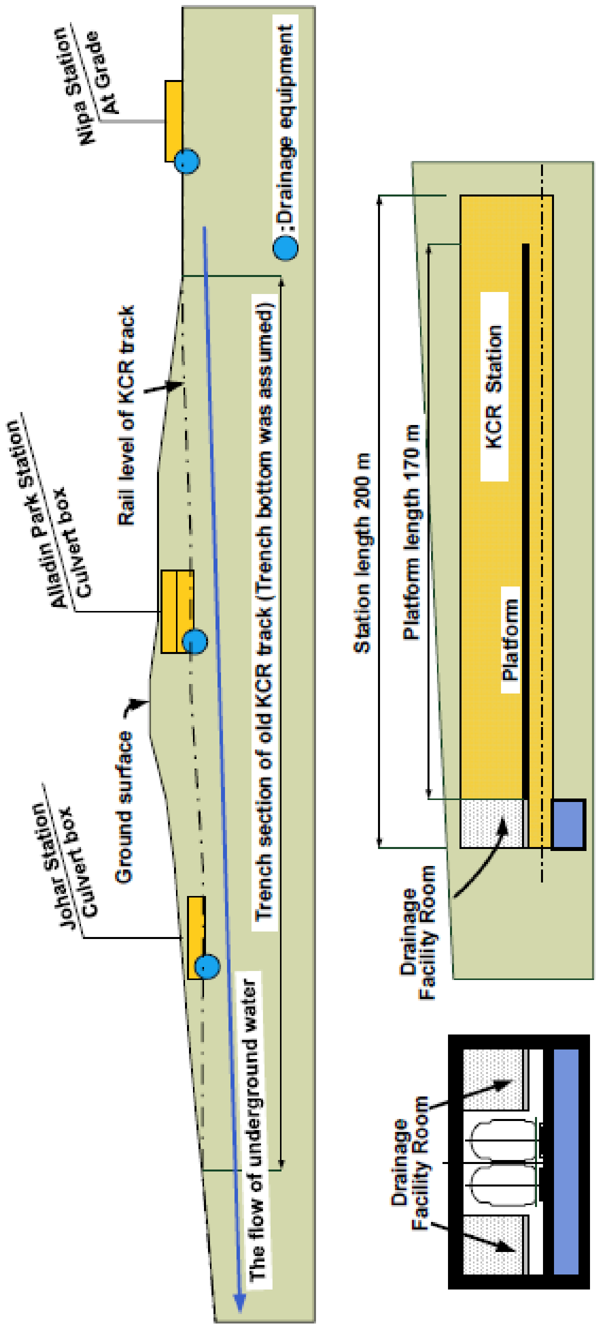
Drainage facility room is planned to be located at the edge of platform as shown in Figure 5.2.20.

JICA Study Team proposes to set up drainage culvert at bottom of culvert station for countermeasure against groundwater as shown in Figure 5.2.21.



Source: JICA Study Team

Figure 5.2.20 Drainage Facility for Underground Water

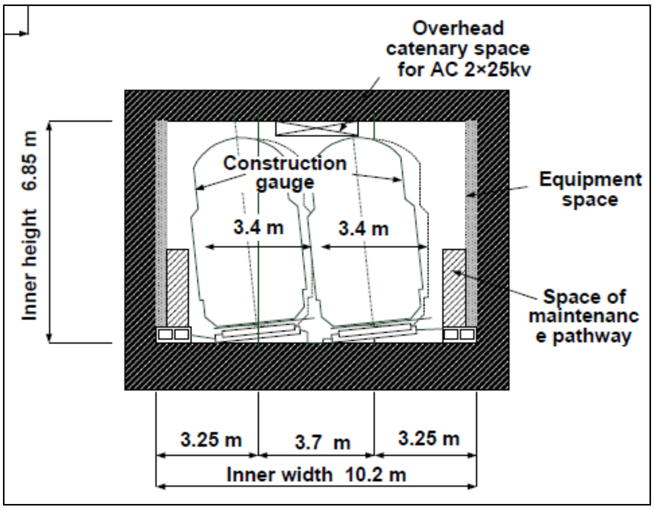


Source: JICA Study Team

Figure 5.2.21 Drainage Facility Plan

b) Other countermeasure for fire-fighting

JICA Study Team confirmed that countermeasure for firefighting is not necessary in this culvert station structure because both side of box-culvert station has the opening. On the other hand in case that box-culvert type is selected due to effective using of space for upper space of railway, standard section is as shown in Figure 5.2.22. Consequently fire-fighting facility might be required because length of box-culvert structure including stations become longer.

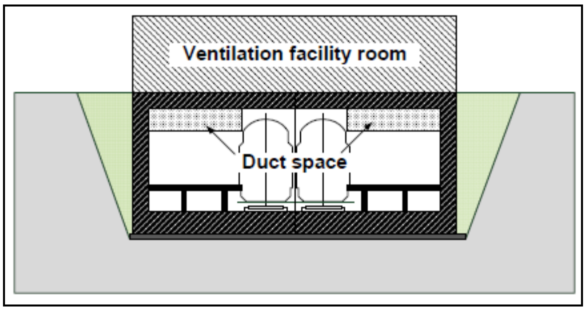


Source: JICA Study Team

Figure 5.2.22 Standard Section of Box-culvert

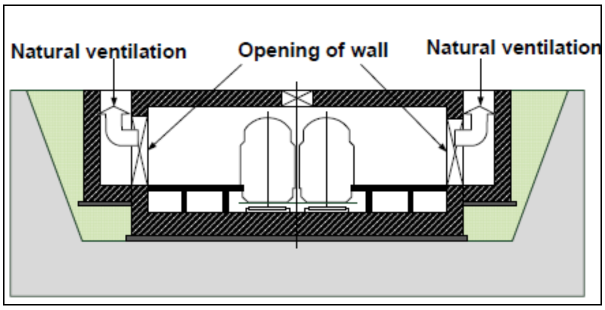
Following two countermeasures for fire-fighting of box-culvert should be considered.

- Setting up fire-fighting facility in each culvert station such as smoke-exhaustion facility and ventilation facility, etc. as shown in Figure 5.2.23. In addition evacuation facility of passengers is also necessary.
- Adopting natural smoke-exhaustion and ventilation due to opening of both culvert walls as shown in Figure 5.2.24.



Source: JICA Study Team

Figure 5.2.23 Setting up Facility



Source: JICA Study Team

Figure 5.2.24 Setting up Opening of Wall

5.2.2 Track Structures

(1) Track Structure

SAPROF (I) recommended two types of track structure for KCR as follows:

A. Ballasted track
B. Solid bed track

Comparison of ballasted track and solid bed track is shown in Table 5.2.5

Table 5.2.5 Characteristics of Track Type

Item	Ballasted track	Solid bed track
Advantage	Reasonable construction cost. Simple Maintenance and no high technical level required. Low noise level.	Lower track irregularities and lower maintenance cost.
Disadvantage	Higher and frequent maintenance volume and sometimes disturbance of train operations.	Higher initial cost. In case of breakage, big repairing and high cost are required. Special design and higher cost required to lower noise level.

Source: JICA Study Team

In modern urban railways very frequent train operations are conducted from early morning till night and track maintenance is always during midnight time. As track maintenance causes large level of noise which bothers people living near track side. Consequently, most of modern urban railways use solid bed track structures.

On the other hand, as solid bed track structure requires very robust base structure, it is technically difficult to set on ground and needs higher cost on earth conditions.

Taking cost-effectiveness into account, JICA Study Team recommends the following application:

A. Solid bed track structures should be applied to viaduct or trench sections.
B. Ballasted track structure should be applied to on-ground sections and depots.

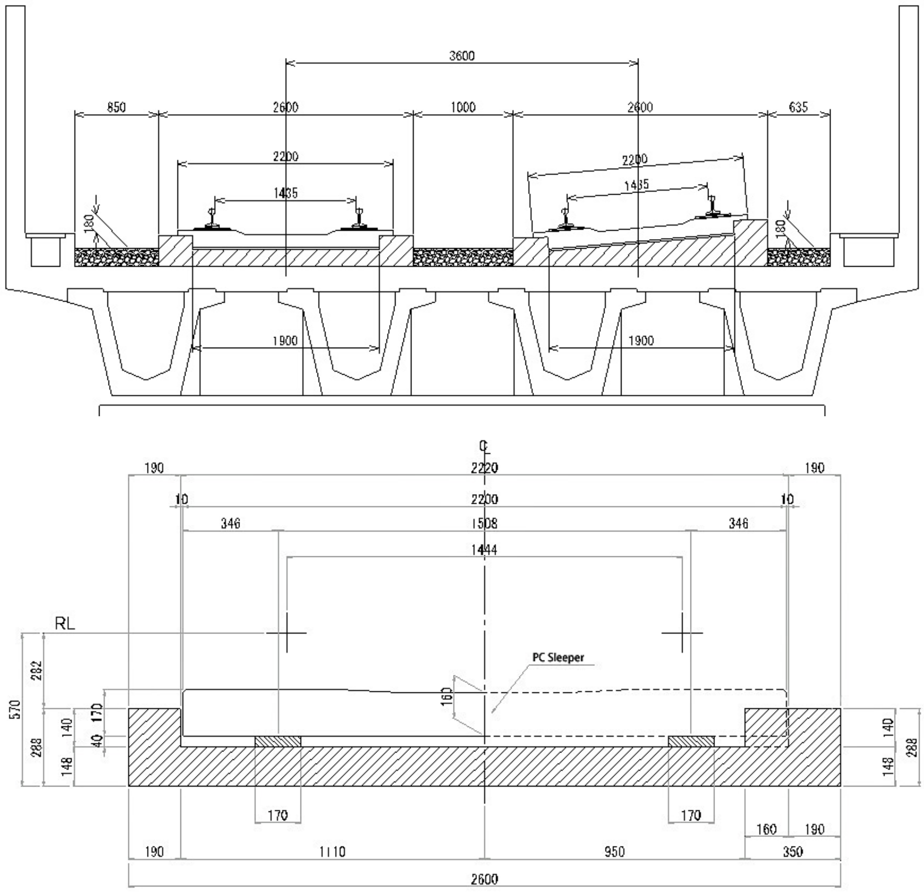
Typical features of these track structures are shown in Figure 5.2.25 and Figure 5.2.26.

Ballasted Track

Solid Bed Track

Source; Internet web-site

Figure 5.2.25 Ballasted Track and Solid Bed Track



Source; Narita New Airport Access Railway Design Material

Figure 5.2.26 Example of Solid Bed Track Structure Design in Japan

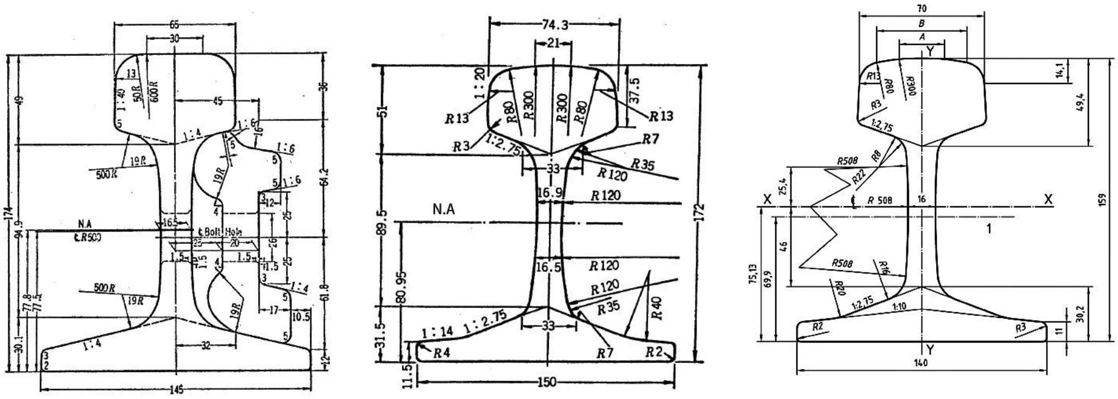
(2) Rail

SAPROF-I Study recommended JIS 60 kg rail as the rail height of UIC 60 kg rail was different from JIS 60 kg rail and at that time manufacturing turnouts to fit UIC rail was deemed difficult for Japanese turnout manufacturers. However, review on the current situations of procurement of UIC rail materials in Japan revealed that Japanese manufacturers have been able to procure UIC rail materials in Japan.

Therefore, JICA Study Team recommends using the following rails taking into account easier procurement of UIC rail in future:

A. UIC 60 kg rail (weight: 60.21 kg/m) for main line
B. UIC 54 kg rail (weight: 54.77 kg/m) for depot

Cross sections for respective rails are shown in Figure 5.2.27.



JIS 60 kg Rail UIC 60 kg Rail UIC 54 kg Rail

Source; New Track, Japan Railway Civil Engineering Association and EN13674-1

Figure 5.2.27 JIS 60kg Rail, UIC 60kg Rail and UIC 54kg Rail

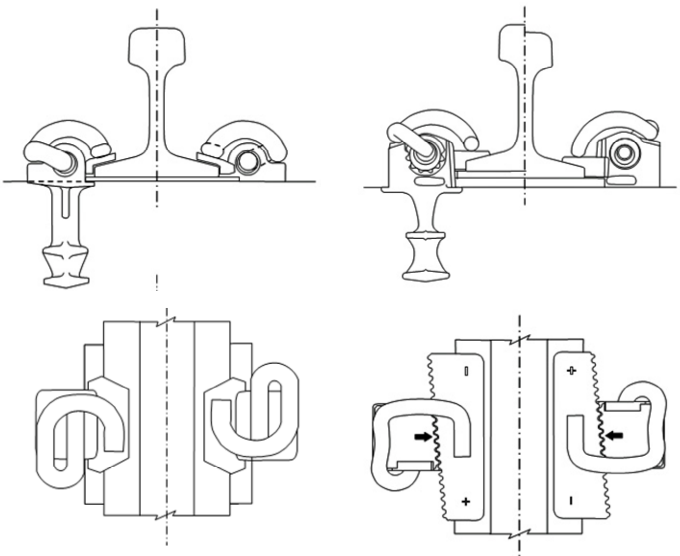
(3) Rail Fastening System

There are many rail fastening systems developed. As mentioned above, solid bed track structures are recently used in most of modern urban railways in Japan taking into account short maintenance time and large impact in case of disturbance of train operations due to track irregularities. However, since the initial installation cost of solid bed track structures is considerably high, numbers of methods for cost-effective solid track structures were developed, one of which uses Pandrol rail fastening system as shown in Figure 5.2.28.

Pandrol rail fastening system (called as 'pandrol clip') was developed by a Norwegian in 1955 and an UK company called Pandrol (UK) Ltd. purchased manufacturing right of Pandrol clips. Pandrol clips have excellent feature of not loosening fastening force and have been used mainly in ballasted tracks widely in the world. As the results, Pandrol rail fastening system can save maintenance work volume and cost. Therefore, JICA Study Team recommends pandrol rail fastening system for not only ballasted tracks but also solid bed tracks. The design of Pandrol clips for ballasted track and for solid bed track is shown in Figure 5.2.29.

(Remark; the ballast is used not for track, but for reduction of noise)
Source; Internet web-site, D-type solid bed track, Nakanoshima Line of Keihan railway

Figure 5.2.28 Pandrol Rail Fastening System in Solid Bed Track



Pandrol Clip for Ballasted Track Pandrol Clip for Solid Bed Track

Source; Japan Railway Track Construction Co. Ltd.

Figure 5.2.29 Design of Pandrol Rail Fastening System

(4) Turnout

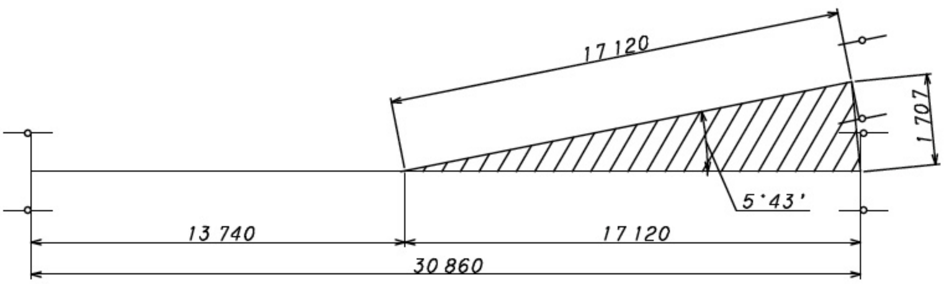
SAPROF-I recommended 12# type of turnout for main line and 10# type of turnout for depots respectively. SAPROF-II Study Team reviewed turnouts to be applied to KCR taking into account cost-effectiveness of the project and consequently proposes the following types:

A. Turnouts for main line: 10# type UIC 60 kg turnouts
B. Turnouts for depots:
   Departure and arrival tracks: 8# type UIC 60 kg turnouts
   Other tracks: 6# type UIC 54 kg turnouts

The reasons why turnout types are changed from SAPROF-I plan are as follows:

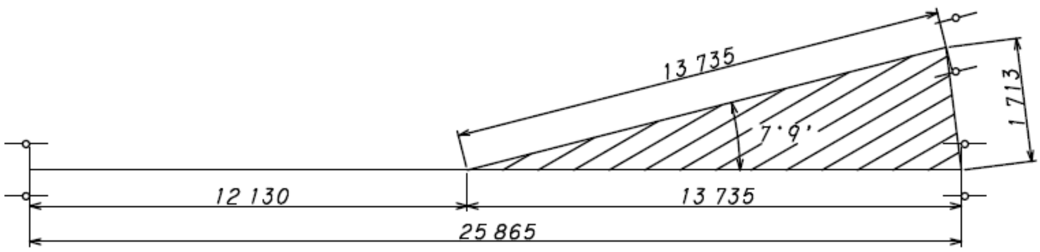
A. All the trains of KCR stop at every stations and there are no passing trains. The trains which enter into siding through turnout are only trains coming from depots or returning to depots or shuttling at the terminal. Consequently the main line train operation is not affected notably by speed restriction at turnouts.
B. However, as the speed of KCR trains is essential, 8# type turnout which is used in urban railways with maximum speed of 80-90 km/h in Japan is not appropriate.
C. The train speed is restricted to 30 km/h or so in depot areas and 6# type turnout can be designed for 1435 mm track gauge. Therefore, adoption of 6# type turnout in depots is proper to reduce initial cost of the project.

The dimensions of turnouts (Skelton) for 10#, 8# and 6# are as shown in Figure 5.2.30, Figure 5.2.31 and Figure 5.2.32 respectively, though minor changes of dimensions may arise due to the use of UIC rail.



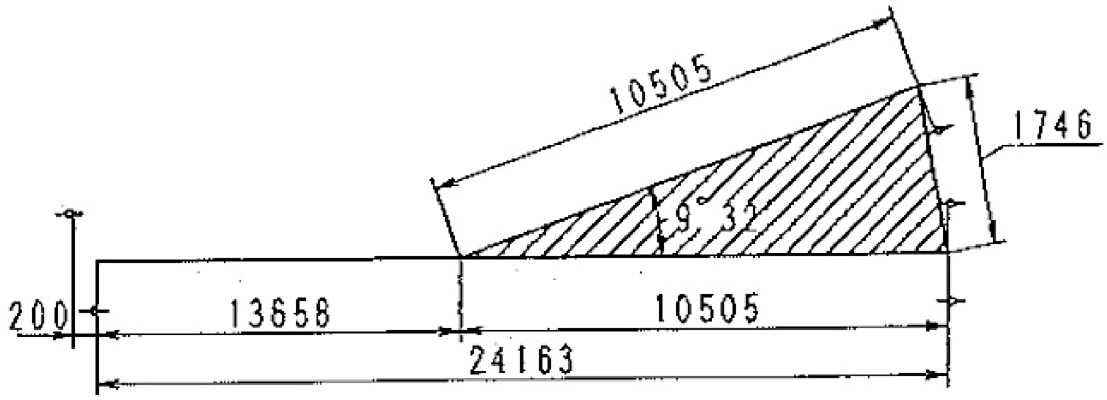
Source; Turnouts Material of Fukuoka City Transportation Department

Figure 5.2.30 Dimension (Skelton) of 10# Turnout



Source; Turnouts Material of Fukuoka City Transportation Department

Figure 5.2.31 Dimensions (Skelton) of 8# Turnout



Source: Turnouts Materials of Transportation Department, Tokyo Metropolitan Government.

Figure 5.2.32 Dimensions (Skelton) of 6# Turnout

5.2.3 Station Architecture

(1) Target Stations for entire draft plan

JICA Study Team picked up some typical types of stations shown in Table 5.2.6 and prepared architecture plans.

Table 5.2.6 Stations Picked up for Draft Plan

Station Name	Type
Karachi Cantt.	Main station of KCR Line
Johar	Underground station
HBL	On-ground side station
Manghopir	Elevated island station
DCOS	On-ground island station

Source: JICA Study Team

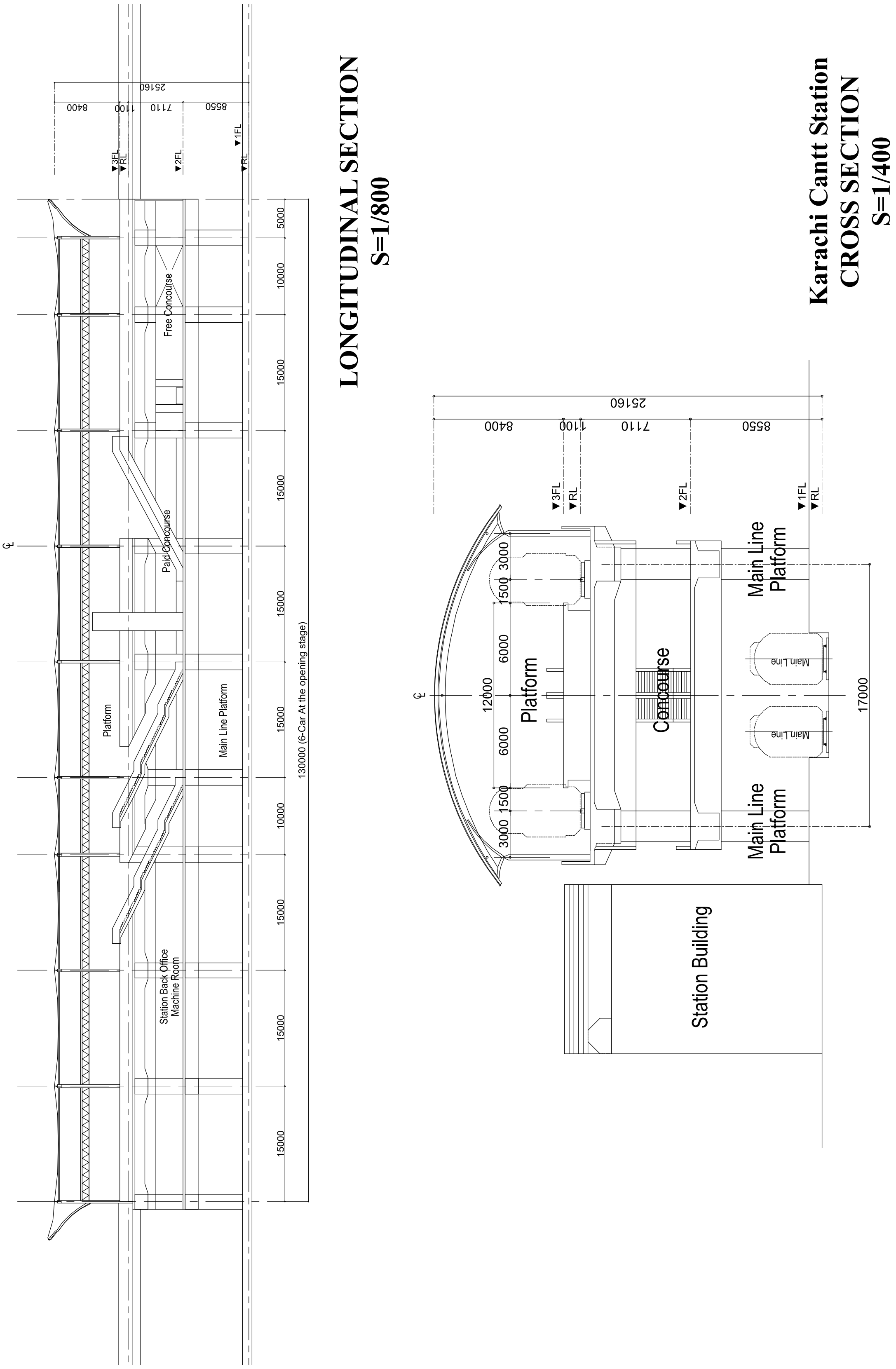
(2) Conceptual drawings of target stations

The station architecture conceptual drawings with the plan view and cross section view based on the civil structural plan are shown in Figure 5.2.33 to Figure 5.2.37, and proposed station facilities are listed in Table 5.2.7.

Table 5.2.7 Station Facilities

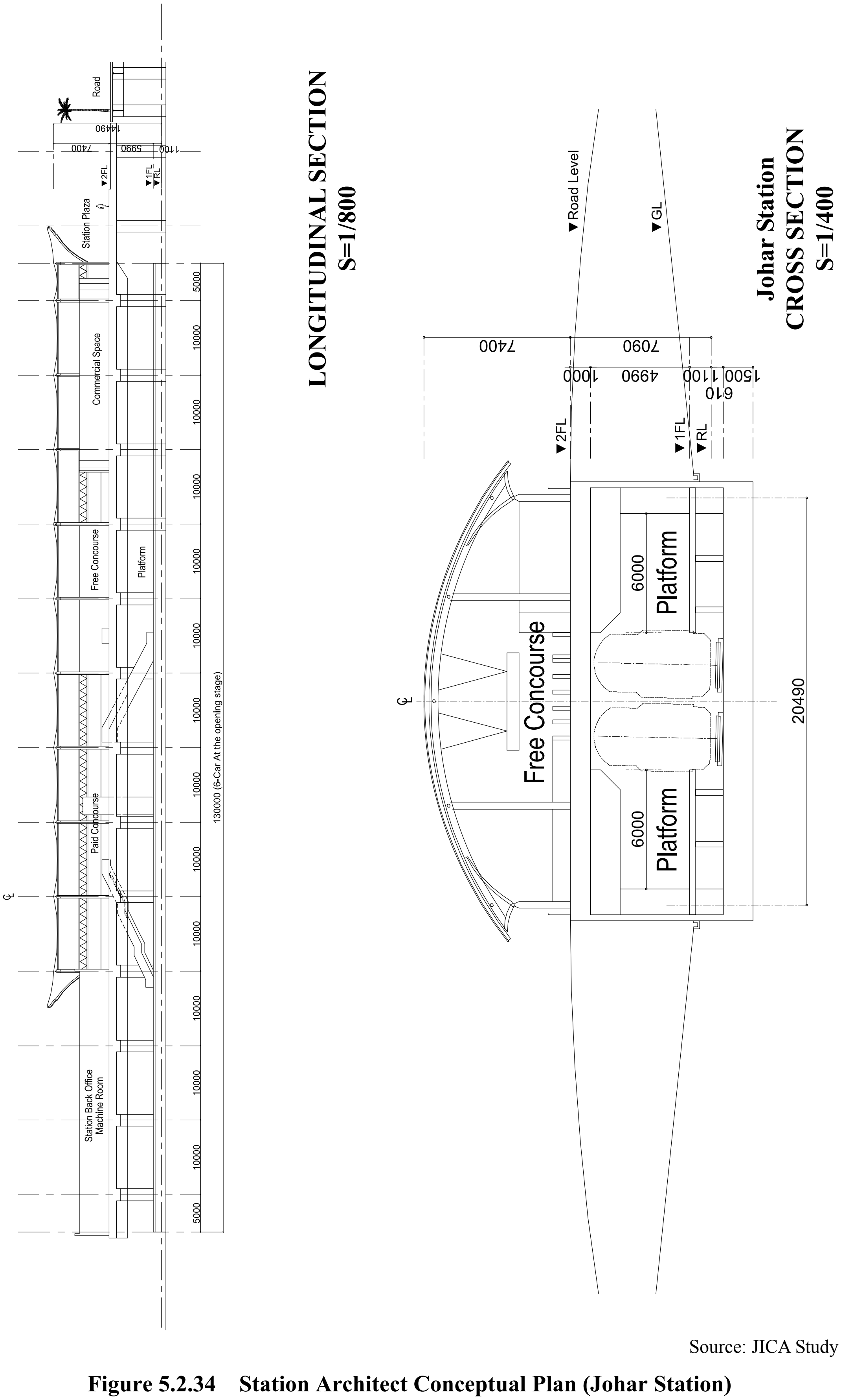
Platform	Building Work	Temporary equipment (Directory)
		Building frame
		Exterior
		Interior
		Elevator exterior
		Platform stairs
	Sign, Furniture	Sign
		Bench
	Water supply/ Drainage and Fire Extinction	
	Air-conditioning/ Ventilation	
	Electricity (outlet for light, broadcast communication, disaster prevention)	
Station Main Building	Building Work	Temporary equipment(Directory)
		Building frame
		Exterior
		Interior
		Elevator exterior
		Stairs
	Sign, Furniture	Sign
		Bench
	Water Supply/ Drainage and Fire Extinction	
	Ventilation and Air-conditioning System	Air Conditioning/ Ventilation
		Ventilation
	Electricity (outlet for light, broadcast communication, disaster prevention)	
Outdoor Facility		

Source: JICA Study Team



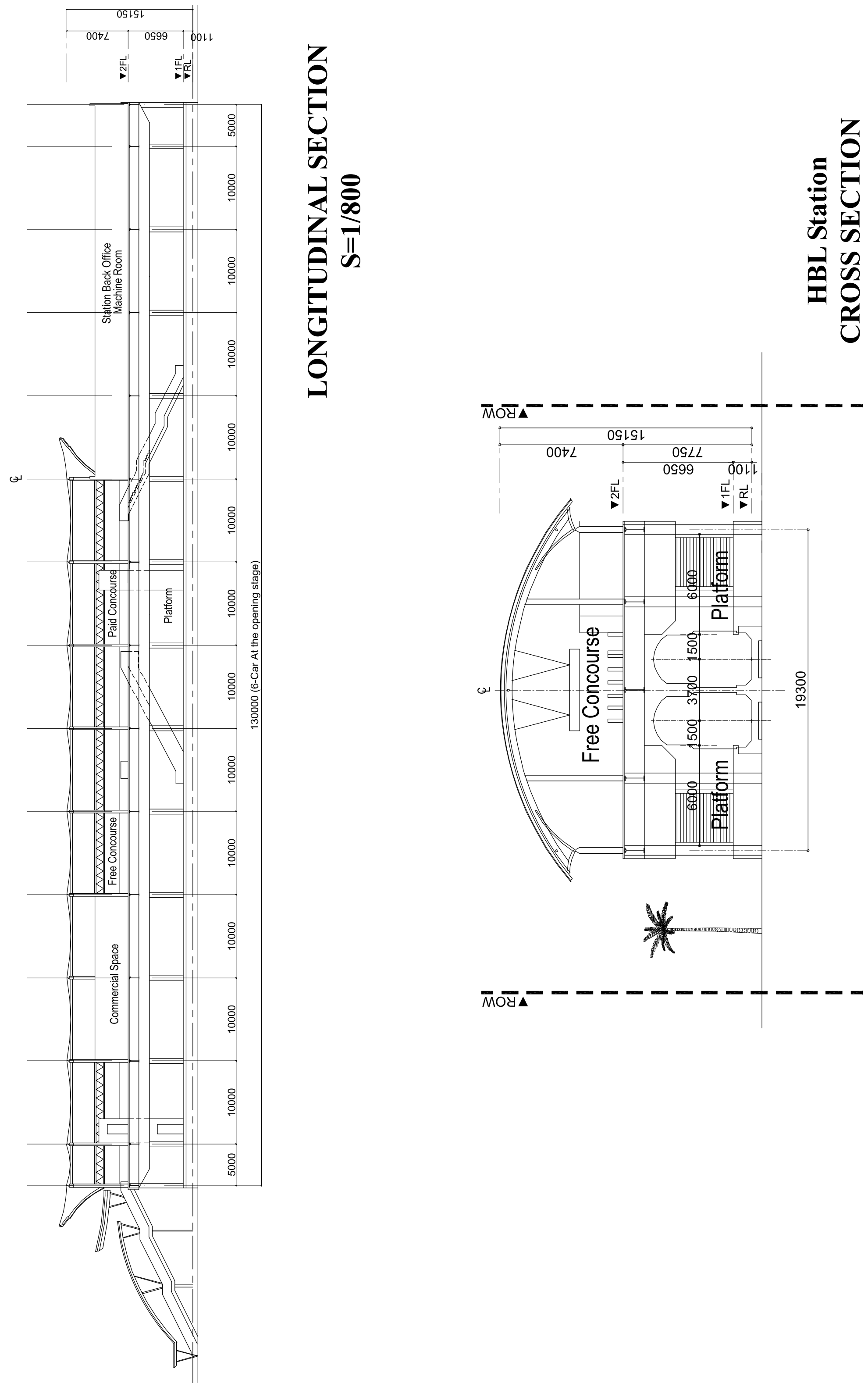
Source: JICA Study Team

Figure 5.2.33 Station Architect Conceptual Plan (Karachi Cantt. Station)



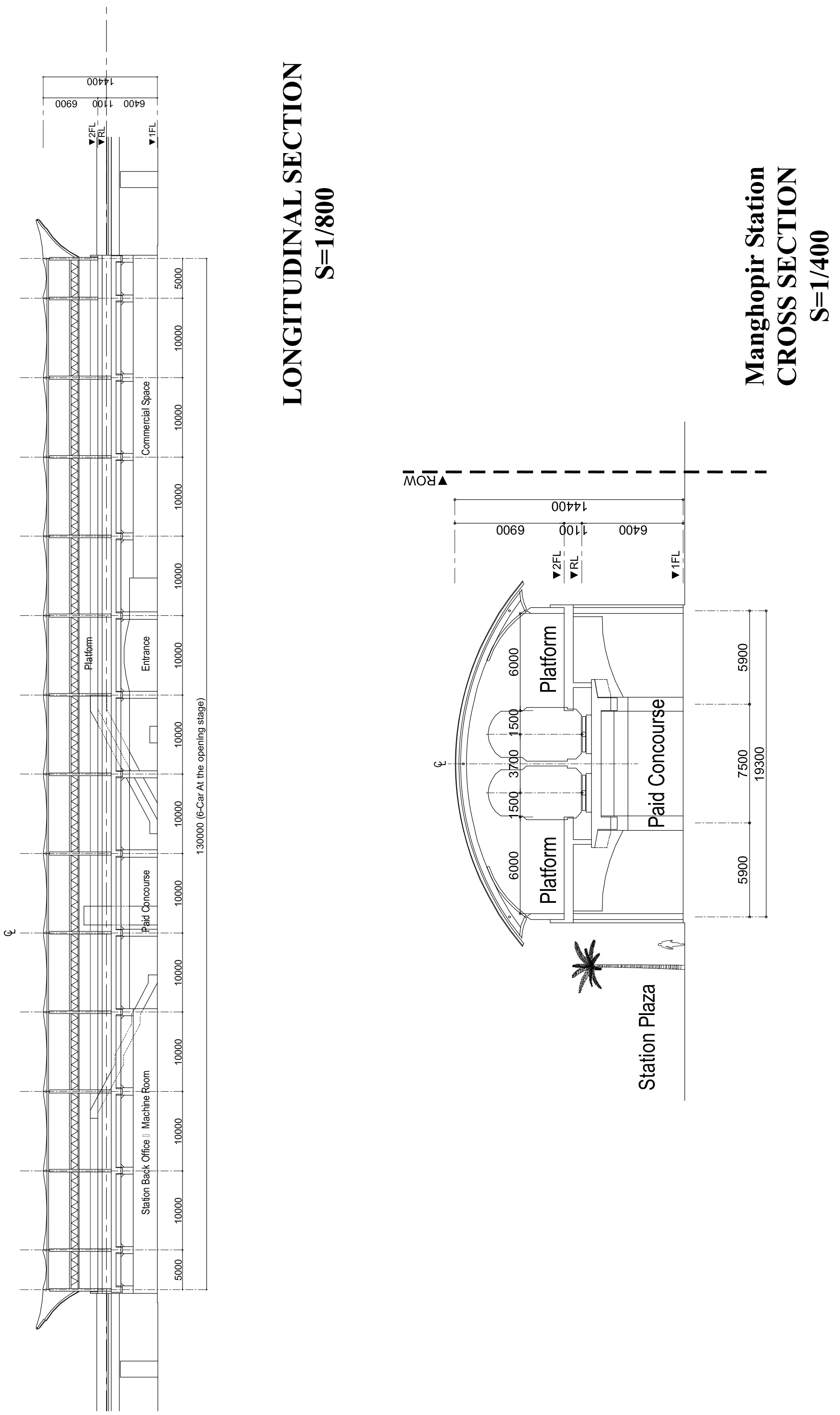
Source: JICA Study Team

Figure 5.2.34 Station Architect Conceptual Plan (Johar Station)



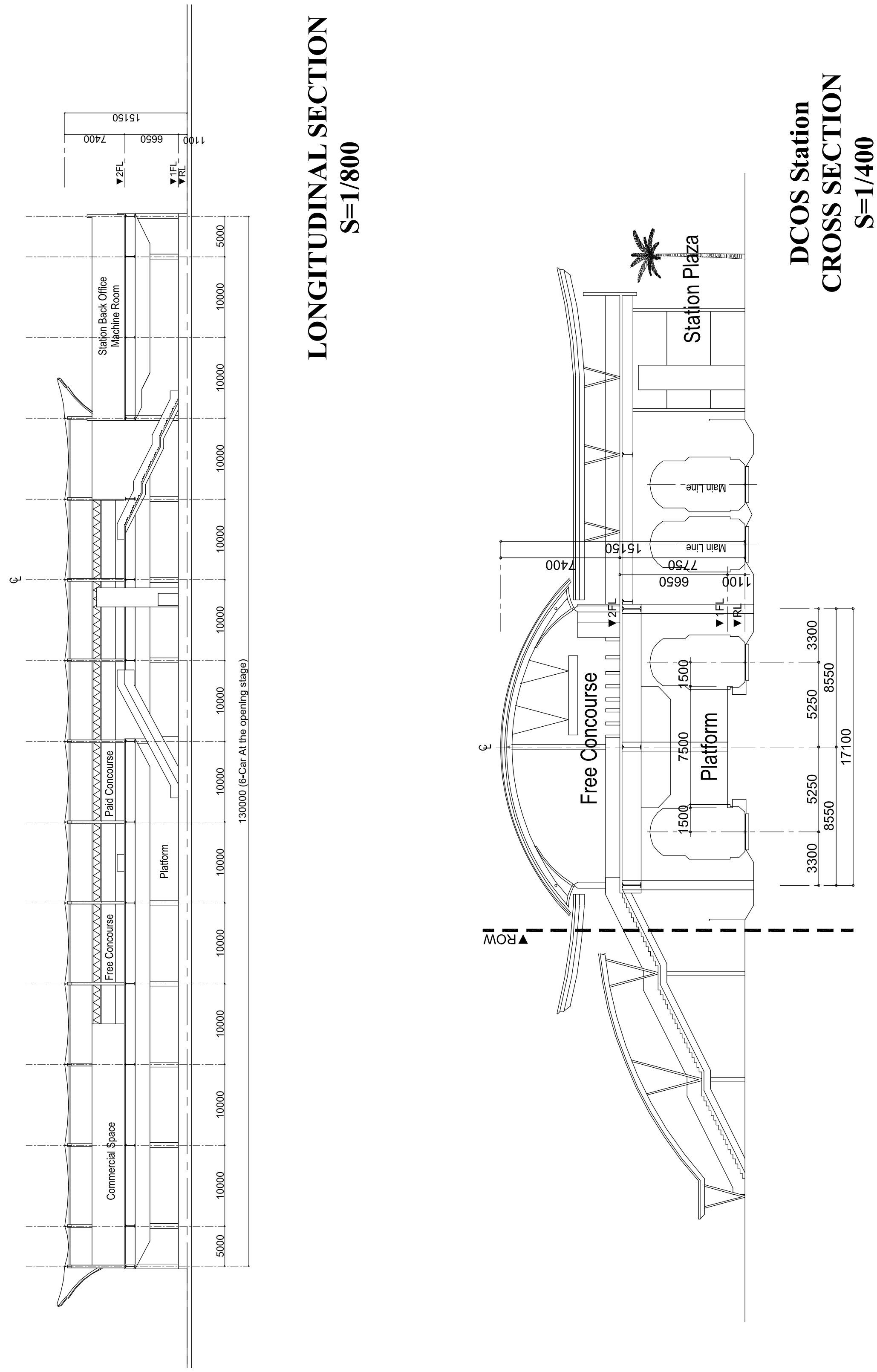
Source: JICA Study Team

Figure 5.2.35 Station Architect Conceptual Plan (HBL Station)



Source: JICA Study Team

Figure 5.2.36 Station Architect Conceptual Plan (Manghopir Station)



Source: JICA Study Team

Figure 5.2.37 Station Architect Conceptual Plan (DCOS Station)

(3) Perspectives of target stations

Perspectives of the five stations, from conceptual plan mentioned above, are presented in Figure 5.2.38 to Figure 5.2.42.

Source: JICA Study Team

Figure 5.2.38 Perspective of Karachi Cantt. Station

Source: JICA Study Team

Figure 5.2.39 Perspective of Johar Station

Source: JICA Study Team

Figure 5.2.40 Perspective of HBL Station

Source: JICA Study Team

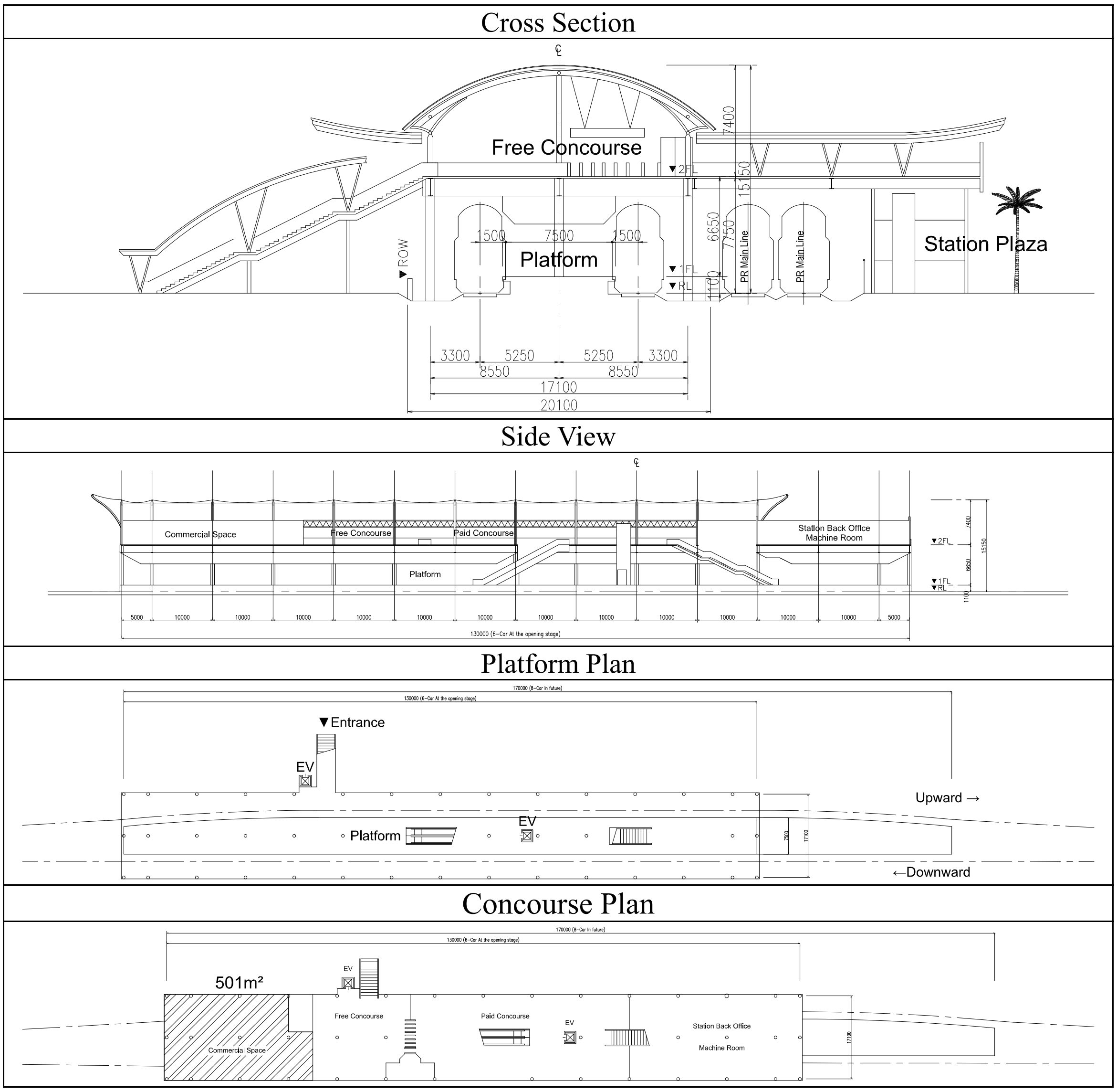
Figure 5.2.41 Perspective of Manghopir Station

Source: JICA Study Team

Figure 5.2.42 Perspective of DCOS Station

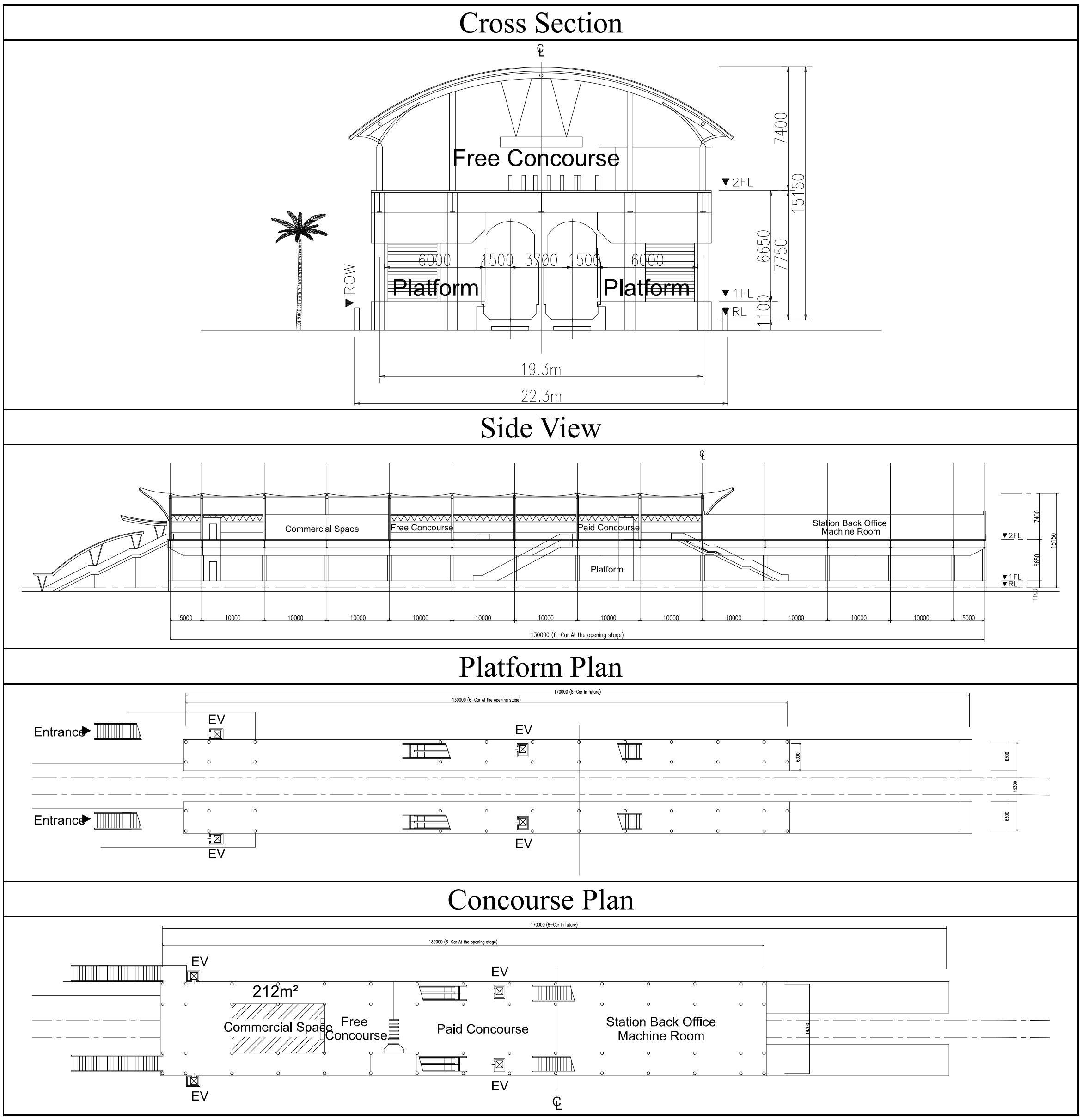
(4) Schematic drawing of all types of stations

JICA Study Team proposes draft plans of all stations based on these five station plans shown in Figure 5.2.43 to Figure 5.2.54. Cost of civil, architecture and O&M is estimated in reference to these drawings.



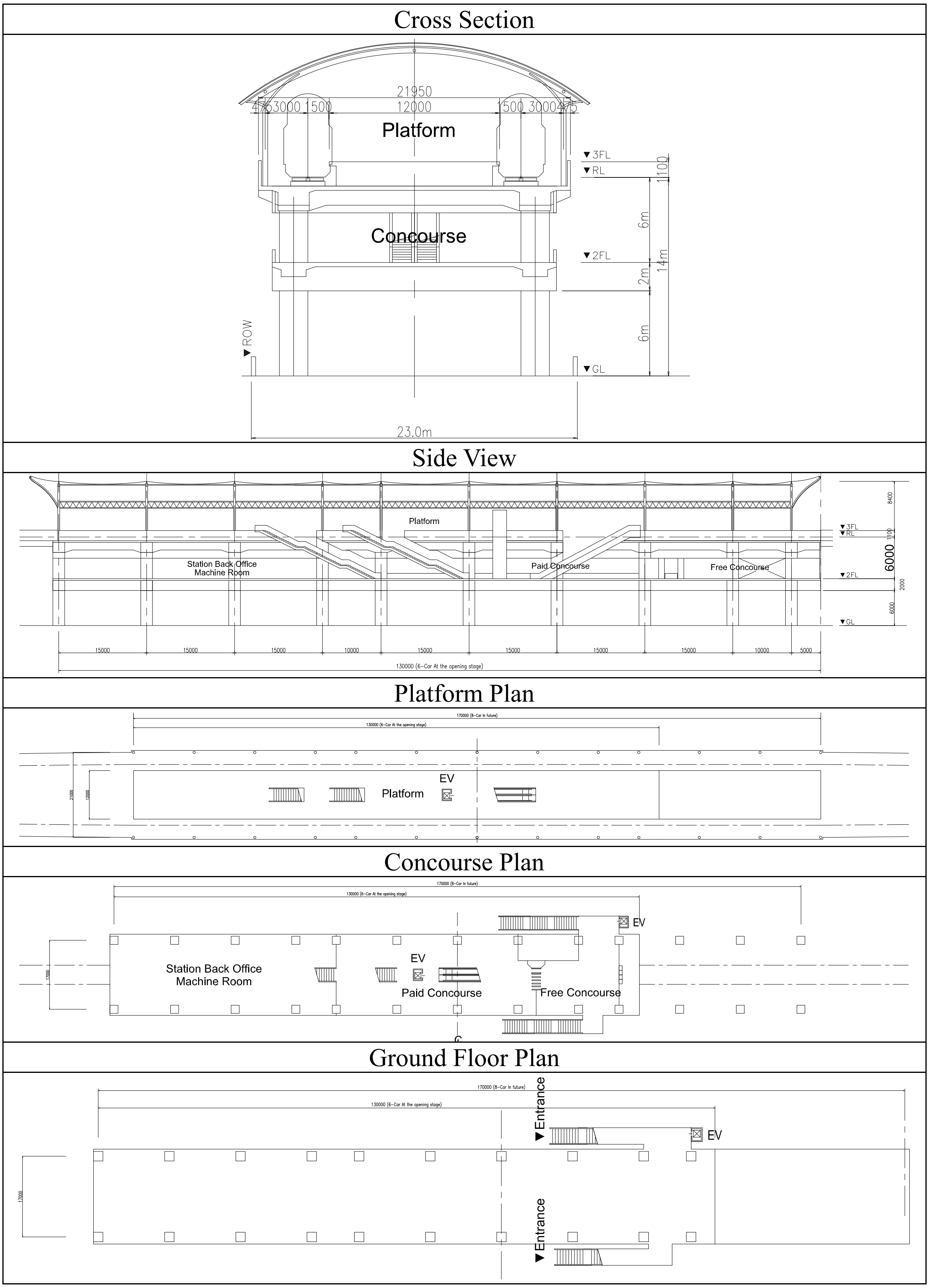
Source: JICA Study Team

Figure 5.2.43 Station Plan (On-ground Island)



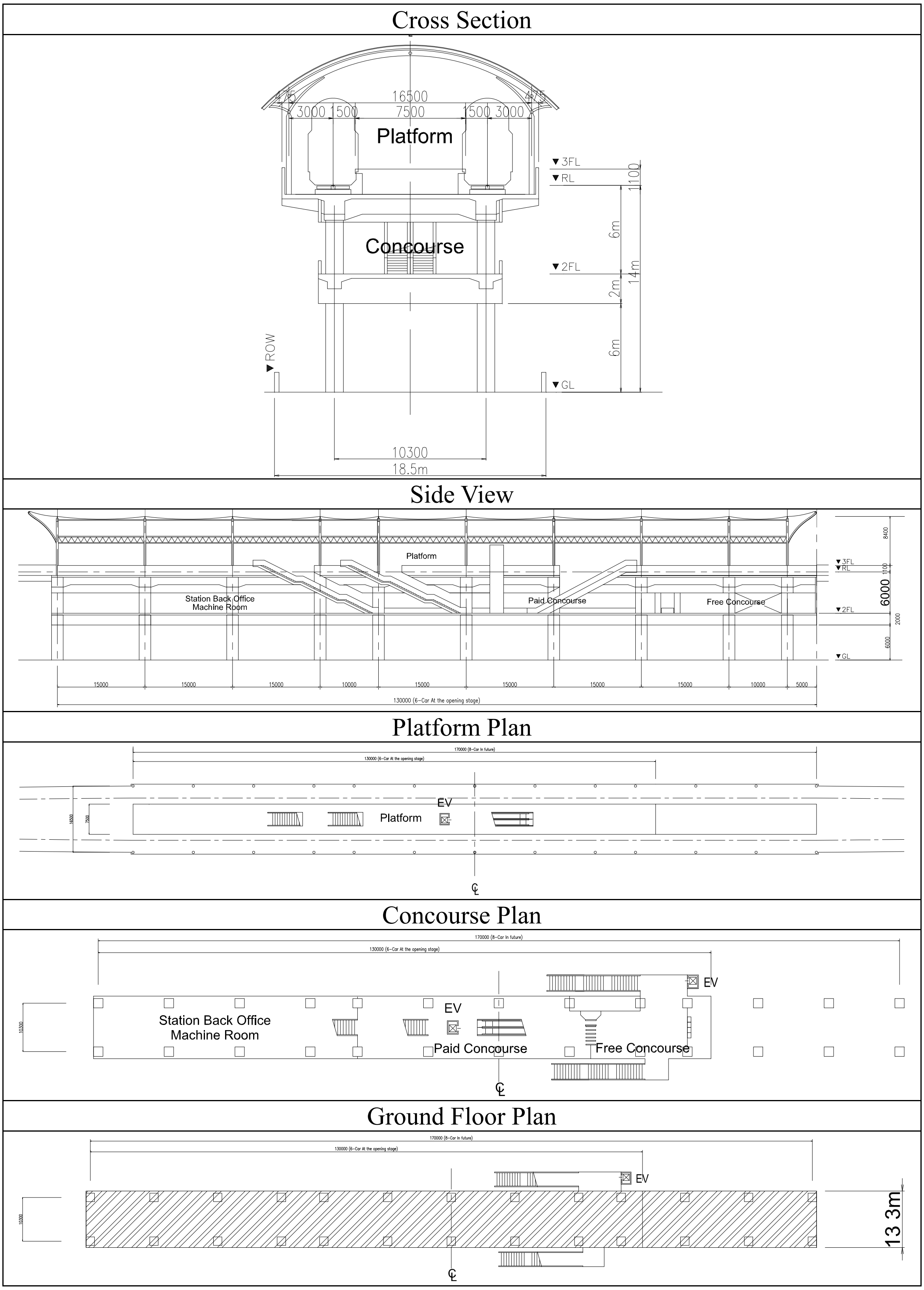
Source: JICA Study Team

Figure 5.2.44 Station Plan (On-ground Side)



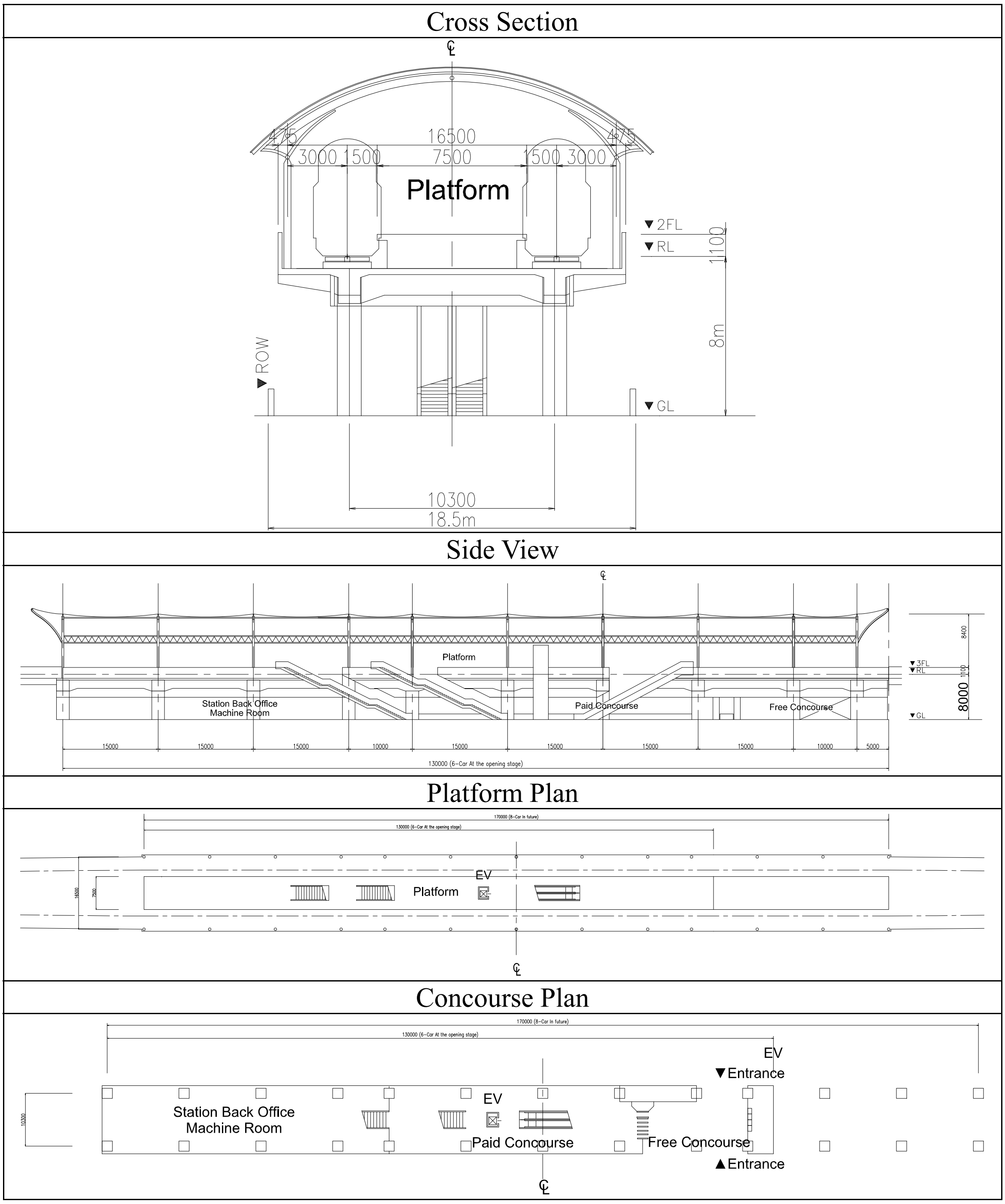
Source: JICA Study Team

Figure 5.2.45 Station Plan (Karachi Cantt.)



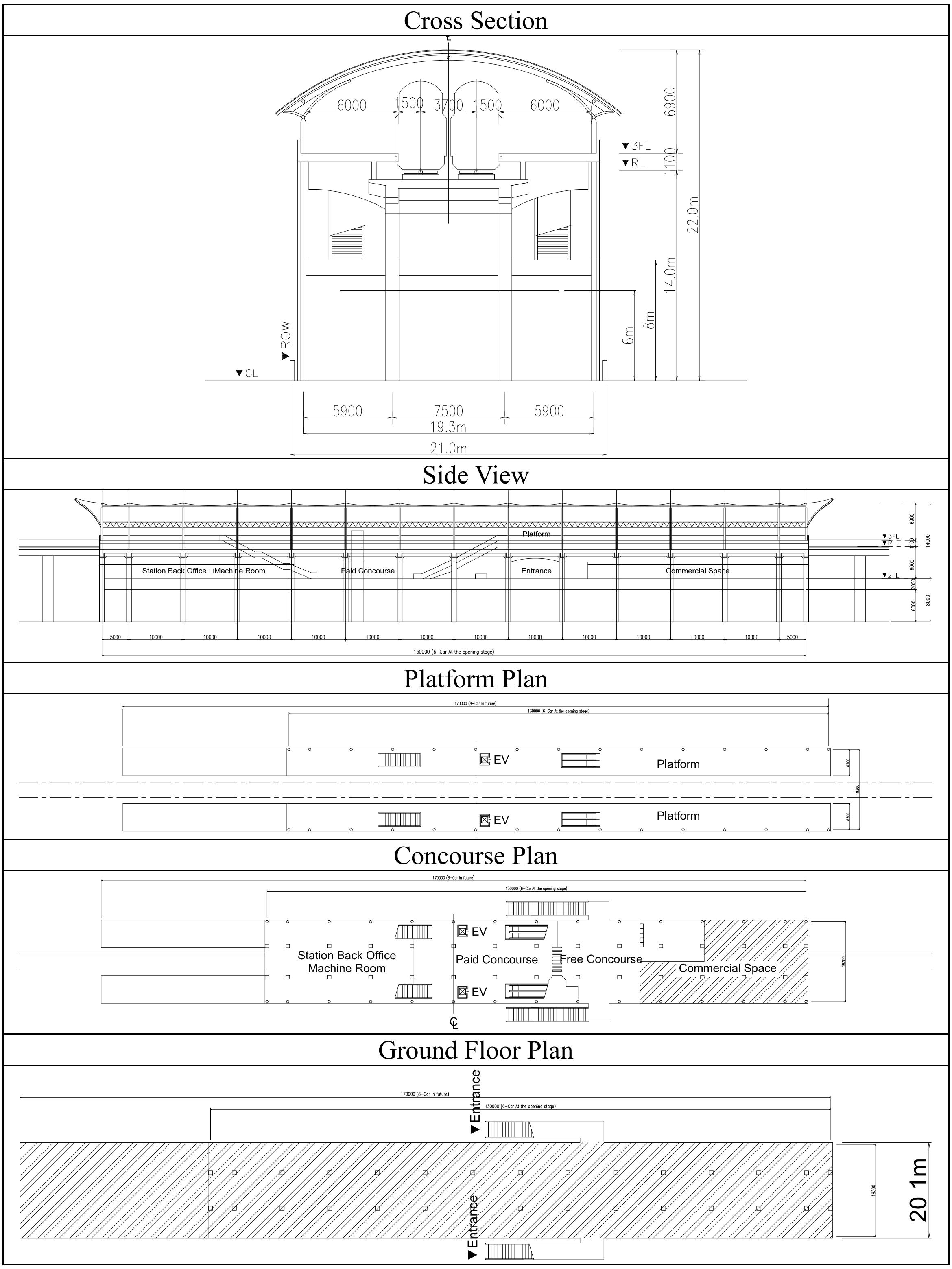
Source: JICA Study Team

Figure 5.2.46 Station Plan (Elevated Island, Elevated Concourse)



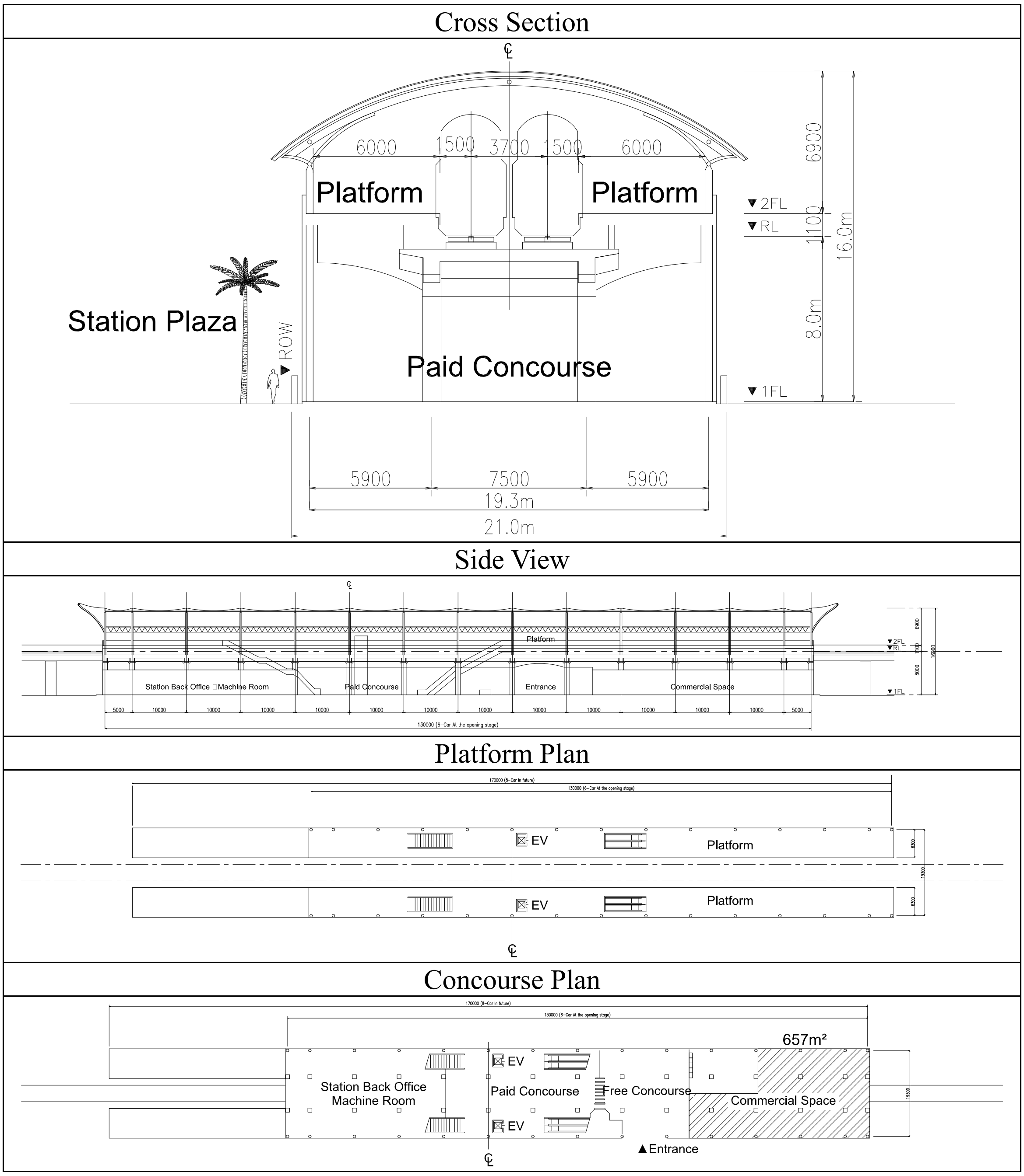
Source: JICA Study Team

Figure 5.2.47 Station Plan (Elevated Island, Ground Concourse)



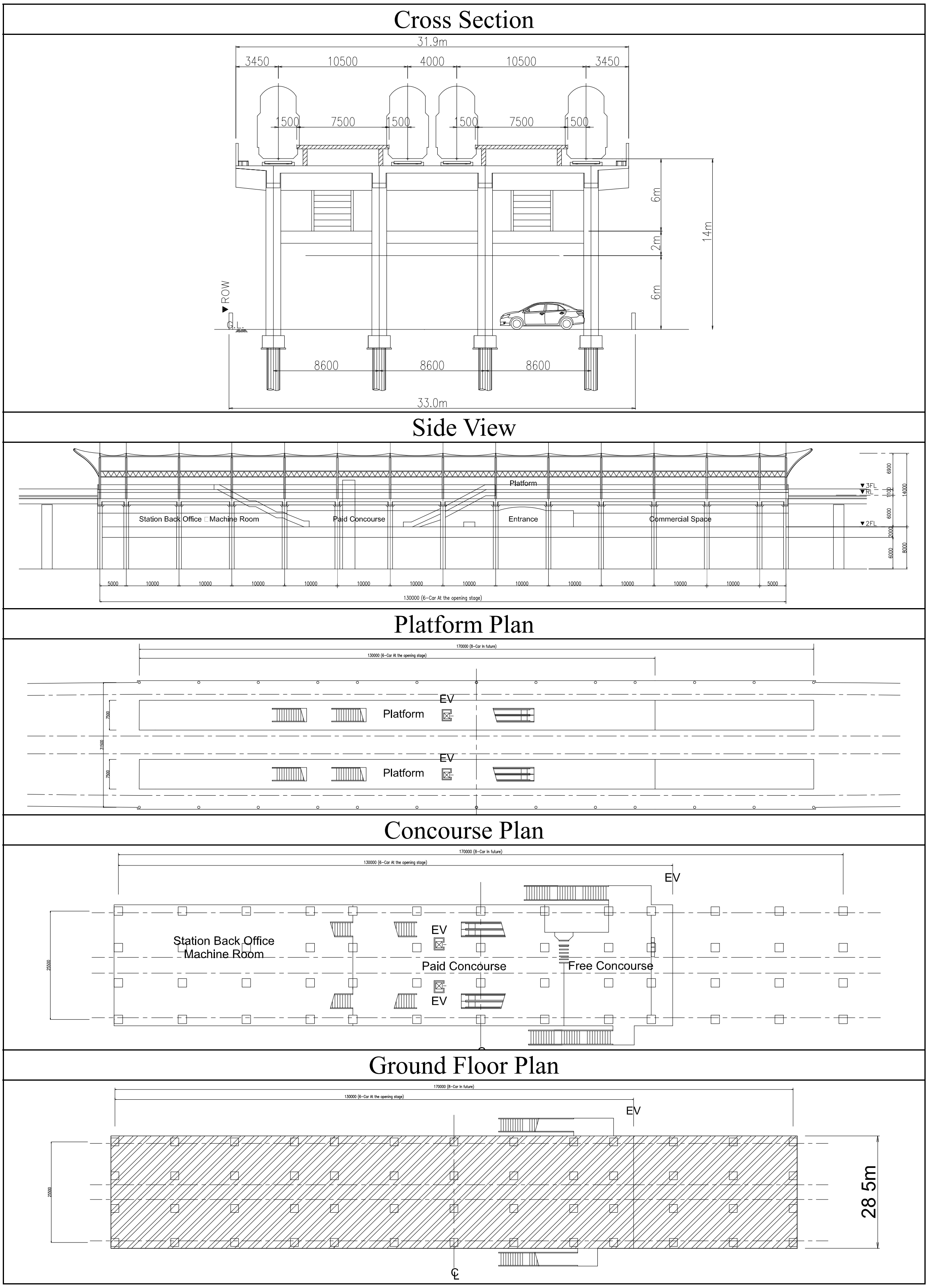
Source: JICA Study Team

Figure 5.2.48 Station Plan (Elevated Side, Elevated Concourse)



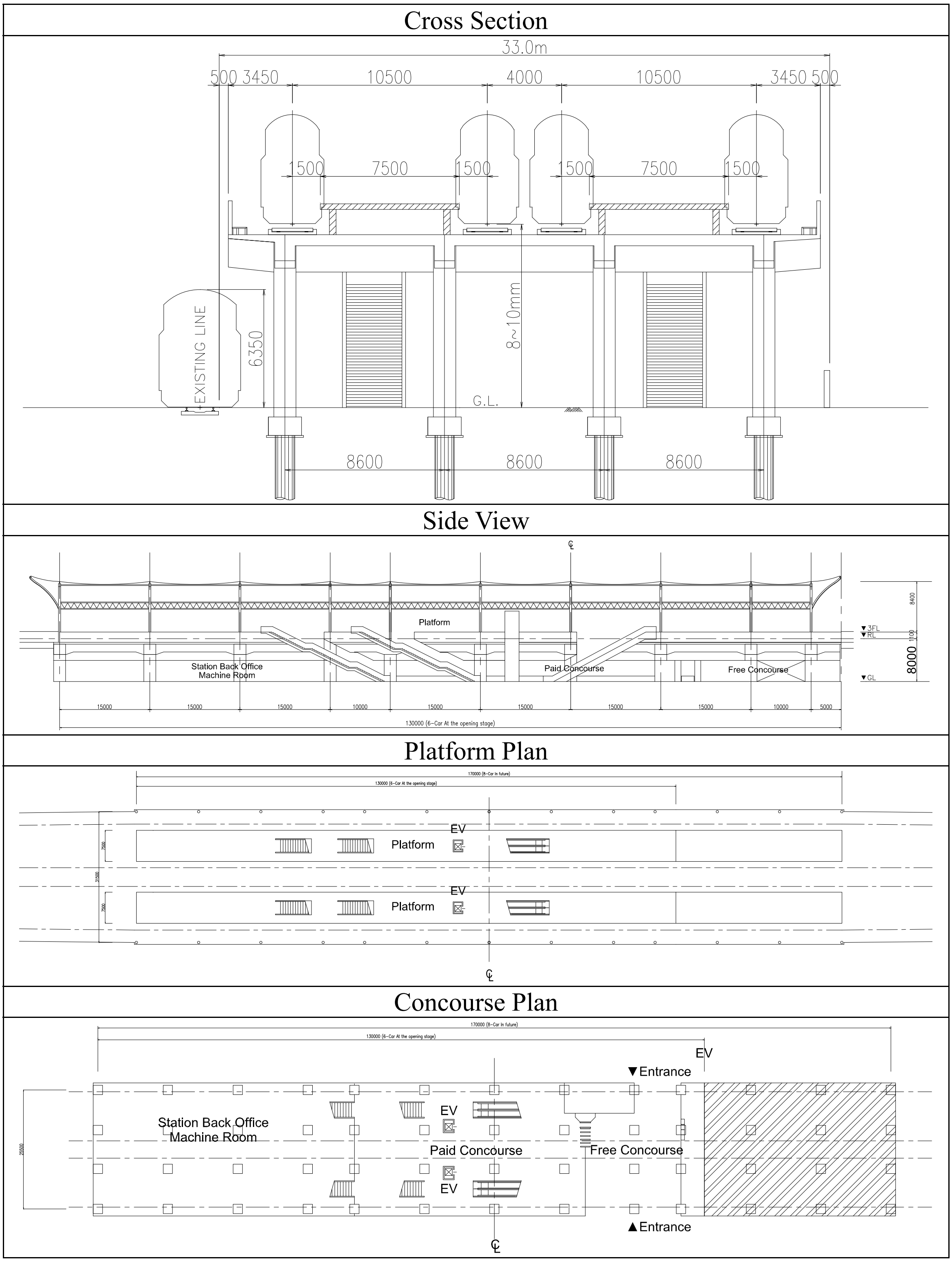
Source: JICA Study Team

Figure 5.2.49 Station Plan (Elevated Side, Ground Concourse)



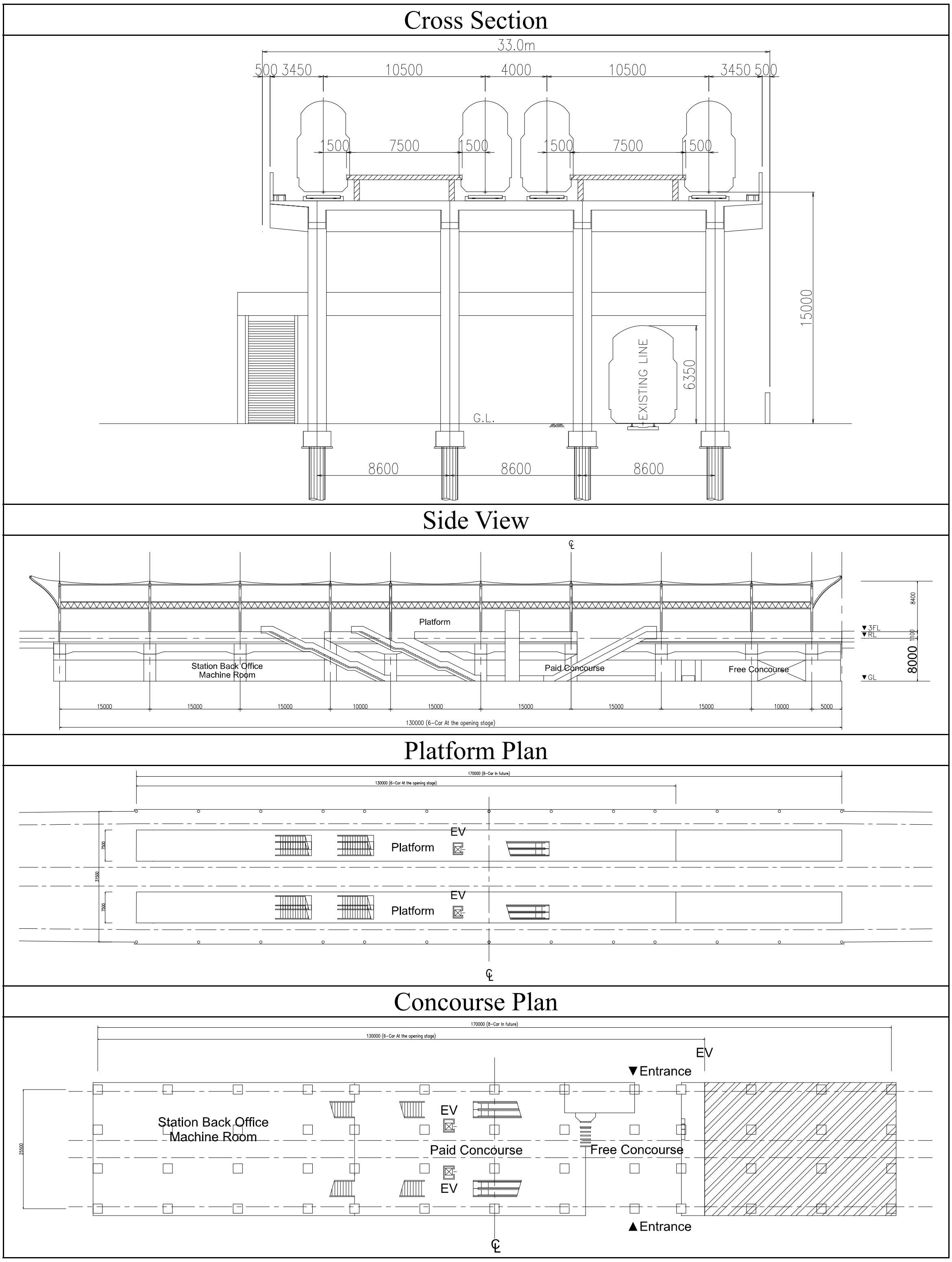
Source: JICA Study Team

Figure 5.2.50 Station Plan (Elevated 2-Island, Elevated Concourse)



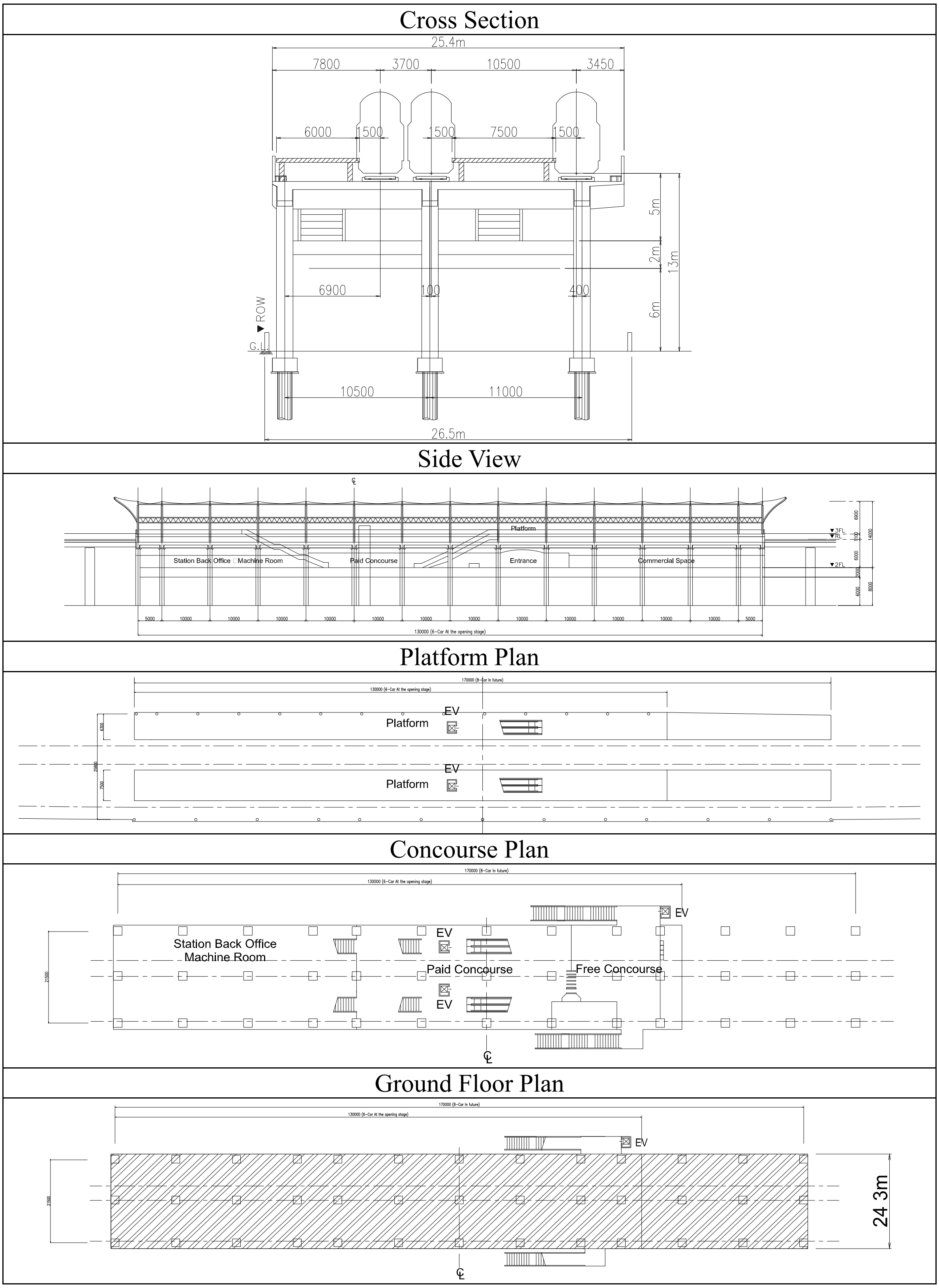
Source: JICA Study Team

Figure 5.2.51 Station Plan (Elevated 2-Island, Ground Concourse)



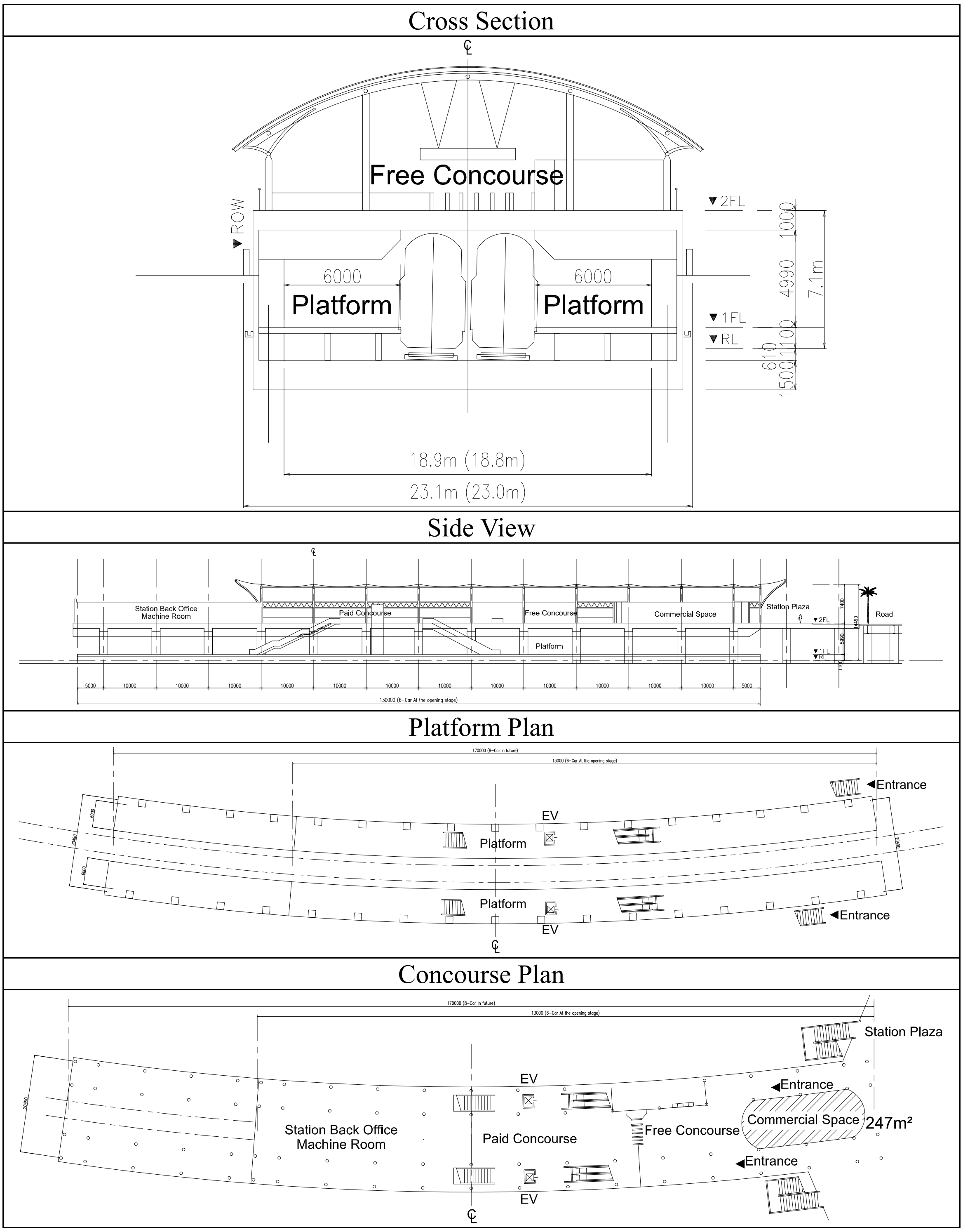
Source: JICA Study Team

Figure 5.2.52 Station Plan (Drigh Road)



Source: JICA Study Team

Figure 5.2.53 Station Plan (Elevated 2-Island, Manghopir)



Source: JICA Study Team

Figure 5.2.54 Station Plan (Culvert, Ground Concourse)

5.2.4 Rolling Stock Depots and Workshop

(1) Overall Depots and Workshop Plan

Two rolling stock depots for KCR are planned at Wazir Mansion and Depot Hill. The situation of the depot sites provided by KUTC was confirmed through the field survey and necessary depot function and facility were examined.

The result of the examination is shown in Table 5.2.9.

The stabling areas for the rolling stock in Wazir Mansion Depot and Depot Hill Stabling Yard are short for Option N-A1 and N-A2. Additional stabling areas are secured at Manghopir and Gilani Stations considering also future increase of the number of train sets. The stabling capacity of respective depots and yards and requirements are as follows:

- Wazir Mansion Depot & Workshop 23 trains
- Depot-Hill Depot 10 trains
- Manghopir Stabling Yard 2 trains
- Gilani Stabling Yard 8 trains

Total Capacity 43 trains

Table 5.2.8 Required Train Sets at the Opening Stage to 2051

Year	2022	2030	2041	2047	2049	2051
N-A1	25	34	-	-	42	-
N-A2	25	29	34	-	-	42
N-B1	16	17	-	20	-	-

Source: JICA Study Team

The following sections give depot facility plan and schematic layout. And plan drawings with scale at each Depot are shown in Appendix 5-2.

(2) Wazir Mansion Depot

Based on the examined depot and workshop functions, the facility for Wazir Mansion Depot was planned.

The layout of Wazir Mansion Depot is shown in Figure 5.2.55.

In addition, summary of the major track in the depot is shown in Table 5.2.10.

The layout of Main Workshop is shown in Figure 5.2.56.

(3) Depot Hill Stabling Yard

Based on the examined depot function and the facility, Depot Hill Stabling Yard was planned.

The layout of Depot Hill Stabling Yard (Option N-A1,A2 and Option N-B1) is shown in Figure 5.2.57 and Figure 5.2.58.

In addition, summary of the major track in the stabling yard (Option N-A1,A2 and Option N-B1) is shown in Figure 5.2.57 and Figure 5.2.58.

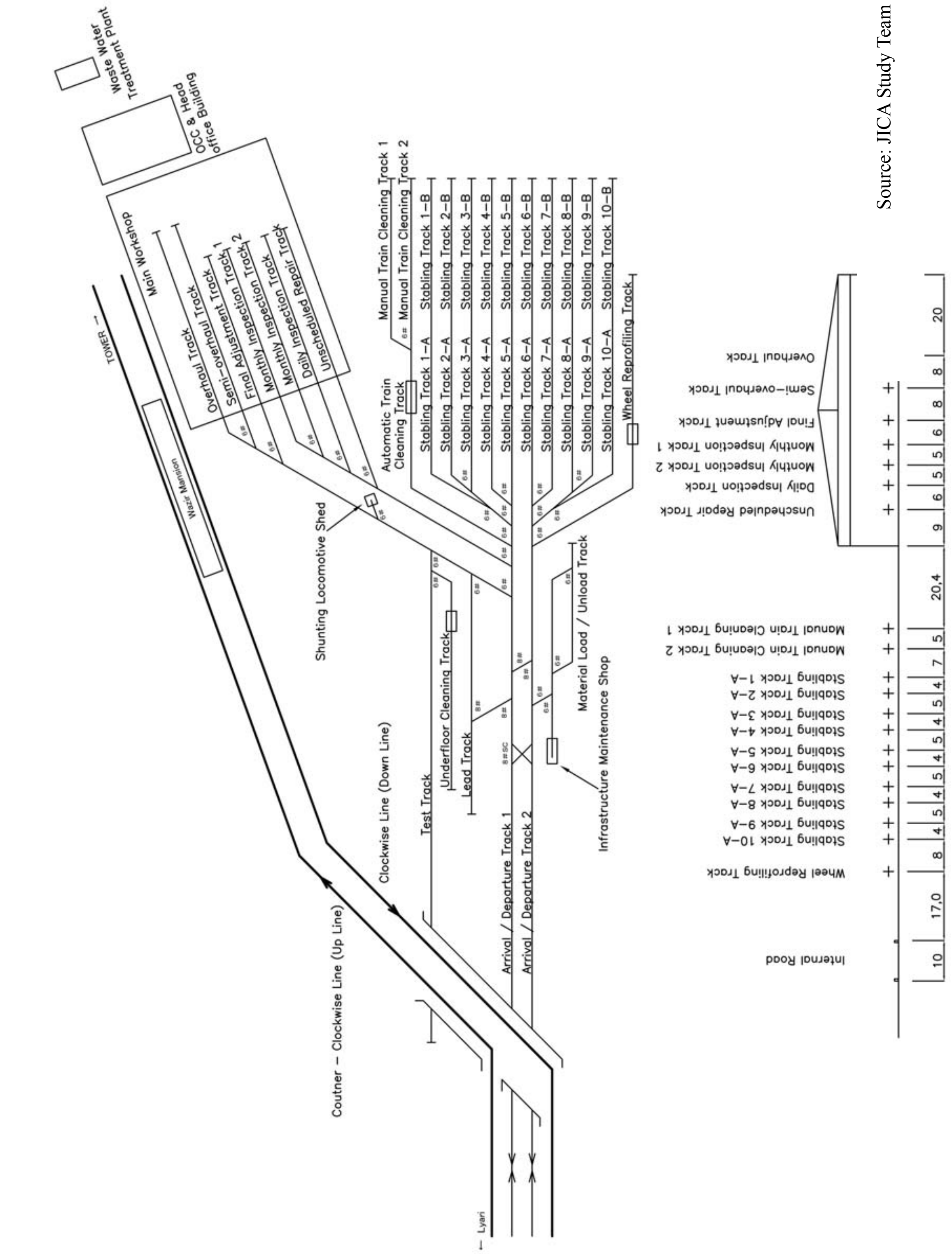
Table 5.2.9 Depot Function Plan

	Wazir Mansion	Depot Hill	
		N-A1,A2	N-B1
Main Depot Function	- Stabling - Repair (Overhaul, Semi-overhaul, unscheduled repair) - Inspection (Check before leaving, Daily inspection, Monthly inspection) - Cleaning (Manual, automatic) - Wheel reprofiling - Infrastructure maintenance - Power receiving, Power distribution	- stabling - inspection (check before leaving, daily inspection) - cleaning track (manual, automatic)	- stabling - train cleaning (manual, automatic)
Stabling way	1 train set stabling on 1 track and 2 train sets on 1 track (tandem array)		
train formation	4-car for Main line 8-car for KCR extension in 2030 to 2051		4 car in 2022 8 car in 2030 to 2051
main facility	- Stabling track, arr/dep track, lead track, test track, cleaning track (manual, automatic), wheel reprofiling track, underfloor cleaning track overhaul track, semi-overhaul track monthly inspection, unschedulued repair track, final adjustment track, material load/ unload track, etc. - main workshop, inspection shop, OCC & office building, infrastructure maintenance shop, maintenance cat shed, material stock place, water supply facility, waste water treatment plant, automatic train cleaning machine, wheel reprofiling shop, etc.)	- stabling track, arr/dep track, lead track, cleaning track (manual, automatic), daily inspection track - inspection shop, drivers/ maintenance staff office, water supply facility, waste water treatment plant, automatic train cleaning machine, etc.)	- stabling track, arr/dep track, lead track, cleaning track (manual, automatic) - Drivers or maintenance staff office, water supply facility, waste water treatment plant, automatic train cleaning machine, etc.
Connecting to	To Liyari	To Drigh Road	
Number of enter/leave track	2 tracks		
Number of arr/dep track	2 tracks		

Source: JICA Study Team

NOTE:

1) Basically the number of stabling track should be secured possible capacity stabling for all train set.
2) In case of impossible case and/or necessary from the view point of operation plan, it will be allowed to use other tracks except stabling track in depot.
3) When KCR extension line start operating in the future, depot, if needed be, is secured newly along the extension line.



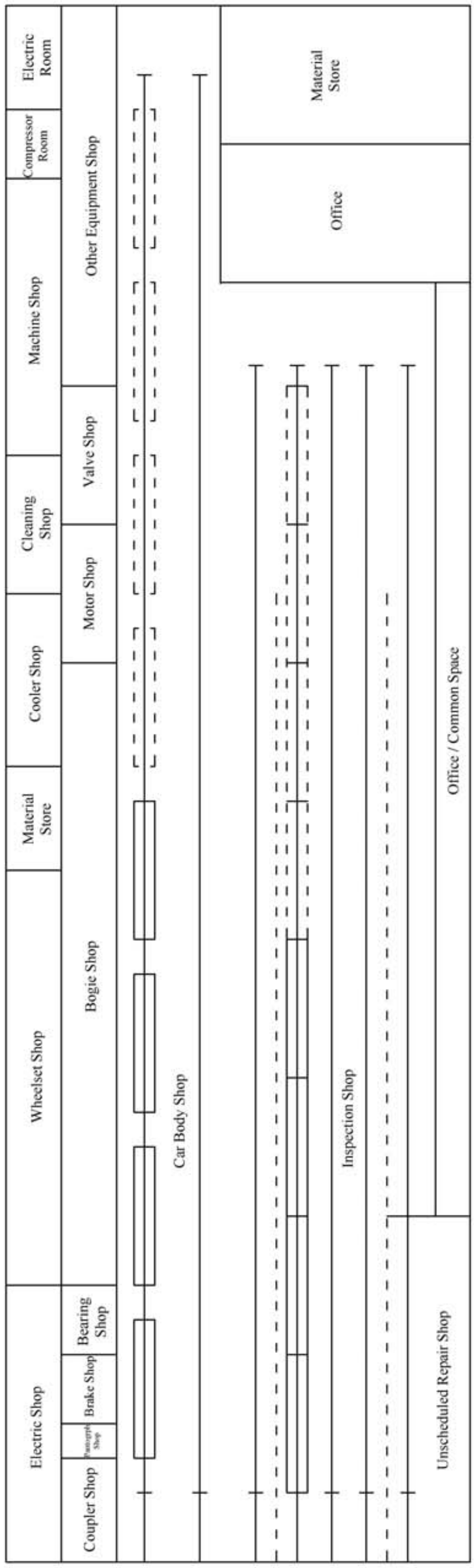
Source: JICA Study Team

Figure 5.2.55 Skeleton Diagram of Wazir Mansion Depot

Table 5.2.10 Major Track of Wazir Mansion Depot

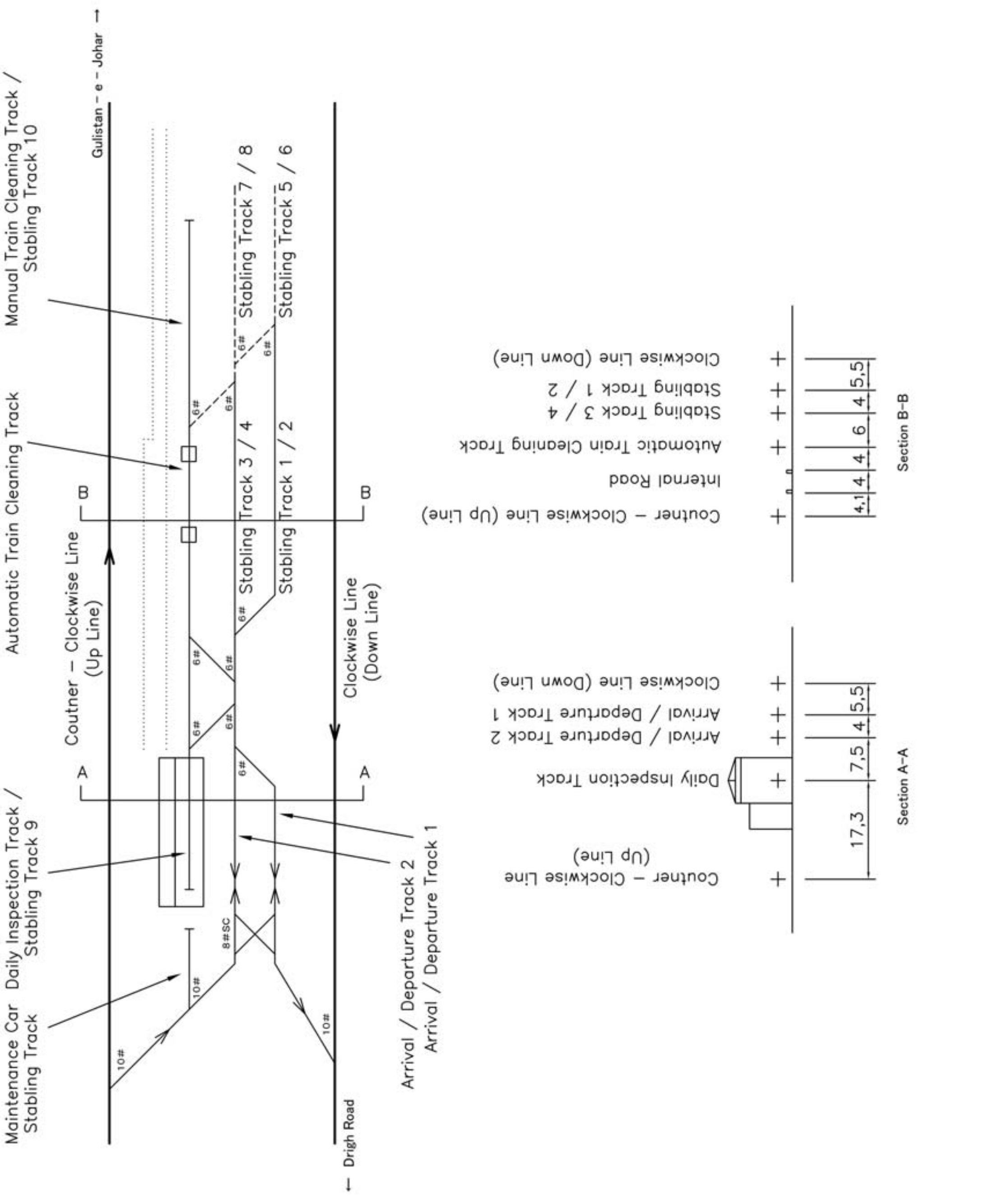
Track	No. of tracks	No. of stabling	Effective Length (m)	Remark
Stabling Track	10	20	360	For 8-car formation, tandem arrayment
Manual Train Cleaning Track	2	2	180	For 8-car formation
Automatic Train Cleaning Track	1		224	installation of automatic cleaning machine (combined unit type) towards the depth side of the depot
Wheel Reprofiling Track	1		348	underfloor wheel lathe type, train is pulled by shunting car
Overhaul Track	1		205	for 8-car formation
Semi-overhaul Track	1		205	for 8-car formation
Final Adjustment Track	1		180	with inspection deck and pit for 8-car formation
Monthly Inspection Track 1	1		180	with inspection deck and pit for 8-car formation
Monthly Inspection Track 2	1		180	with inspection deck and pit for 8-car formation
Daily Inspection Track	1	1	180	with inspection deck and pit for 8-car formation
Unscheduled Repair Track	1		180	with inspection deck and pit for 8-car formation
Underfloor Cleaning Track	1		206	underfloor cleaning before enter to main workshop
Arrival/ Departure Track	2		180	for switching signal on the train
Lead Track	1		180	for train shunting in the depot
Test Track	1		500	for test run after repair with signal and catenary facilities
Total	26	23	-	
Material Load/ Unload Track	1		65	for maintenance material loading/ unloading (Track equipment, electric material, etc.)
Infrastructure Maintenance Shop Track	1		40	for infrastructure maintenance car stabling (Track/ Catenary maintenance motor car, etc.)
Siding for Locomotive Track	1		132	for siding for maintenance car
Total	3	0	-	

Source: JICA Study Team



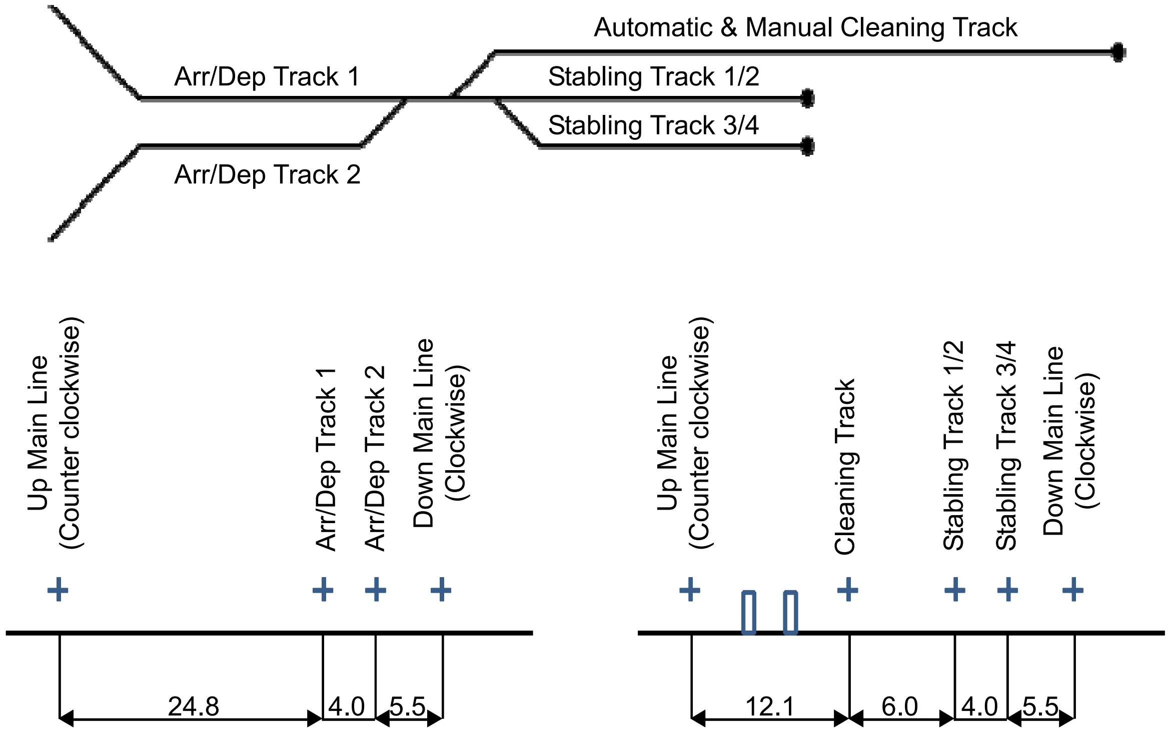
Source: JICA Study Team

Figure 5.2.56 Layout of Main Workshop



Source: JICA Study Team

Figure 5.2.57 Skeleton Diagram of Depot Hill Stabling Yard (Option N-A1,A2)



Source: JICA Study Team

Figure 5.2.58 Skeleton Diagram of Depot Hill Stabling Yard (Option N-B1)

Table 5.2.11 Major Track of Depot Hill Stabling Yard

	Track	No. of Track	No. of Stabling	Effective Length (m)	Remark
Option N-A1, A2	Arrival/ Departure Track 1	1		180	For signal switching for train
	Arrival/ Departure Track 2	1		180	For signal switching for train
	Automatic Train Cleaning Track	1		285	Installation of automatic cleaning machine (combined unit type)
	Stabling Track 1/ 2	1	2	360	For 8-car formation, tandem array
	Stabling Track 3/ 4	1	2	360	For 8-car formation, tandem array
	Stabling Track 5/ 6	1	2	360	For 8-car formation, tandem array
	Stabling Track 7/ 8	1	2	360	For 8-car formation, tandem array
	Daily Inspection/ Stabling Track 9	1	1	180	With inspection deck and pit for 8-car formation
	Manual Cleaning/ Stabling Track 10	1	1	180	For 8-car formation
	Maintenance Car Stabling Track	1		97	For stabling and maintenance car
	TOTAL	10	10	-	
Option N-B1	Arrival/ Departure Track 1	1		180	For signal switching for the train
	Arrival/ Departure Track 2	1		180	For signal switching for the train
	Automatic Train Cleaning Track	1		285	Install an automatic cleaning machine (combined unit type)
	Stabling Track 1/2	1	2	360	For 8-car formation, tandem array
	Stabling Track 3/4	1	2	360	For 8-car formation, tandem array
	Manual Train Cleaning Track/ Stabling Track 3	1	1	180	For 8-car-formation
	TOTAL	6	5	-	

Source: JICA Study Team