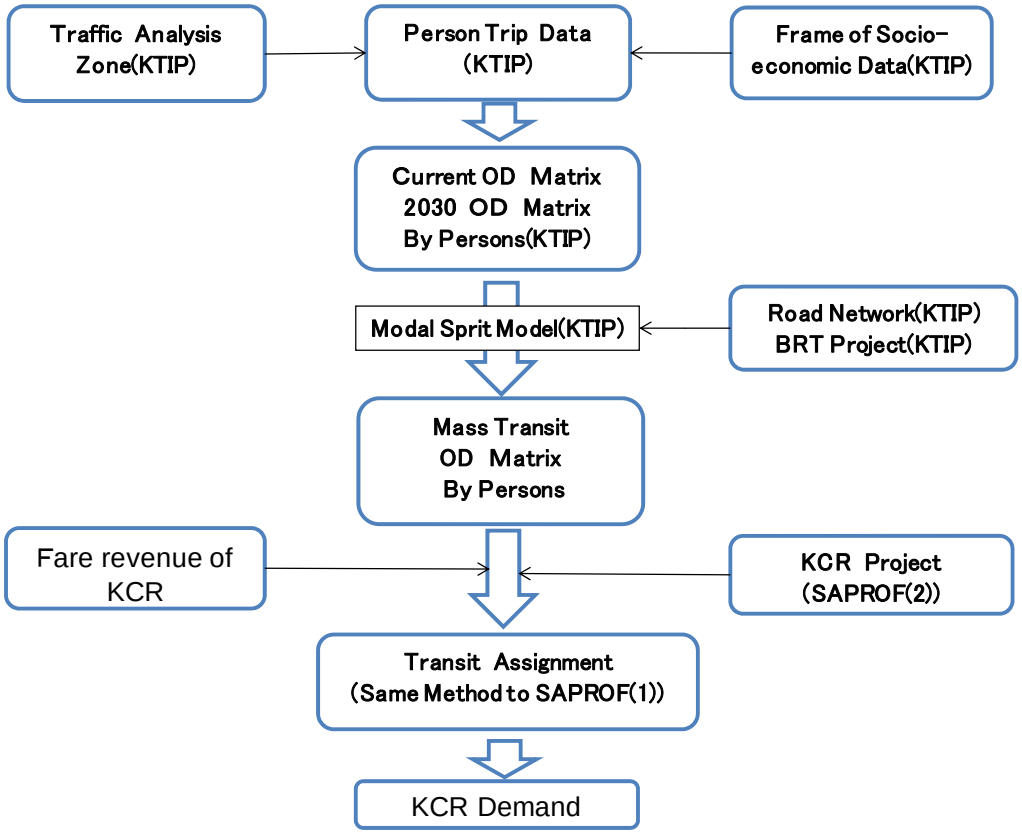
3. REVIEW OF DEMAND FORECAST

The demand forecast was reviewed as shown in the following flow chart, based on the public traffic OD matrix of KTIP. The demand forecast of KCR was conducted by the same method, Transit Assignment, as SAPROF-I.



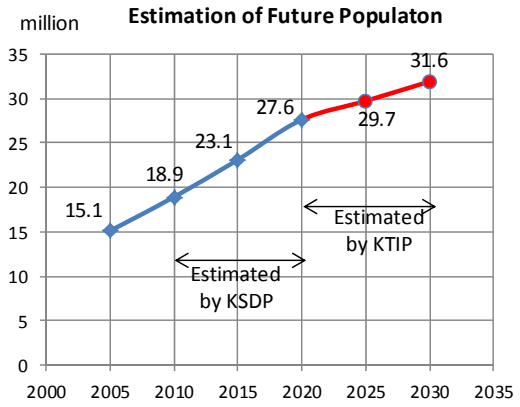
Source: JICA Study Team

Figure 3.1.1 Flow of Demand Forecast

3.1 Socio-Economic Framework and Urban Planning

3.1.1 Future Population

Population of Karachi City until 2020 was estimated in KSDP2020. The Average Annual Growth Rate (AAGR) after 2005 decreases by 0.5% every five years. On the basis of prediction of KSDP2020, in 2020 and afterwards, KTIP assumed that a pace of expansion became slow, and estimated the population in 2030 to be 31.6 million people.

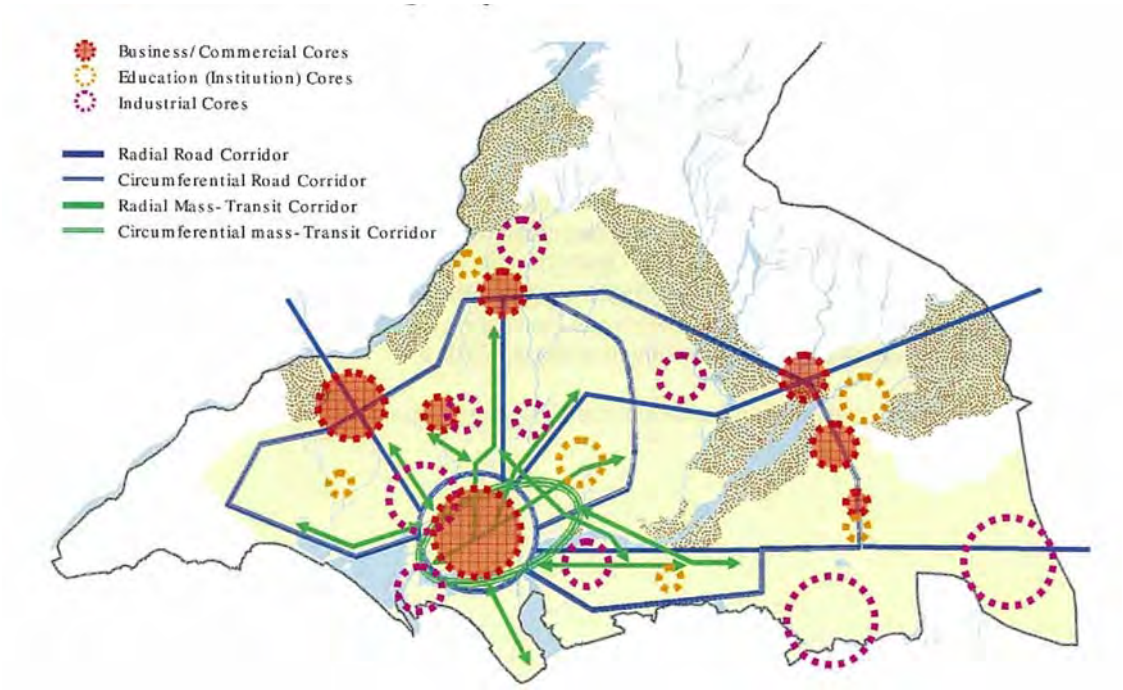


Source: KTIP

Figure 3.1.1 Estimation of Future Population

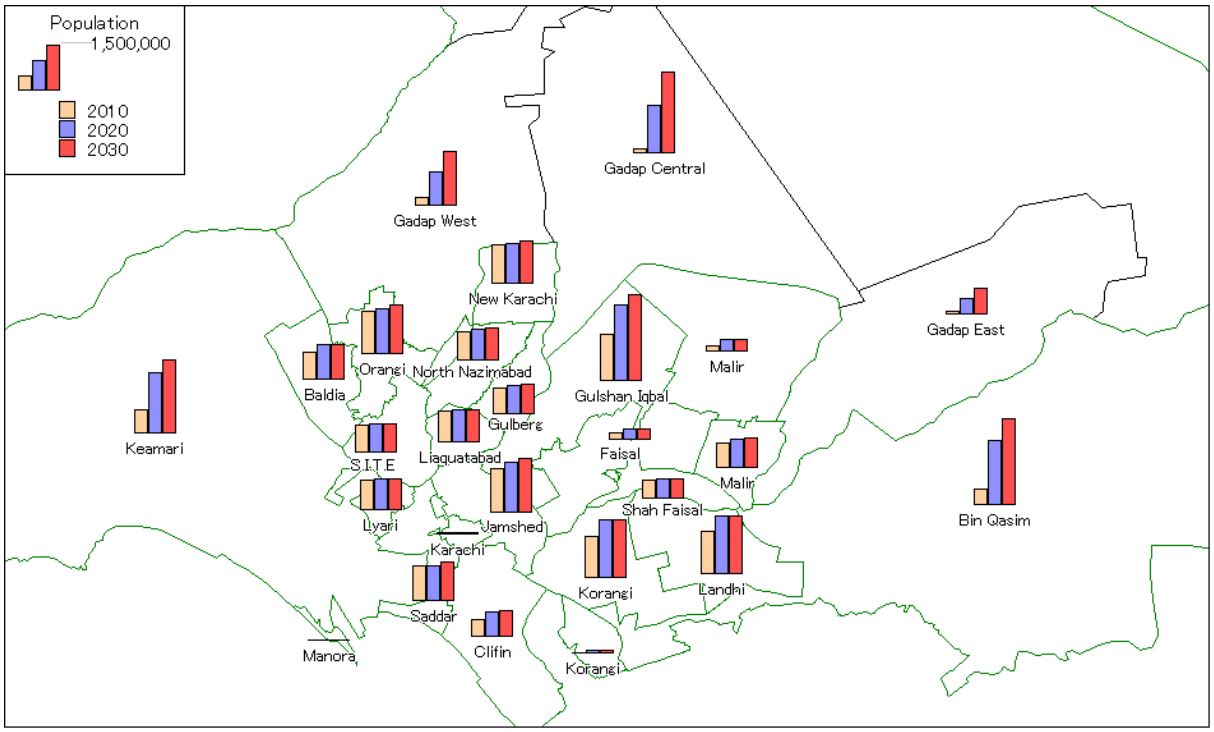
3.1.2 Urban Planning

In 2010, the population density of the urban area in Karachi is 238 persons/ha, and it is a quite high level even compared in the world. KTIP assumed that it became a level of 200 persons/ha in the whole Karachi city, and formulated the land use plan corresponding to 12.7 million increase in population predicted in 2030. In this case, it is assumed that urban area is expanded from 79,567 ha to 158,000 ha in 2030. KTIP follows the plan of KSDP2020 considered as a plan to arrange a city base in the suburban part. As the result, the increases in the population by 2030 will be 4.5 million people in Gadap Town of northern part, 2.1 million people in Bin Qasim Town of eastern part and 1.5 million people in Keamari Town of western part.



Source: KTIP

Figure 3.1.3 Future Urban Structure , Karachi 2030



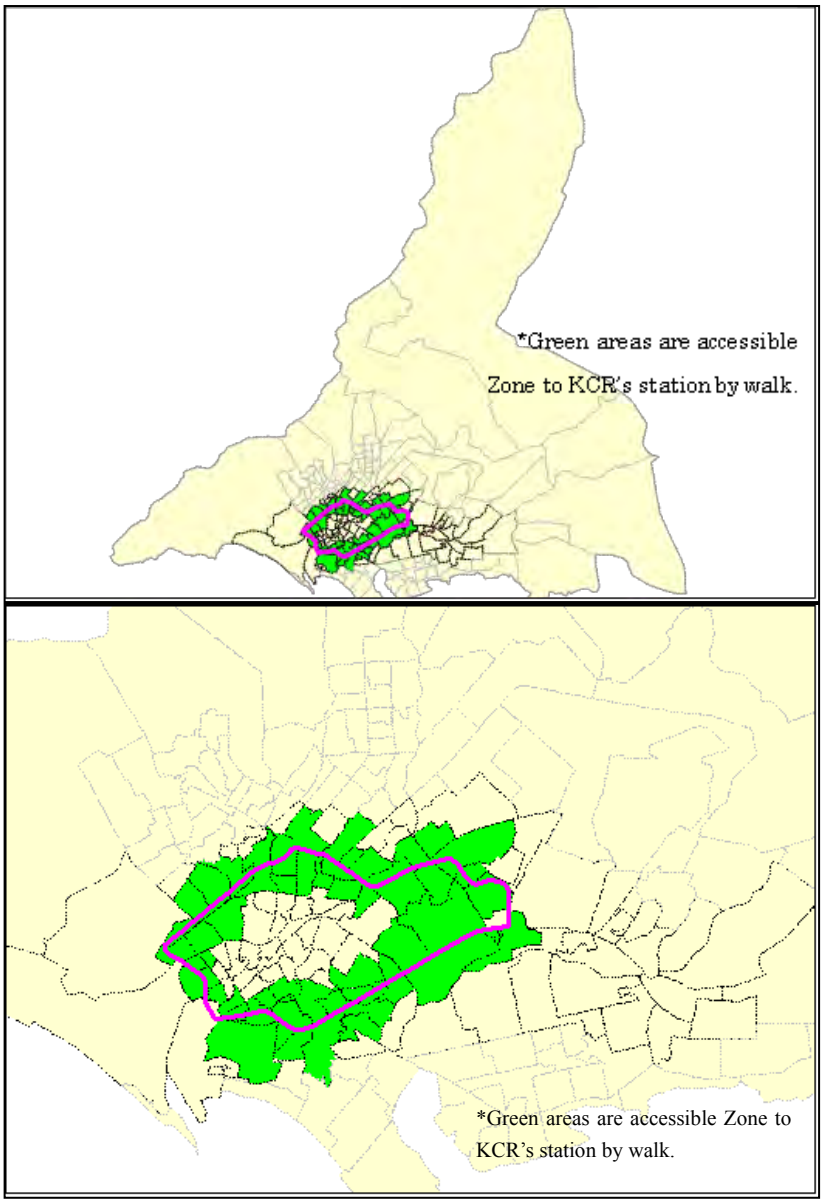
Source: KTIP

Figure 3.1.4 Future Population growth by Town/Cantonment (2010, 2020, 2030)

3.2 Traffic Analysis Zones

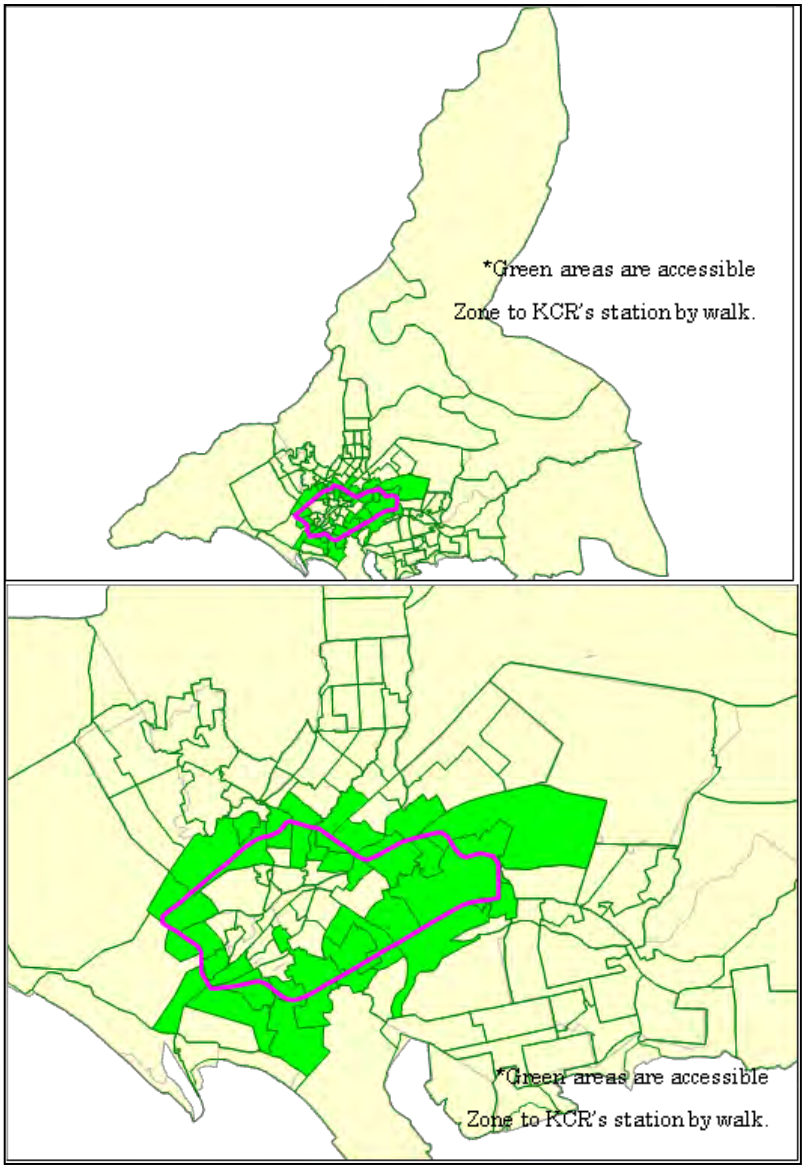
The traffic analysis zones for demand forecast was set into 216 zones of KTIP more finely divided from 151 zones of SAPROF-I. The range of access by walk from a KCR station was supposed to be within a radius of 1 km of the station. The traffic analysis zones in KTIP and SAPROF-I which include such accessible ranges are shown in Figure 3.2.1 and Figure 3.2.2 respectively.

The Cantonment area was subdivided more, and the boundary is scrutinized and changed also in the zone of Town. As a result, as compared with SAPROF-I, the area of the zone corresponding to a KCR sphere of train station decreased for a while.



Source: JICA Study Team

Figure 3.2.1 Traffic Analysis Zone of KTIP



Source: JICA Study Team

Figure 3.2.2 Traffic Analysis Zone of SAPROF-I

3.3 OD Data for Public Transport

The used OD matrix of KTIP is estimated with full network case that includes all future highway projects and mass transit.

The total transport volume from KTIP has 18.3 million trips per day in year 2020. This indicates 45% lower than the predicted volume in SAPROF-I, that is 33.8 million trips per day in year 2023. The public transport volume from KTIP is 9.3 million trips per day in year 2020, which is 32% lower than the predicted volume of SAPROF-I, that is 13.9 million trips in year 2023.

Table 3.3.1 shows the number of trips by mode forecasted in SAPROF-I and KTIP.

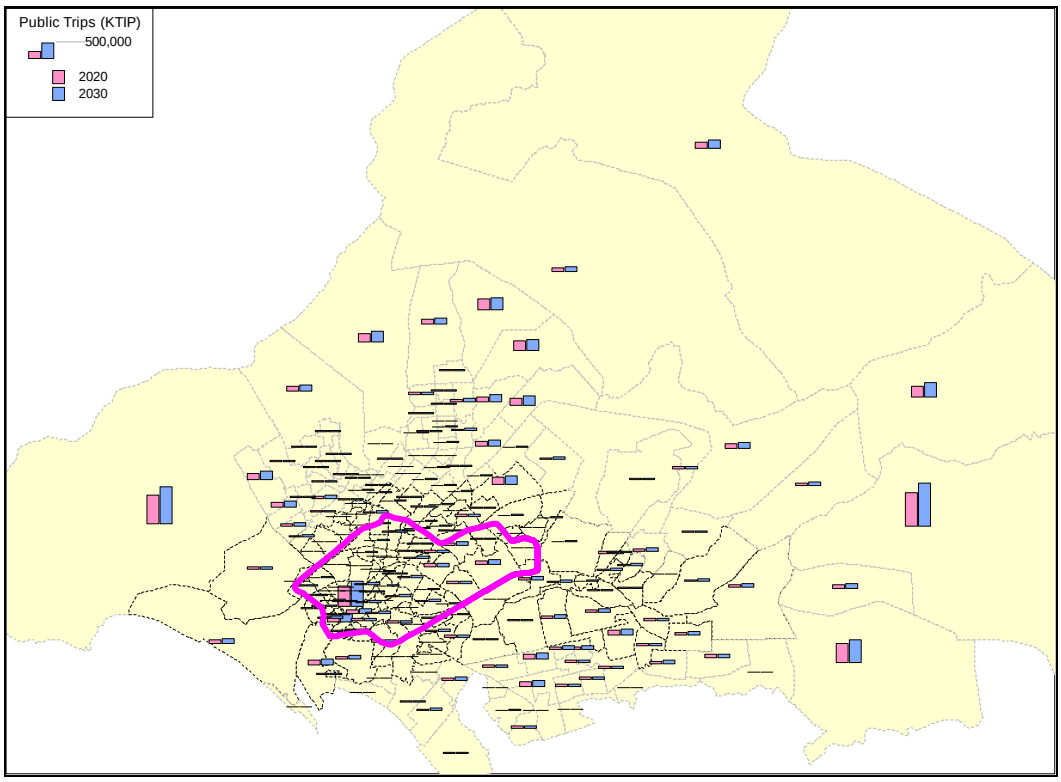
Table 3.3.1 Number of Trips and Modal Share by Mode

	Year	Motorcycle	Passenger car	Public	Truck	Total
SAPROF-I	2023	9,813,424	10,057,563	13,878,226	12,822	33,762,035
		29%	30%	41%	0%	100%
KTIP	2020	2,929,114	5,963,006	9,353,627	47,938	18,293,685
		16%	33%	51%	0%	100%
KTIP	2022	3,008,249	6,122,130	9,757,767	50,222	18,938,368
		16%	32%	52%	0%	100%
KTIP	2030	3,325,528	6,758,517	11,376,018	59,544	21,519,607
		15%	31%	53%	0%	100%

Source: JICA Study Team

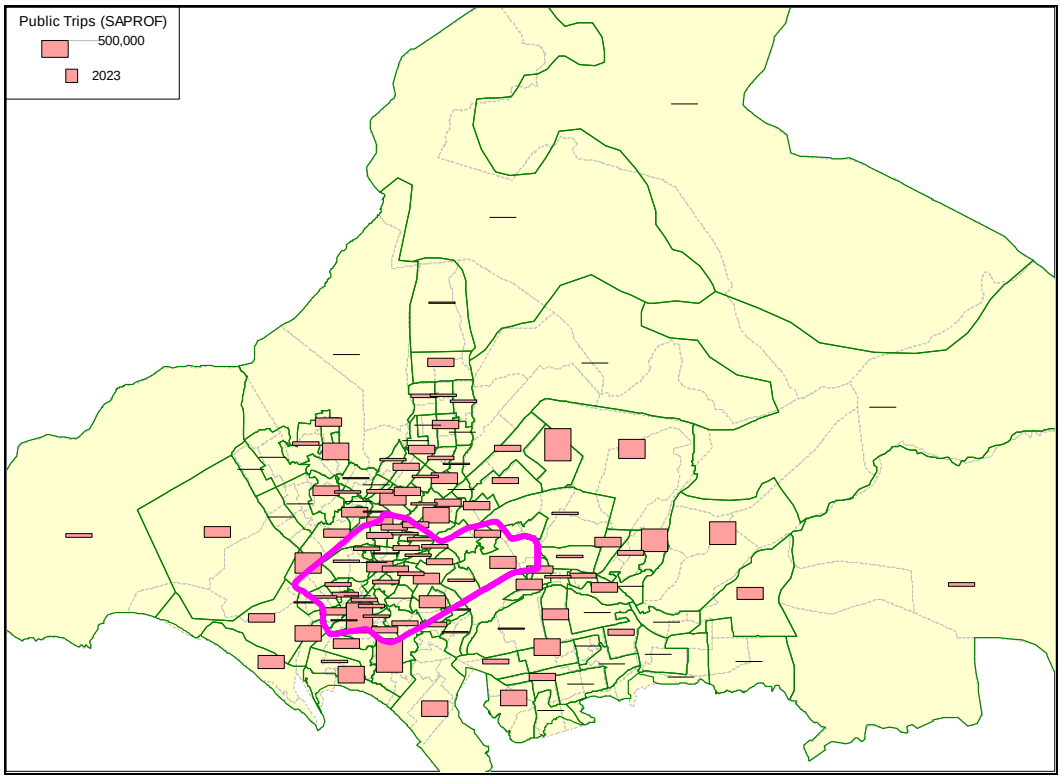
The public transport generation/attraction trips by zones in KTIP and SAPROF-I are shown in Figure 3.3.1 and Figure 3.3.2 respectively. The public transport trips of central parts decreases in volume as compared with SAPROF-I. On the other hand, in the suburban areas forecasted public transport demand is fairly large in KTIP, and traffic distribution pattern differs greatly.

The number of trips at the beginning of operation 2022 year was divided proportionally and estimated based on the data in 2030 and 2020.



Source: JICA Study Team

Figure 3.3.1 Public Trips by Zone (Year 2020/2030 KTIP)



Source: JICA Study Team

Figure 3.3.2 Public Trips by Zone (Year 2023 SAPROF-I)

3.4 Conditions of Demand Forecasting

3.4.1 Mass Transit Development Program

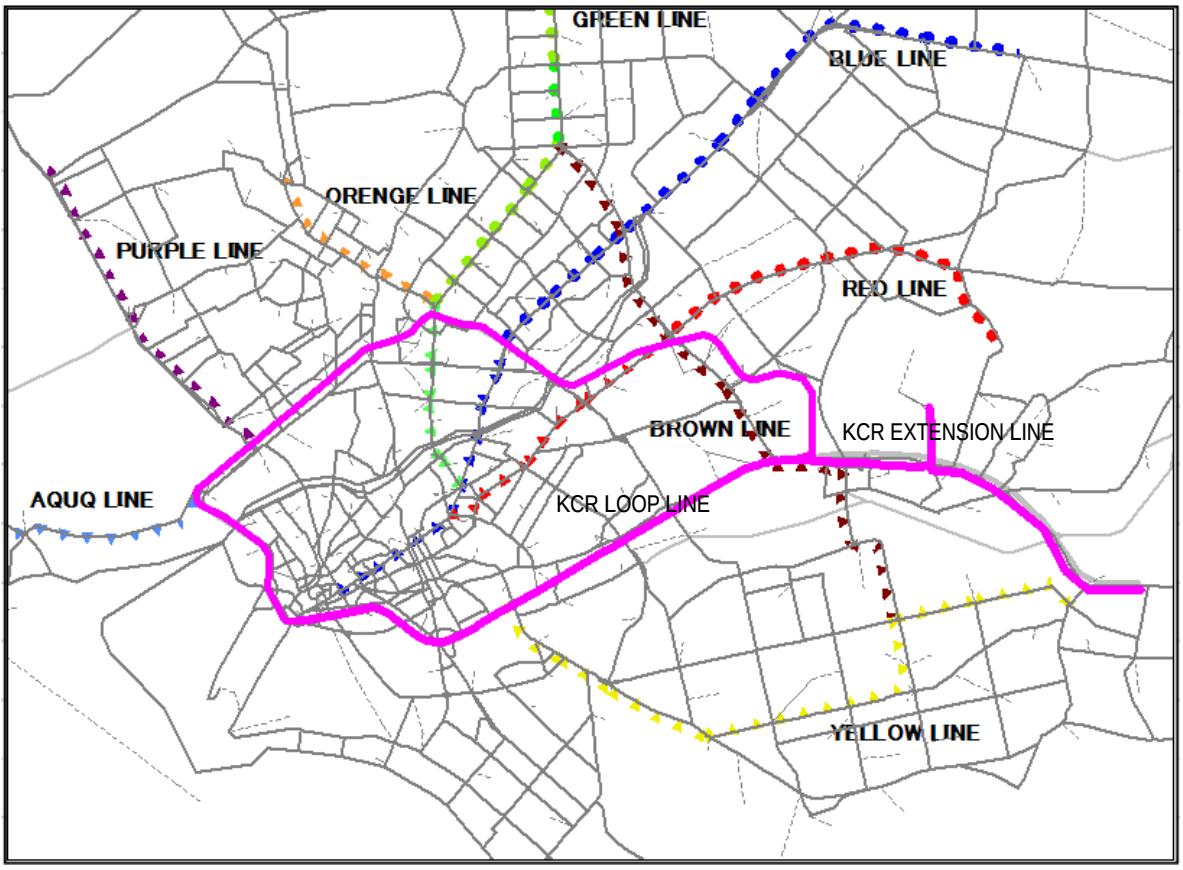
KCR development programs were assumed as two cases, while mass transit development programs were based on KTIP as shown in Table 3.4.1 and Figure 3.4.1.

Usually, since bus routes are what change in connection with urban structure or the traffic condition, the present bus routes shall be extended with development of the suburban area. Moreover, if KCR comes to operate, it is possible that the new feeder bus routes to the station are also improved.

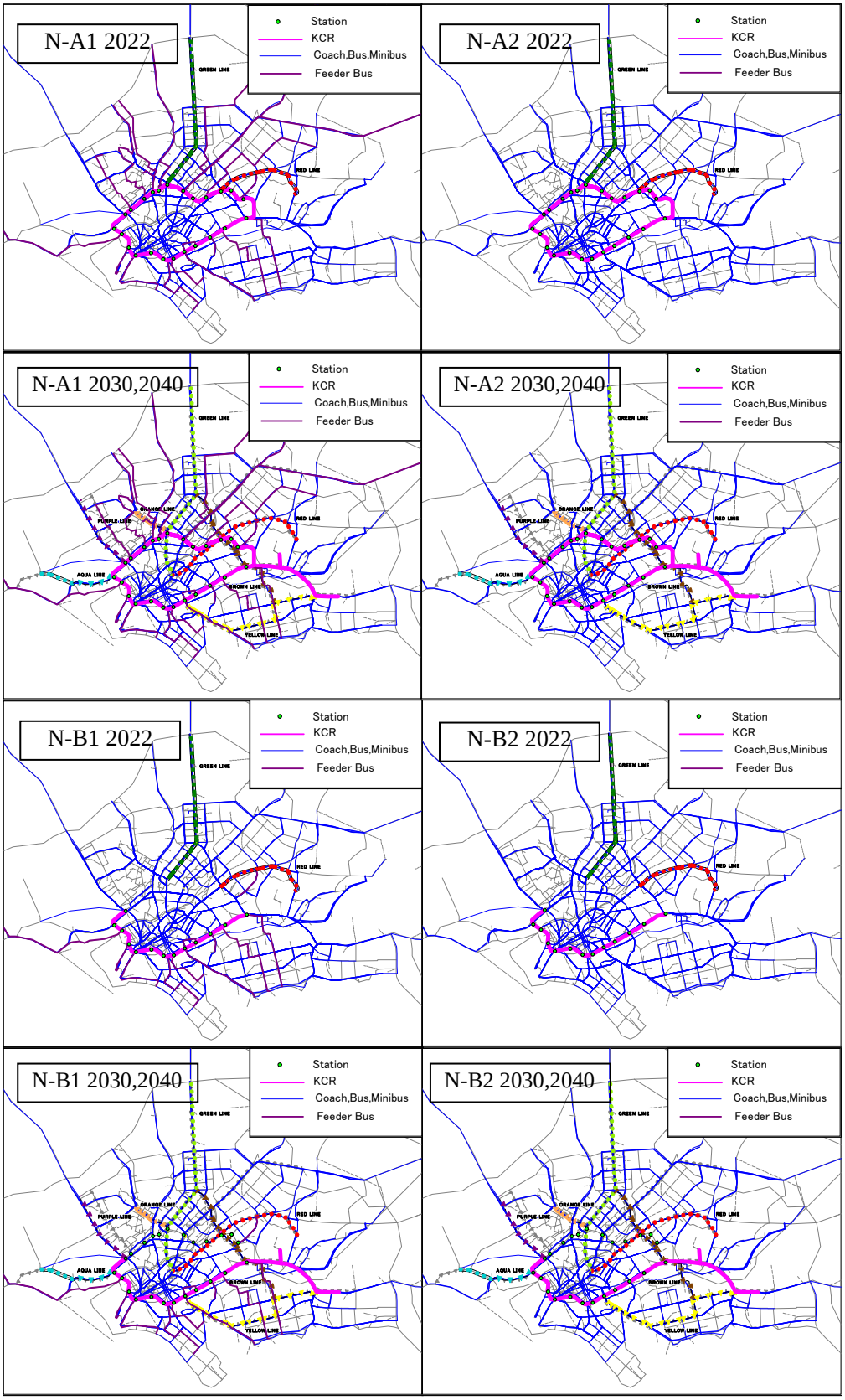
Then, the conditions of the network of bus routes were assumed about the case which the present bus one extended to the suburban area, and the case where the feeder bus routes from KCR stations are fixed in addition. The assumed feeder network of bus routes are as shown in Figure 3.4.1.

Table 3.4.1 KCR Development Cases

Year		2022	2030	2040
KCR	N-A	Loop line	Loop line + Extension line	Loop line + Extension line
	N-B	Shah-Abdul-Latif ～ Karachi Cantt ～ Drigh Road	Shah-Abdul-Latif ～ Karachi Cantt ～ Drigh Road + Extension line	
Buses	1	Extension to the suburban area of the existing bus route network + Establishment feeder routes from the station of loop line (except BRT route)		
	2	Extension to the suburban area of the existing bus route network		
BRT		Green and Red line （Out of KCR）	Green, Red, Brown, Aqua, Orange, Yellow and Purple line Velocity (outside of KCR : 25km/h inside of KCR 15km/h)	Green, Red, Brown, Aqua, Orange, Yellow and Purple line Velocity (25km/h)
Road		Projects under construction	Projects of Master Plan	Projects of Master Plan



Source: JICA Study Team



Source: JICA Study Team

Figure 3.4.1 Mass Transit Network by Each Cases

3.4.2 Level of Service by Public Transport

The service levels of public transport modes were set as shown in Table 3.4.2.

The fare of KCR made small the difference with the present public transport modes for promotion of utilization at the beginning of operation. Then, after the user was established, it was considered as the strategy which raises a few. The time of the charge price increase was assumed to be 2030 when extension of KCR is improved.

Table 3.4.2 Level of Service by Public Transport Mode

Mode	Travel Speed (km/h)	Capacity (Full Seating Full Standing) (Person/vehi.orTrains.)	Frequency (Vehi.orTrains/hr.)	Fare System (Rs.)
Coach	15	45	10-20	19+(D-10)×0.1
Minibus	15	45	10-20	14+(D- 5)×0.3
Bus	15	65	10-20	13+(D- 5)×0.3
KPTS[*1]	15	58	10-20	15+(D-10)×0.2
UTS[*2]	15	58	10-20	15+(D-10)×0.2
BRT	15/25	200	20	15+(D- 5)×0.5
KCR	43	1690	20	From 2022 to 2029 16+(D-5) ×0.5 From 2030 17+(D- 5)×0.5

[*1]KPTS: Buses which are operated by Karachi Public Transport and Education society
[*2]UTS : Buses which are operated by Urban Transport Scheme
D: Distance(km)

Source: JICA Study Team

3.4.3 Transfer Mode between KCR and Other Public Transportation

The transfer from KCR stations to bus stops are on foot. Usually, a railroad station and a station square are improved simultaneously and the transfer which is between a railroad and a bus becomes easy. However, since the lack of place for the station square, there are some KCR stations which cannot improve the station one.

This demand estimating of KCR is selected at a shortest path and its course up to 1.2 times based on the generalization travel cost in consideration of boarding time, waiting time, transfer time and its charge. At this time, it is selected at the path whose number of transfer times is up to 2 times as a realistic path.

Since transfer resistance was large when transfer distance is 240 m (3 minutes) or more, walking was considered one of traffic mode, and it counted to the number of transfer times . When transfer distance is less than 240 m, walking is not considered to be traffic mode and it does not count to the number of transfer times.

Table 3.4.3 Transfer Distance Between KCR and Buses

Station	Transfer Distance	Walking Mode
Drigh Road	160 m	
Johar	50 m	
Alladin Park	680 m	✓
Nipa	80m (Rahid Minas)	
	410m (University)	✓
Giliani	550 m	✓
Yasinabad	160 m	
Liaquatabad	180 m	
North Nazimabad	180 m	
Orangi	600 m	✓
HBL	480 m	✓
Manghopir	400 m	✓
SITE	240 m	
Shah-Abdul-Latif	180 m	
Baldia	410m	✓
Liyari	160 m	
Wazir Mansion	140 m	
Tower	460 m	✓
Karachi City	400 m	✓
DCOS	320 m	✓
Karachi Cantt.	100 m	
Naval	220 m	
Chanesar	800 m	✓
Shaheed-e-Millat	160 m	
Karzas Halt	130 m	

Source: JICA Study Team

3.5 KCR Demand

The result of demand forecast for the KCR is summarized in Table 3.5.1. Passengers loading is presented in Figure 3.5.1 and Figure 3.5.2. Boarding and alighting passengers at each station are shown in Table 3.5.3, Table 3.5.4, Table 3.5.5 and Table 3.5.6. The estimated KCR demand for each year is shown in Table 3.5.7.

In case N-A1, the total numbers of passenger are estimated as 578,362 persons per day in 2022 and 1,223,066 persons per day in 2030. In case N-A2 the total number of passenger is estimated as 526,738 persons per day in 2022 and 1,174,107 persons per day in 2030. The difference of this amount demanded is the difference in whether the feeder buses to stations are improved, and its influence is about 10% for the demand of 2022 and 4% for that of 2030 respectively.

In case N-B1, the total numbers of passenger are estimated as 306,236 persons per day in 2022 and 828,018 persons per day in 2030. The numbers of passenger of the case N-B1 constitutes 53% of one of the case N-A1 in 2022 and 68% in 2030.

Table 3.5.1 Case wised KCR Demand in 2022 and 2030

		2022	2030
Case N-A1	Number of Passenger	578,362	1,223,066
	Max. Number of Passengers loaded by section	236,999	448,476
	Counter-clockwise	111,312	221,106
	Clockwise	125,687	227,370
Case N-A2	Number of Passenger	526,738	1,174,107
	Max. Number of Passengers loaded by section	219,548	426,870
	Counter-clockwise	102,925	210,076
	Clockwise	116,623	216,794
Case N-B1	Number of Passenger	306,236	828,018
	Max. Number of Passengers loaded by section	225,101	449,858
	Counter-clockwise	106,980	218,875
	Clockwise	118,121	230,983
Case N-B2	Number of Passenger	283,543	798,716
	Max. Number of Passengers loaded by section	207,820	427,397
	Counter-clockwise	97,818	206,638
	Clockwise	110,002	220,759

Source: JICA Study Team

In case N-A1, the maximum section numbers of passengers are 236,999 persons between Karachi Cantt and Naval in 2022 and 448,476 persons in 2030. In case N-B1, the maximum section numbers of passengers are 225,101 persons in 2022 and 449,858 persons in 2030 at the same section. That is, even if KCR is loop route and it is the south route, there is no difference with the maximum section numbers of passengers.

The demand in 2040 is analyzed taking into account the increased travel speed of BRT inside the KCR to 25 km/h while the OD table remains unchanged from that in 2030.

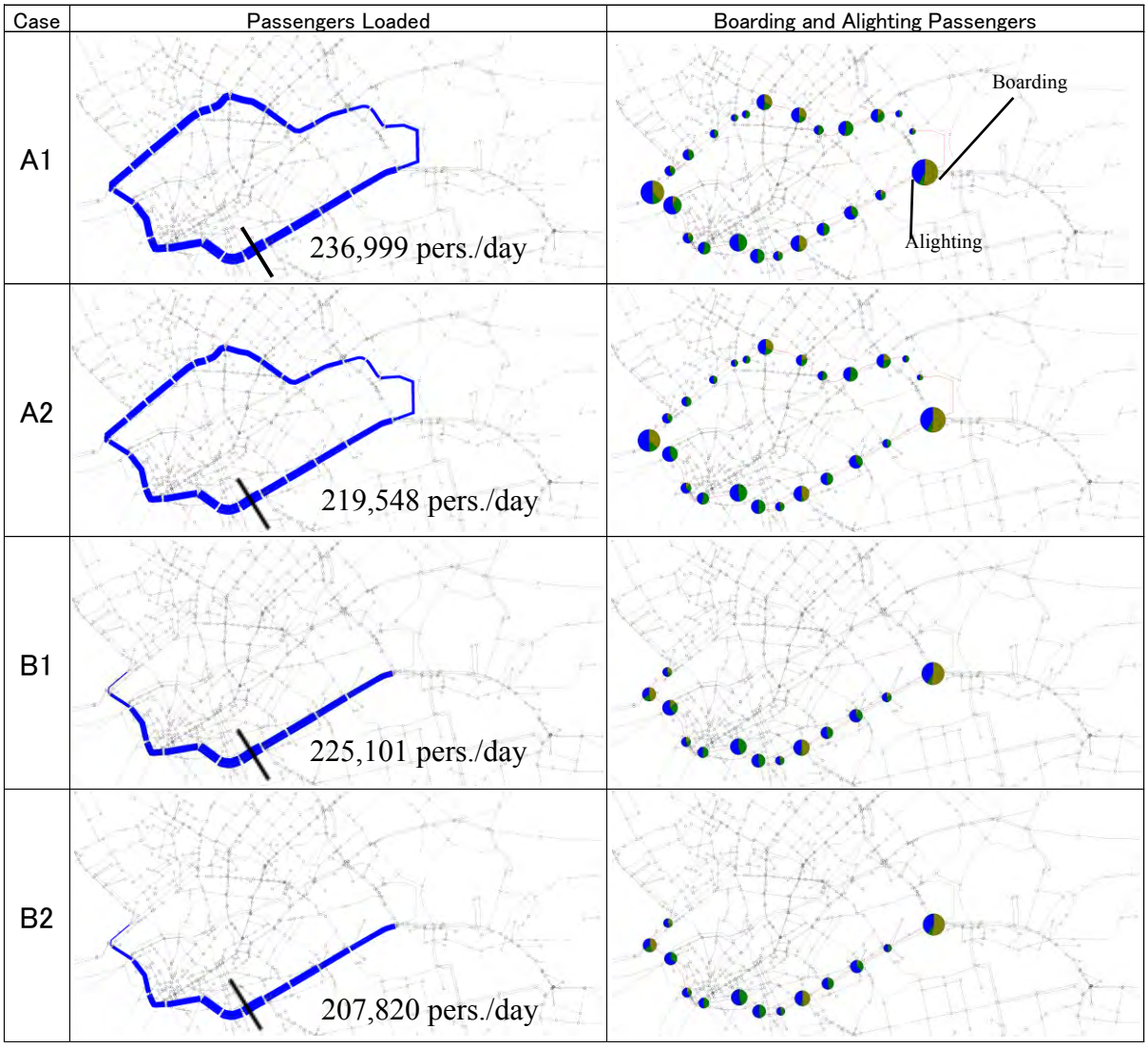
In the case N-A1,A2 speedup of BRT inside KCR shows that the number of passengers decreases by 2%. On the other hand, it is concluded that the KCR demand will not be influenced evidently by the speed-up of BRT inside the KCR in the case N-B1,B2.

Table 3.5.2 Number of Passenger

Cases	2030 (a)	2040* (b)	(a/b)
N-A1	1,223,066	1,197,964	98%
N-A2	1,174,107	1,148,103	98%
N-B1	828,018	825,415	100%
N-B2	798,716	795,939	100%

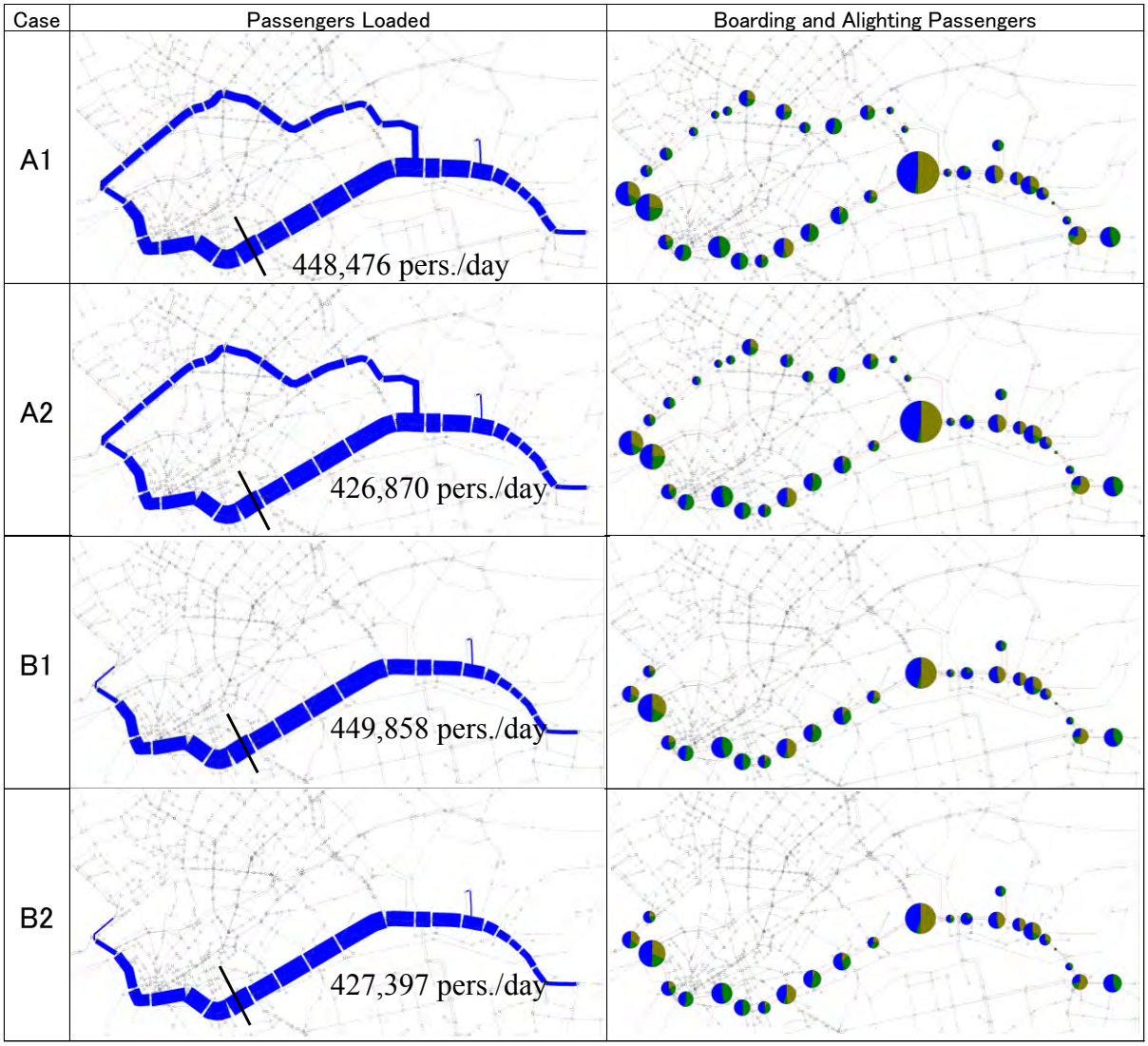
*2040:OD Table is the same one to year 2030.BRT's velocity is changed 25 km/h inside KCR.

Source: JICA Study Team



Source: JICA Study Team

Figure 3.5.1 Passengers Loading (Year 2022)



Source: JICA Study Team

Figure 3.5.2 Passengers Loading (Year 2030)

Table 3.5.3 Boarding and Alighting Passengers (Case N-A1)

Year	2022							2030						
Direction	Counterclockwise			Clockwise				Counterclockwise			Clockwise			
Station		Alight	Board + Transfer	Carried		Alight	Board + Transfer	Carried		Alight	Board + Transfer	Carried		Alight	Board + Transfer	Carried
Drigh Road		49,055	25,956			22,573	73,696			78,995	72,514			60,428	31,467	
	↓			34,975	↑			32,482	↓			80,141	↑			69,824
Johar		2,283	3,812			2,309	1,777			3,998	3,634			2,611	3,021	
	↓			36,504	↑			33,014	↓			79,777	↑			69,414
Alladin Park		3,440	2,808			2,912	3,117			4,273	3,168			2,731	4,038	
	↓			35,872	↑			32,809	↓			78,672	↑			68,107
NiPA		2,841	19,300			18,587	3,988			6,125	22,145			20,595	6,245	
	↓			52,331	↑			47,408	↓			94,692	↑			82,457
Gilani		11,632	18,898			14,096	11,197			17,697	19,181			14,180	17,155	
	↓			59,597	↑			50,307	↓			96,176	↑			79,482
Yasinabad		3,184	10,410			8,018	1,855			8,144	9,874			7,437	5,694	
	↓			66,823	↑			56,470	↓			97,906	↑			81,225
Liaquatabad		6,918	21,165			21,581	7,011			13,217	17,974			16,798	13,724	
	↓			81,070	↑			71,040	↓			102,663	↑			84,299
North-Nazimabad		9,124	21,286			19,750	9,726			14,381	19,458			17,635	14,162	
	↓			93,232	↑			81,064	↓			107,740	↑			87,772
Orangi		2,338	5,337			5,015	3,948			4,356	5,598			5,443	6,061	
	↓			96,231	↑			82,131	↓			108,982	↑			87,154
HBL		5,115	1,940			1,922	4,357			7,326	1,729			1,496	5,916	
	↓			93,056	↑			79,696	↓			103,385	↑			82,734
Manghopir		6,926	2,348			2,789	5,688			8,474	2,263			2,780	6,790	
	↓			88,478	↑			76,797	↓			97,174	↑			78,724
SITE		9,775	6,851			6,788	7,313			16,350	8,123			6,010	10,432	
	↓			85,554	↑			76,272	↓			88,947	↑			74,302
Shah-Abdul-Latif		9,510	4,032			6,296	7,259			12,770	6,357			7,206	9,359	
	↓			80,076	↑			75,309	↓			82,534	↑			72,149
Baldia		51,511	30,145			16,232	36,798			50,756	34,081			30,449	35,837	
	↓			58,710	↑			54,743	↓			65,859	↑			66,761
Liyari		8,100	21,727			39,562	13,051			8,531	65,283			84,726	28,510	
	↓			72,337	↑			81,254	↓			122,611	↑			122,977
Wazir Mansion		2,686	7,454			13,115	3,912			3,049	20,225			27,472	4,624	
	↓			77,105	↑			90,457	↓			139,787	↑			145,825
Tower		7,647	11,399			9,896	10,030			9,075	25,955			21,307	11,444	
	↓			80,857	↑			90,323	↓			156,667	↑			155,688
Karachi City		6,257	25,981			34,145	11,443			7,431	44,336			55,962	12,405	
	↓			100,581	↑			113,025	↓			193,572	↑			199,245
DCOS		6,637	16,683			19,697	8,322			7,521	26,418			29,299	8,828	
	↓			110,627	↑			124,400	↓			212,469	↑			219,716
Karachi Kanttt.		5,226	5,911			6,617	5,330			6,715	15,352			14,757	7,103	
	↓			111,312	↑			125,687	↓			221,106	↑			227,370
Naval		28,916	3,470			3,758	30,725			35,239	12,872			10,595	39,406	
	↓			85,866	↑			98,720	↓			198,739	↑			198,559
Chanesar		8,089	9,163			12,821	10,959			11,791	28,364			26,814	15,606	
	↓			86,940	↑			100,582	↓			215,312	↑			209,767
Shaheed-e-Millat		23,465	5,312			4,791	12,329			24,901	19,864			15,120	17,070	
	↓			68,787	↑			93,044	↓			210,275	↑			207,817
Karzas Halt		12,587	1,874			1,850	11,289			14,725	10,842			4,497	13,751	
	↓			58,074	↑			83,605	↓			206,392	↑			198,563
Drigh Road		0	0			0	0			19,532	121,085			52,679	8,398	
	↓			0	↑			0	↓			221,323	↑			201,981
Drigh Colony		0	0			0	0			2,674	4,056			6,212	3,434	
	↓			0	↑			0	↓			222,705	↑			204,759
Star Gate		0	0			0	0			40,510	815			1,435	7,981	
	↓			0	↑			0	↓			183,010	↑			198,213
Proposed St1		0	0			0	0			22,430	2,669			5,186	19,630	
	↓			0	↑			0	↓			163,249	↑			183,769
Malir Halt		0	0			0	0			19,254	1,088			2,547	21,402	
	↓			0	↑			0	↓			145,083	↑			164,914
Kara Board		0	0			0	0			43,089	689			1,174	40,044	
	↓			0	↑			0	↓			102,683	↑			126,044
Malir City		0	0			0	0			23,302	1,111			0	14,248	
	↓			0	↑			0	↓			80,492	↑			111,796
Proposed St2		0	0			0	0			34	251			67	2,536	
	↓			0	↑			0	↓			80,709	↑			109,327
Proposed St3		0	0			0	0			11,748	8			0	6,119	
	↓			0	↑			0	↓			68,969	↑			103,208
Landi Junction		0	0			0	0			14,210	2,113			4,829	62,253	
	↓			0	↑			0	↓			56,872	↑			45,784
Madina Masjid Zafar		0	0			0	0			56,872	0			0	45,784	
Proposed St1		0	0			0	0			0	15,277			17,817	0	
	↓			0				0	↓			15,277				17,817
Jinnah Airport		0	0			0	0			15,277	0			0	17,817	
		283,262	283,262			295,120	295,120			644,772	644,772			578,294	578,294	

Source: JICA Study Team

Table 3.5.4 Boarding and Alighting Passengers (Case N-A2)

Year	2022							2030						
Direction	Counterclockwise			Clockwise				Counterclockwise			Clockwise			
Station	Alight	Board + Transfer	Carried		Alight	Board + Transfer	Carried	Alight	Board + Transfer	Carried		Alight	Board + Transfer	Carried
Drigh Road	45,347	23,640			21,094	69,184		77,241	71,460			59,056	30,208	
	↓		31,242	↑			30,326	↓		77,845	↑			68,182
Johar	1,894	3,702			2,240	1,411		3,760	3,555			2,467	2,973	
	↓		33,050	↑			31,155	↓		77,640	↑			67,676
Alladin Park	3,314	2,887			2,937	3,026		4,226	3,215			2,854	3,945	
	↓		32,623	↑			31,066	↓		76,629	↑			66,585
NiPA	2,248	21,840			20,777	4,089		5,928	24,352			23,655	6,646	
	↓		52,215	↑			47,754	↓		95,053	↑			83,594
Gilani	11,158	18,248			13,952	10,306		17,866	18,515			14,279	16,816	
	↓		59,305	↑			51,400	↓		95,702	↑			81,057
Yasinabad	3,131	9,644			7,659	1,758		8,247	9,374			7,189	5,918	
	↓		65,818	↑			57,301	↓		96,829	↑			82,328
Liaquatabad	5,962	9,814			9,329	6,313		12,609	8,116			7,475	13,333	
	↓		69,670	↑			60,317	↓		92,336	↑			76,470
North-Nazimabad	8,993	21,636			19,919	9,696		14,491	19,761			17,737	14,336	
	↓		82,313	↑			70,540	↓		97,606	↑			79,871
Orangi	1,981	4,799			4,587	3,544		4,008	5,332			5,067	5,926	
	↓		85,131	↑			71,583	↓		98,930	↑			79,012
HBL	4,869	1,923			1,968	3,871		7,271	1,706			1,534	5,852	
	↓		82,185	↑			69,680	↓		93,365	↑			74,694
Manghopir	6,725	2,193			2,554	5,398		8,143	2,235			2,560	6,527	
	↓		77,653	↑			66,836	↓		87,457	↑			70,727
SITE	6,944	6,464			5,276	5,268		13,223	7,923			4,871	8,529	
	↓		77,173	↑			66,844	↓		82,157	↑			67,069
Shah-Abdul-Latif	8,980	3,815			6,837	6,983		12,326	6,231			7,576	9,127	
	↓		72,008	↑			66,698	↓		76,062	↑			65,518
Baldia	46,014	29,377			16,353	32,147		46,585	37,036			32,442	32,785	
	↓		55,371	↑			50,904	↓		66,513	↑			65,175
Liyari	6,249	13,637			28,717	11,298		6,635	53,295			72,760	28,159	
	↓		62,759	↑			68,323	↓		113,173	↑			109,776
Wazir Mansion	2,708	7,248			14,863	3,440		3,219	19,839			30,471	4,120	
	↓		67,299	↑			79,746	↓		129,793	↑			136,127
Tower	7,313	10,836			9,351	9,008		8,879	25,016			20,267	10,495	
	↓		70,822	↑			80,089	↓		145,930	↑			145,899
Karachi City	6,005	25,473			33,485	10,695		7,186	43,420			54,704	11,426	
	↓		90,290	↑			102,879	↓		182,164	↑			189,177
DCOS	6,044	17,521			19,283	7,389		6,849	26,551			27,972	8,085	
	↓		101,767	↑			114,773	↓		201,866	↑			209,064
Karachi Kanttt.	4,502	5,660			6,480	4,630		6,151	14,361			14,238	6,508	
	↓		102,925	↑			116,623	↓		210,076	↑			216,794
Naval	26,884	3,155			3,297	28,245		34,085	12,542			9,697	38,723	
	↓		79,196	↑			91,675	↓		188,533	↑			187,768
Chanesar	7,820	8,462			12,519	10,699		11,457	28,070			26,781	15,034	
	↓		79,838	↑			93,495	↓		205,146	↑			199,515
Shaheed-e-Millat	23,126	5,456			4,836	11,947		24,220	20,139			15,263	16,414	
	↓		62,168	↑			86,384	↓		201,065	↑			198,364
Karzas Halt	9,641	422			571	8,539		9,688	8,708			3,475	9,659	
	↓		52,949	↑			78,416	↓		200,085	↑			192,180
Drigh Road	0	0			0	0		18,475	119,661			52,071	7,349	
	↓		0	↑			0	↓		217,645	↑			197,568
Drigh Colony	0	0			0	0		3,101	4,176			6,351	3,943	
	↓		0	↑			0	↓		218,720	↑			199,976
Star Gate	0	0			0	0		40,092	822			1,435	7,671	
	↓		0	↑			0	↓		179,450	↑			193,740
Proposed St1	0	0			0	0		21,287	2,901			5,134	18,592	
	↓		0	↑			0	↓		161,064	↑			180,282
Malir Halt	0	0			0	0		19,337	1,091			2,602	21,360	
	↓		0	↑			0	↓		142,818	↑			161,524
Kara Board	0	0			0	0		42,201	689			1,225	39,494	
	↓		0	↑			0	↓		101,306	↑			123,255
Malir City	0	0			0	0		23,671	1,125			42	14,454	
	↓		0	↑			0	↓		78,760	↑			108,843
Proposed St2	0	0			0	0		50	251			67	2,565	
	↓		0	↑			0	↓		78,961	↑			106,345
Proposed St3	0	0			0	0		11,455	8			0	5,929	
	↓		0	↑			0	↓		67,514	↑			100,416
Landi Junction	0	0			0	0		14,369	2,026			4,685	61,304	
	↓		0	↑			0	↓		55,171	↑			43,797
Madina Masjid Zafar	0	0			0	0		55,171	0			0	43,797	
Proposed St1	0	0			0	0		0	15,013			17,590	0	
	↓		0				0	↓		15,013				17,590
Jinnah Airport	0	0			0	0		15,013	0			0	17,590	
	257,852	257,852			268,884	268,884		618,515	618,515			555,592	555,592	

Source: JICA Study Team

Table 3.5.5 Boarding and Alighting Passengers (Case N-B1)

Year	2022								2030							
Direction	Counterclockwise				Clockwise				Counterclockwise				Clockwise			
Station		Alight	Board + Transfer	Carried		Alight	Board + Transfer	Carried		Alight	Board + Transfer	Carried		Alight	Board + Transfer	Carried
Shah-Abdul-Latif		0	10,270			11,892	0			0	16,129			21,113	0	
	↓			10,270	↑			11,892	↓			16,129	↑			21,113
Baldia		490	30,270			16,183	641			380	35,989			32,233	531	
	↓			40,050	↑			27,434	↓			51,738	↑			52,815
Liyari		703	22,670			34,806	480			5,881	71,192			93,552	29,180	
	↓			62,017	↑			61,760	↓			117,049	↑			117,187
Wazir Mansion		1,568	8,253			11,358	1,738			1,868	20,783			26,165	2,716	
	↓			68,702	↑			71,380	↓			135,964	↑			140,636
Tower		5,374	11,113			9,313	4,222			7,503	25,512			20,873	6,556	
	↓			74,441	↑			76,471	↓			153,973	↑			154,953
Karachi City		4,804	24,776			31,525	5,659			6,336	42,961			54,134	8,152	
	↓			94,413	↑			102,337	↓			190,598	↑			200,935
DCOS		4,940	17,063			19,277	4,942			6,473	26,422			28,931	6,896	
	↓			106,536	↑			116,672	↓			210,547	↑			222,970
Karachi Kanttt.		4,951	5,395			5,915	4,466			6,412	14,740			14,499	6,486	
	↓			106,980	↑			118,121	↓			218,875	↑			230,983
Naval		27,659	2,894			2,911	31,501			33,494	11,994			10,421	40,677	
	↓			82,215	↑			89,531	↓			197,375	↑			200,727
Chanesar		8,275	8,868			12,111	9,086			11,692	28,220			26,594	13,728	
	↓			82,808	↑			92,556	↓			213,903	↑			213,593
Shaheed-e-Millat		23,135	4,717			3,964	11,745			25,272	20,121			15,466	16,133	
	↓			64,390	↑			84,775	↓			208,752	↑			212,926
Karzas Halt		12,152	312			380	10,326			14,853	11,160			3,958	13,369	
	↓			52,550	↑			74,829	↓			205,059	↑			203,515
Drigh Road		52,550	0			0	74,829			101,697	78,854			8,017	52,019	
	↓			0	↑			0	↓			182,216	↑			159,513
Drigh Colony		0	0			0	0			2,060	4,102			6,718	4,036	
	↓			0	↑			0	↓			184,258	↑			162,195
Star Gate		0	0			0	0			28,172	598			1,692	7,122	
	↓			0	↑			0	↓			156,684	↑			156,765
Proposed St1		0	0			0	0			18,726	2,678			5,987	16,804	
	↓			0	↑			0	↓			140,636	↑			145,948
Malir Halt		0	0			0	0			19,092	1,856			3,736	20,578	
	↓			0	↑			0	↓			123,400	↑			129,106
Kara Board		0	0			0	0			39,155	879			1,580	36,965	
	↓			0	↑			0	↓			85,124	↑			93,721
Malir City		0	0			0	0			19,158	1,111			0	13,407	
	↓			0	↑			0	↓			67,077	↑			80,314
Proposed St2		0	0			0	0			50	251			67	1,409	
	↓			0	↑			0	↓			67,278	↑			78,972
Proposed St3		0	0			0	0			8,860	8			0	5,543	
	↓			0	↑			0	↓			58,426	↑			73,429
Landi Junction		0	0			0	0			11,762	2,228			5,489	42,478	
	↓			0	↑			0	↓			48,892	↑			36,440
Madina Masjid Zafar		0	0			0	0			48,892	0			0	36,440	
Proposed St1		0	0			0	0			0	13,472			15,533	0	
	↓			0				0	↓			13,472				15,533
Jinnah Airport		0	0			0	0			13,472	0			0	15,533	
		146,601	146,601			159,635	159,635			431,260	431,260			396,758	396,758	

Source: JICA Study Team

Table 3.5.6 Boarding and Alighting Passengers (Case N-B2)

Year		2022							2030						
Direction		Counterclockwise			Clockwise				Counterclockwise			Clockwise			
Station		Alight	Board + Transfer	Carried		Alight	Board + Transfer	Carried	Alight	Board + Transfer	Carried		Alight	Board + Transfer	Carried
Shah-Abdul-Latif		0	10,211			11,637	0		0	15,931			20,650	0	
	↓			10,211	↑			11,637	↓		15,931	↑			20,650
Baldia		654	29,740			16,630	779		422	39,061			34,260	552	
	↓			39,297	↑			27,488	↓		54,570	↑			54,358
Liyari		670	14,716			25,686	377		5,811	59,473			82,408	30,458	
	↓			53,343	↑			52,797	↓		108,232	↑			106,308
Wazir Mansion		1,619	7,883			12,686	1,563		1,887	20,020			29,336	2,351	
	↓			59,607	↑			63,920	↓		126,365	↑			133,293
Tower		5,137	10,521			8,768	4,121		7,141	24,495			19,833	6,337	
	↓			64,991	↑			68,567	↓		143,719	↑			146,789
Karachi City		4,466	24,079			30,701	5,451		5,941	41,560			52,558	7,978	
	↓			84,604	↑			93,817	↓		179,338	↑			191,369
DCOS		4,531	16,897			18,751	4,506		5,958	25,529			27,737	6,409	
	↓			96,970	↑			108,062	↓		198,909	↑			212,697
Karachi Kanttt.		4,329	5,177			5,801	3,861		5,943	13,672			13,921	5,859	
	↓			97,818	↑			110,002	↓		206,638	↑			220,759
Naval		25,749	2,647			2,615	29,598		32,102	11,621			9,387	40,026	
	↓			74,716	↑			83,019	↓		186,157	↑			190,120
Chanesar		8,033	8,168			11,452	8,832		11,330	27,582			26,234	13,416	
	↓			74,851	↑			85,639	↓		202,409	↑			202,938
Shaheed-e-Millat		22,785	4,720			3,897	11,485		24,623	20,158			15,435	15,615	
	↓			56,786	↑			78,051	↓		197,944	↑			202,758
Karzas Halt		9,022	31			129	7,601		9,776	10,473			3,510	9,166	
	↓			47,795	↑			70,579	↓		198,641	↑			197,102
Drigh Road		47,795	0			0	70,579		97,592	77,728			8,000	48,986	
	↓			0	↑			0	↓		178,777	↑			156,116
Drigh Colony		0	0			0	0		2,254	4,218			6,849	4,403	
	↓			0	↑			0	↓		180,741	↑			158,562
Star Gate		0	0			0	0		27,742	602			1,689	6,814	
	↓			0	↑			0	↓		153,601	↑			153,437
Proposed St1		0	0			0	0		17,593	2,901			6,248	15,838	
	↓			0	↑			0	↓		138,909	↑			143,847
Malir Halt		0	0			0	0		19,174	1,859			3,750	20,541	
	↓			0	↑			0	↓		121,594	↑			127,056
Kara Board		0	0			0	0		38,262	879			1,587	36,451	
	↓			0	↑			0	↓		84,211	↑			92,192
Malir City		0	0			0	0		18,944	1,125			42	13,387	
	↓			0	↑			0	↓		66,392	↑			78,847
Proposed St2		0	0			0	0		50	251			67	1,434	
	↓			0	↑			0	↓		66,593	↑			77,480
Proposed St3		0	0			0	0		8,586	8			0	5,440	
	↓			0	↑			0	↓		58,015	↑			72,040
Landi Junction		0	0			0	0		11,765	2,141			5,398	41,239	
	↓			0	↑			0	↓		48,391	↑			36,199
Madina Masjid Zafar		0	0			0	0		48,391	0			0	36,199	
Proposed St1		0	0			0	0		0	13,225			15,305	0	
	↓			0				0	↓		13,225				15,305
Jinnah Airport		0	0			0	0		13,225	0			0	15,305	
		134,790	134,790			148,753	148,753		414,512	414,512			384,204	384,204	

Source: JICA Study Team

Table 3.5.7 Estimated KCR Demand for Each Year

Year	Case N-A1		Case N-A2		Case N-B1		Case N-B2	
	Number of Passenger	Max. Number of Passengers loaded by section	Number of Passenger	Max. Number of Passengers loaded by section	Number of Passenger	Max. Number of Passengers loaded by section	Number of Passenger	Max. Number of Passengers loaded by section
2022	578,362	236,999	526,738	219,548	306,236	225,101	283,543	207,820
2023	588,929	241,417	536,493	223,712	312,012	229,238	288,967	211,691
2024	599,688	245,918	546,429	227,955	317,896	233,451	294,495	215,634
2025	610,645	250,503	556,549	232,279	323,892	237,741	300,129	219,650
2026	621,801	255,173	566,856	236,685	330,000	242,110	305,870	223,742
2027	633,161	259,931	577,354	241,174	336,224	246,560	311,722	227,909
2028	644,729	264,777	588,047	245,748	342,565	251,091	317,685	232,154
2029	656,509	269,713	598,938	250,409	349,026	255,706	323,762	236,479
2030	1,223,066	448,476	1,174,107	426,870	828,018	449,858	798,716	427,397
2031	1,245,411	456,670	1,195,851	434,776	843,634	458,342	813,995	435,573
2032	1,268,165	465,013	1,217,999	442,828	859,545	466,987	829,567	443,906
2033	1,291,334	473,509	1,240,556	451,029	875,756	475,794	845,437	452,398
2034	1,314,927	482,160	1,263,531	459,382	892,273	484,768	861,610	461,052
2035	1,338,951	490,969	1,286,932	467,890	909,101	493,910	878,093	469,872
2036	1,363,413	499,939	1,310,766	476,555	926,247	503,225	894,891	478,860
2037	1,388,323	509,073	1,335,041	485,381	943,716	512,716	912,010	488,021
2038	1,413,688	518,374	1,359,766	494,370	961,515	522,386	929,457	497,357
2039	1,439,516	527,844	1,384,949	503,526	979,649	532,238	947,237	506,871
2040	1,436,499	526,738	1,382,386	502,594	998,125	542,276	965,358	516,568
2041	1,462,744	536,362	1,407,988	511,902	1,016,950	552,504	983,825	526,450
2042	1,489,469	546,161	1,434,064	521,382	1,036,129	562,924	1,002,646	536,521
2043	1,516,681	556,139	1,460,623	531,038	1,055,671	573,541	1,021,826	546,784
2044	1,544,391	566,300	1,487,673	540,873	1,075,581	584,357	1,041,374	557,244
2045	1,572,607	576,646	1,515,225	550,890	1,095,866	595,378	1,061,295	567,904
2046	1,601,339	587,182	1,543,287	561,093	1,116,534	606,607	1,081,598	578,768
2047	1,630,595	597,909	1,571,869	571,484	1,137,592	618,048	1,102,289	589,840
2048	1,660,386	608,833	1,600,980	582,068	1,159,047	629,704	1,123,375	601,124
2049	1,690,721	619,957	1,630,630	592,848	1,180,906	641,581	1,144,866	612,623
2050	1,721,611	631,283	1,660,829	603,828	1,203,178	653,681	1,166,767	624,343
2051	1,753,065	642,817	1,691,588	615,010	1,225,870	666,009	1,189,087	636,287
2052	1,785,093	654,561	1,722,916	626,400	1,248,990	678,570	1,211,834	648,459
2053	1,817,707	666,520	1,754,824	638,001	1,272,546	691,368	1,235,017	660,864

Year	Case N-A1			Case N-A2			Case N-B1			Case N-B2		
	Counter-clockwise	Clockwise	Section	Counter-clockwise	Clockwise	Section	Counter-clockwise	Clockwise	Section	Counter-clockwise	Clockwise	Section
2022	111,312	125,687	236,999	102,925	116,623	219,548	106,980	118,121	225,101	97,818	110,002	207,820
2023	113,390	128,027	241,417	104,900	118,812	223,712	108,962	120,276	229,238	99,682	112,008	211,691
2024	115,507	130,411	245,918	106,913	121,042	227,955	110,981	122,469	233,451	101,582	114,051	215,634
2025	117,664	132,839	250,503	108,965	123,314	232,279	113,038	124,703	237,741	103,519	116,132	219,650
2026	119,860	135,313	255,173	111,056	125,629	236,685	115,132	126,978	242,110	105,492	118,250	223,742
2027	122,098	137,832	259,931	113,187	127,987	241,174	117,266	129,294	246,560	107,502	120,407	227,909
2028	124,378	140,399	264,777	115,359	130,389	245,748	119,439	131,652	251,091	109,551	122,603	232,154
2029	126,700	143,013	269,713	117,573	132,836	250,409	121,652	134,054	255,706	111,639	124,839	236,479
2030	221,106	227,370	448,476	210,076	216,794	426,870	218,875	230,983	449,858	206,638	220,759	427,397
2031	225,146	231,524	456,670	213,967	220,809	434,776	223,003	235,339	458,342	210,591	224,982	435,573
2032	229,259	235,754	465,013	217,929	224,898	442,828	227,209	239,778	466,987	214,620	229,286	443,906
2033	233,448	240,061	473,509	221,965	229,064	451,029	231,494	244,300	475,794	218,725	233,672	452,398
2034	237,713	244,447	482,160	226,076	233,306	459,382	235,860	248,908	484,768	222,909	238,142	461,052
2035	242,056	248,913	490,969	230,263	237,627	467,890	240,308	253,602	493,910	227,174	242,698	469,872
2036	246,478	253,461	499,939	234,528	242,027	476,555	244,840	258,385	503,225	231,520	247,341	478,860
2037	250,981	258,092	509,073	238,871	246,510	485,381	249,458	263,258	512,716	235,949	252,073	488,021
2038	255,567	262,807	518,374	243,295	251,075	494,370	254,163	268,223	522,386	240,462	256,895	497,357
2039	260,236	267,608	527,844	247,801	255,725	503,526	258,956	273,282	532,238	245,062	261,809	506,871
2040	259,691	267,048	526,738	247,342	255,252	502,594	263,840	278,436	542,276	249,750	266,817	516,568
2041	264,435	271,927	536,362	251,923	259,979	511,902	268,816	283,687	552,504	254,528	271,922	526,450
2042	269,266	276,895	546,161	256,589	264,794	521,382	273,886	289,037	562,924	259,397	277,124	536,521
2043	274,186	281,954	556,139	261,341	269,698	531,038	279,052	294,489	573,541	264,359	282,425	546,784
2044	279,195	287,105	566,300	266,181	274,693	540,873	284,315	300,043	584,357	269,417	287,828	557,244
2045	284,296	292,350	576,646	271,110	279,780	550,890	289,677	305,702	595,378	274,571	293,334	567,904
2046	289,490	297,691	587,182	276,131	284,962	561,093	295,140	311,467	606,607	279,823	298,945	578,768
2047	294,779	303,130	597,909	281,245	290,239	571,484	300,707	317,341	618,048	285,176	304,664	589,840
2048	300,165	308,669	608,833	286,454	295,614	582,068	306,378	323,326	629,704	290,632	310,492	601,124
2049	305,649	314,308	619,957	291,759	301,089	592,848	312,156	329,424	641,581	296,191	316,432	612,623
2050	311,233	320,050	631,283	297,162	306,665	603,828	318,043	335,637	653,681	301,857	322,485	624,343
2051	316,919	325,898	642,817	302,666	312,345	615,010	324,042	341,967	666,009	307,632	328,655	636,287
2052	322,709	331,852	654,561	308,271	318,129	626,400	330,153	348,417	678,570	313,517	334,942	648,459
2053	328,605	337,915	666,520	313,980	324,021	638,001	336,380	354,988	691,368	319,515	341,349	660,864

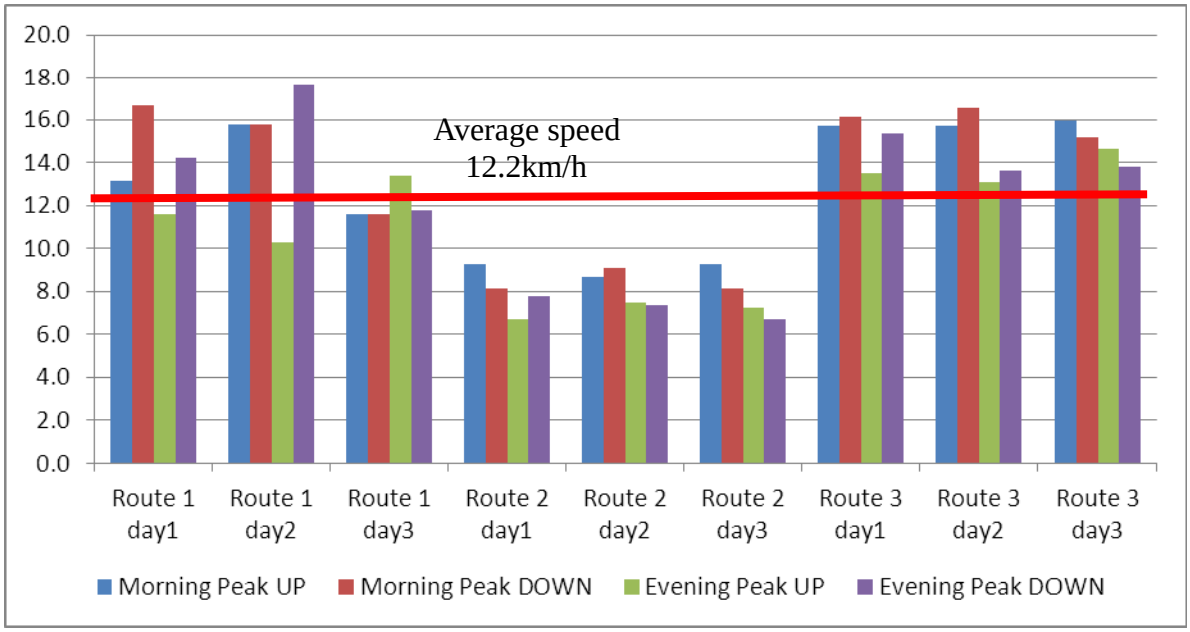
Source: JICA Study Team

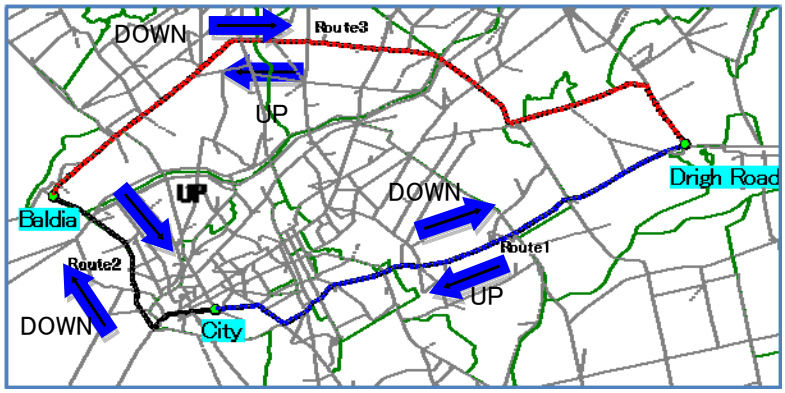
3.6 KCR Demand with Alternative Fare Level

The fare level of KCR in demand forecasting of the foregoing paragraph is set up so that a user may be easily alike and it can convert into KCR from a bus in consideration of the fare level of the existing bus.

The amount of time crunches by KCR use is so large that distance is long. Therefore, the slope of the example charge of a distance ratio can count upon use of KCR also by a steep slope as compared with the one of a bus. Then, the fare level which can acquire a higher profit was studied as there was no burden in short distance use.

Moreover, although the speed of the bus at the time of demand forecasting of the foregoing paragraph used 15 km/h (the results of the investigation in 2011 by KTIP), the average speed of the bus route which competes with KCR was 12 km/h (the results of the investigation in 2012 by Study Team). Then, about the study here, speed of bus was carried out on condition of 12 km/h.

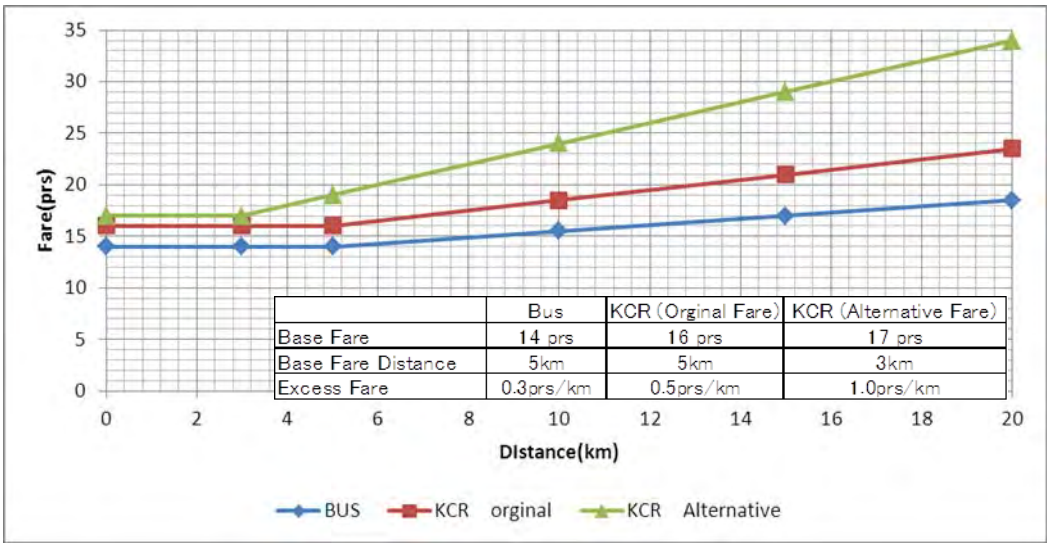




Source: JICA Study Team

Figure 3.6.1 Mini Bus Travel Time Survey

The studied fare structure is as being shown in Figure 3.6.2, in the case of 10 km which is the average trip length at the time of demand forecasting, the charge of KCR comes from 19 PRs. to 24 PRs.



Source: JICA Study Team

Figure 3.6.2 Fare Level

The demand-forecasting result by two fare structure is as in Table 3.6.1, and although the number of passenger and the maximum number of passengers loaded are almost the same, the fare receipts of alternatives are 1.27 times.

Table 3.6.1 KCR Demand (Case N-B1)

Fare Structure Case	Original	Alternative
Base Fare	16 PRs	17 PRs
Base Fare Distance	5 km	3 km
Excess Fare	0.5 PRs/km	1.0 PRs/km
Number of Passenger	306,236 pers./day (1.00)	300,309 pers./day (0.98)
Max. Number of Passengers loaded	225,101 pers./section (1.00)	218,140 pers./section (0.97)
Fare receipts	5,740282 PRs/day (1.00)	7,284,509 PRs/day (1.27)
Average Trip Length	10.3 km	10.2 km
Bus Speed	15 km/h	12 km/h

Source: JICA Study Team

Since bus speed and monetary value also change in the future, it is predicted that the preference consciousness of KCR also changes. Therefore, before operation, it is required by conducting preference opinion survey and running speed survey to scrutinize the fare level of KCR.

4. REVIEW OF TECHNICAL STANDARDS AND RAILWAY ALIGNMENT

In SAPROF (II), JICA Study Team has studied two options in terms of operating route as mentioned in Chapter 3. One is "Option N-A1" or "Option N-A2" which has entire circular route and the other is "Option N-B1" or "Option N-B2" where KCR operates between Drigh Road and Shah Abdul Latif via Karachi Cantt. Hereinafter, these options are referred to as "Option N-A" and "Option N-B" respectively as route alignment are examined in this section.

4.1 Technical Standards to be applied to KCR

4.1.1 Basic Policy of Technical Standards to be applied to KCR

Pakistan Government requested Japan Government to provide Yen STEP Loan for the implementation of the KCR Revival Project in December 2008. Japanese technologies are presumed to be adopted for the project with the financing of Yen STEP Loan. Therefore, the technical standards to be applied to KCR should be based on Japanese railway standards, and this was authorized through ECNEC's approval of PC-1 modified May 2009 and confirmed at the wrap-up meeting held on 29 October 2011.

4.1.2 Outline of Technical Standards to be applied to KCR

The Japanese technical standards on railway are compiled under the supervision of Ministry of Land, Infrastructure, Transport and Tourism (Ministry of LITT). The outline of technical standards applied to KCR with track gauge of 1435 mm relating to alignment planning is shown in Table 4.1.1.

4.1.3 Rolling Stock Gauge for KCR

According to Japanese technical standards, the vehicle gauge mostly used in Japan is Option-1 as shown in Figure 4.1.1. Option-1 is set down in a way that the car width may be expanded over the platform height taking into account the gap between vehicle and platform which is mostly used in Japan. This shape of rolling stock is used not only in Japan but also in worldwide. Therefore, Option-1 has an advantage of scale production.

On the other hand Option-2 is planned in a foreign country project and can be introduced in consideration of the design of platform to be newly constructed. The reason of selection of Option-2 is that Option-2 has an advantage of processing cost reduction thanks to omitting bend of car side.

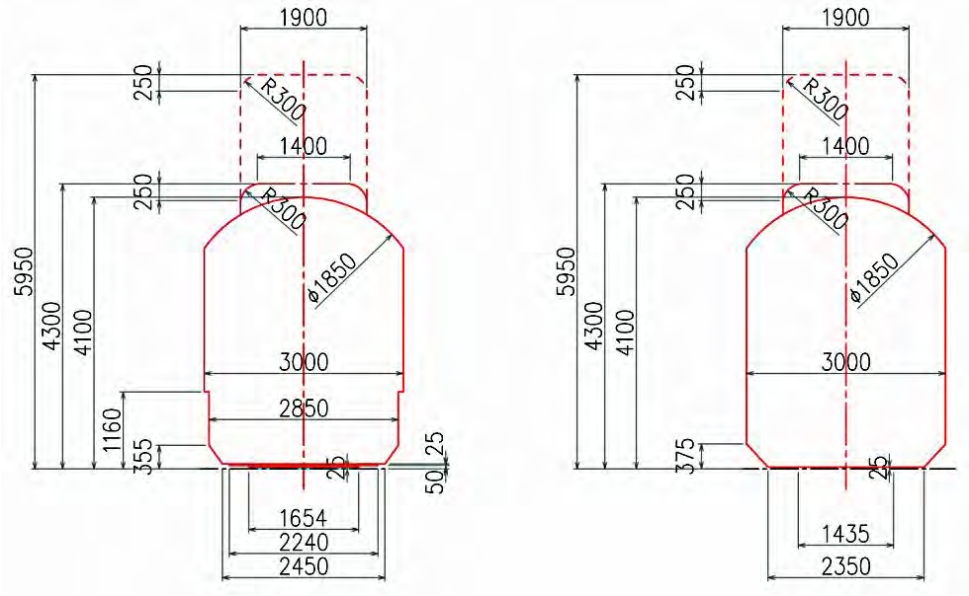
However, the consultation with Japanese reputable manufacturers of rolling stock revealed that total cost of fabrication for Option-2 is not always more economic than Option-1 because Option-2 needs specific templates to form side plates.

Therefore, Option-1 is recommended that KCR vehicle gauge is 3m in width.

Table 4.1.1 Outline of Technical Standards to be Applied to KCR

Item		Standards		Remark
		Value	Unit	
Minimum Curve Radius	Main line	400 (200)	m	Figures in the parenthesis are applicable in inevitable cases due to topographic reasons and so on.
	Depot	100	m	
Basic Width of Construction Gauge		3,400	mm	Assumption of adoption of the proposed rolling stock
Cant	Equivalent Super-elevation	$11.3* V^2/R$	mm	Track Gauges Actual Super-elevation of 1435mm
	Maximum Super-elevation	150	mm	Referring to Cases of Other Railways
	Maximum Super-elevation Deficiency (C_d)	90	mm	
Maximum Speed		110	km/h	Shorter Scheduled Time
Maximum Gradient		3.5	%	Speed Restriction for Downward=85km/h or less
Transitional Curve Length	Type of Curve	Cubic Parabola		Easy to setting and maintenance
	L_1	$300C_m$	mm	Cm stands for the actual cant set in the curve section concerned
	L_2	$7.4C_mV(5.9C_mV)$	mm	
	L_3	$6.7C_dV(5.2C_dV)$	mm	
Turnout	Main line	10#		12# in SAPROF(I)
	Depot	8# (6# at sub-main track)		10# in SAPROF(I)
Width of Vehicle Gauge		3000	Mm	See Vehicle Gauge
Width between Track Centers		3700	mm	Assumption of adoption of the proposed rolling stock
Vertical Curve	10/1000 or more	R=2000	m	SAPROF: 3000m. In case of competition of horizontal curve radius 600m or less , the vertical curve radius is required at 3,000m
	Less than 10/1000	not required		
Extra Clearance by Curve (Over-throw and End throw)		24400/R	mm	L_0=2,100mm, L_1=13,800mm In case of R=200m Over-throw=122mm
Platform Height from Rail Level		1100	mm	Consideration of Height of Car Floor
Distance from Track Center to Platform Edge in curved Section	Inward Platform	K=W+s+C*h/G		K and K': Extra clearance W: Over-throw, C: Cant G: Track Gauge, h: Platform height S: Slacking in case of Electric car (negligible small)
	Outward Platform	K'=W-C*h/G		
Upper Clearance for Pakistan Railways (PR)		6350	mm	According to PR Technical Standard, the upper clearance for future 25kV AC is 6,325mm.

Source; JICA Study Team referring to Japanese Railway Standards complied by Ministry of LITT



Option-1 Otion-2

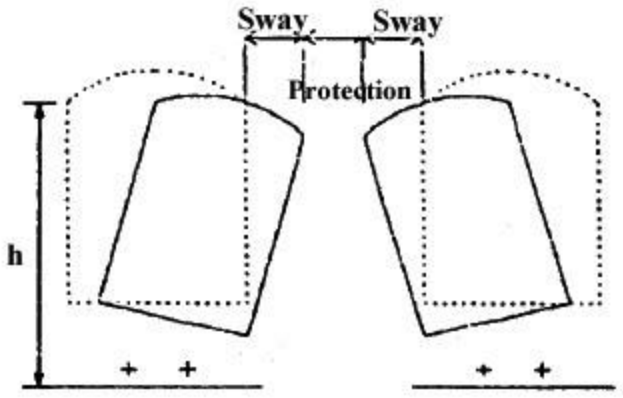
Source; Drawn by Study Team referring to Japanese Railway Standards compiled by Ministry of LITT

Figure 4.1.1 Vehicle Gauge of KCR

4.1.4 Construction Gauge for KCR

(1) Width of construction gauge

The maximum car sway is estimated as 20 cm and the vehicle gauge of KCR is 3 m. The protection space for the passengers in trains who poke their arms or heads out of the windows of cars is required as 20 cm. Therefore, generally the construction gauge needs the width of 3.6 m or more (= car gauge 3 m + minimum 60 cm), and is normally adopted at 3.8 m.



Source; New Track Structures: The Japan Railway Civil Engineering Association

Figure 4.1.2 Required Distance between Track Centers

When cars are designed in such a way that passengers cannot poke their arms or heads out of the windows of the trains by limiting opening space of the windows, Japanese standards permit omission of the protection space. In this case the width of construction gauge is reduced to 3.4 m.

JICA Study Team proposed such type of cars as rolling stock of KCR and KUTC agreed. Therefore, the construction gauge of KCR is changed from 3.8 m proposed in SAPROF (I) to 3.4 m as shown in Figure 4.1.3.

(2) Upper clearance

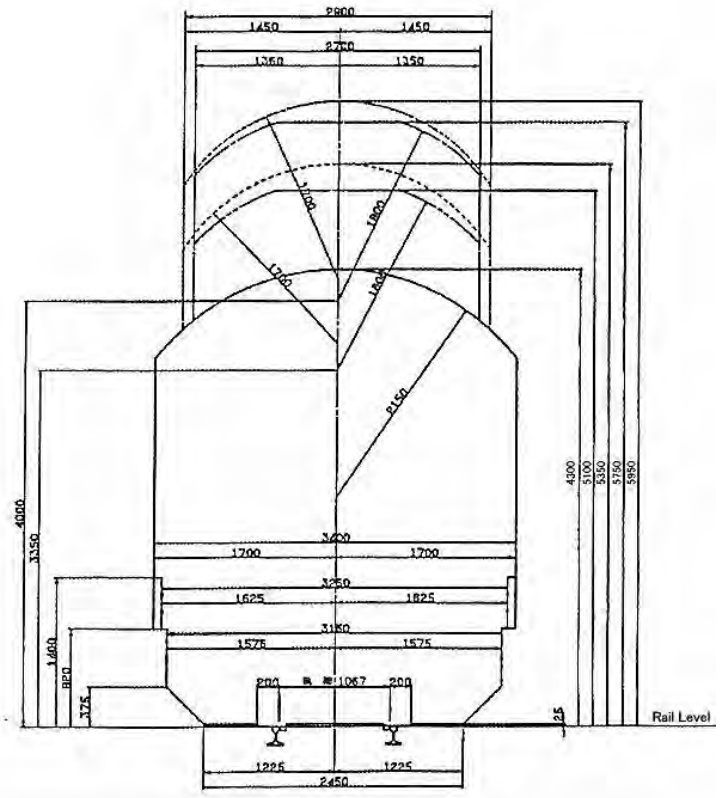
Upper clearance in construction gauge depends on the Electrification System.
As the traction power of KCR is alternating current (AC) 25 kV x 2 (AT system), Study Team referred to the same system in Japanese case adopted to Tsukuba Express (TX) which was newly constructed as independent urban railway including 20 kV alternative current section based on the Japanese modern railway technologies.
Thus, Study Team determined the upper clearance of KCR shown in Table 4.1.2 based on TX construction gauge.

Table 4.1.2 Upper Clearance of KCR and Tsukuba Express

Item	Tsukuba Express			KCR		
	Open	Over-bridge	Culvert Tunnel	Open	Over-bridge	Culvert Tunnel
Height with Pantograph Down	4,300	4,300	4,300	4,300	4,300	4,300
*Insulation Distance	250	250	250	300	300	300
Allowance for Sag or Deflection of Trolley	500	150	50	500	150	50
Height of Trolley	5,050	4,700	4,600	5,100	4,750	4,650
Distance of Overhead Centenary System	850	450	450	850	450	450
Allowance for feeder etc.	0	500	250	0	500	250
Clearance	5,900	5,650	5,300	5,950	5,700	5,350

* Insulation distance of Tukuba Express is 250mm for 20kV and that of KCR is 300mm for 25kV.

Source; JICA Study Team



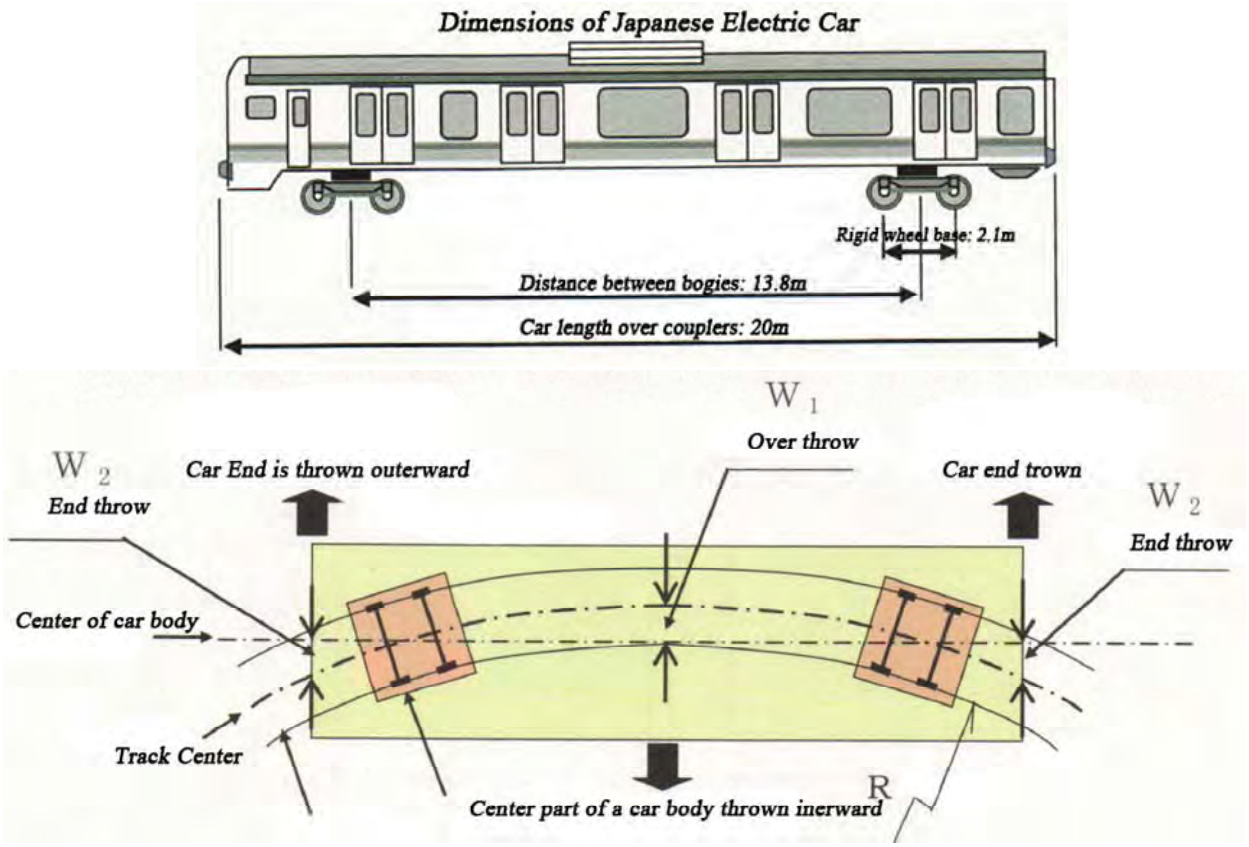
Source; JICA Study Team

Figure 4.1.3 Construction Gauge for KCR

4.1.5 Distance between Track Centers

(1) Over Throw and End Throw due to Curvature

A car of trains has a rectangular box body supported by 2 bogies with 2 axles each which have fixed wheels respectively as shown in Figure 4.1.4. When a car runs in a curve section, the center of cars gives an over throw to the center of the curve and the both ends of a car gives an end throw outward of curve. Furthermore, a car in curve section gives a lean due to the super-elevation. Therefore, in curve sections the distance between track centers needs expansion according to the radius of the curve and actual super-elevation.



Source; Japan Railway Contractors Association Seminar Materials 2007

Figure 4.1.4 Railway Car Structure and Throw in Curve Sections

As the over throw W_1 is larger compared with the end throw W2, the over throw is used as the representative value W of the two. W is calculated using the following formula.

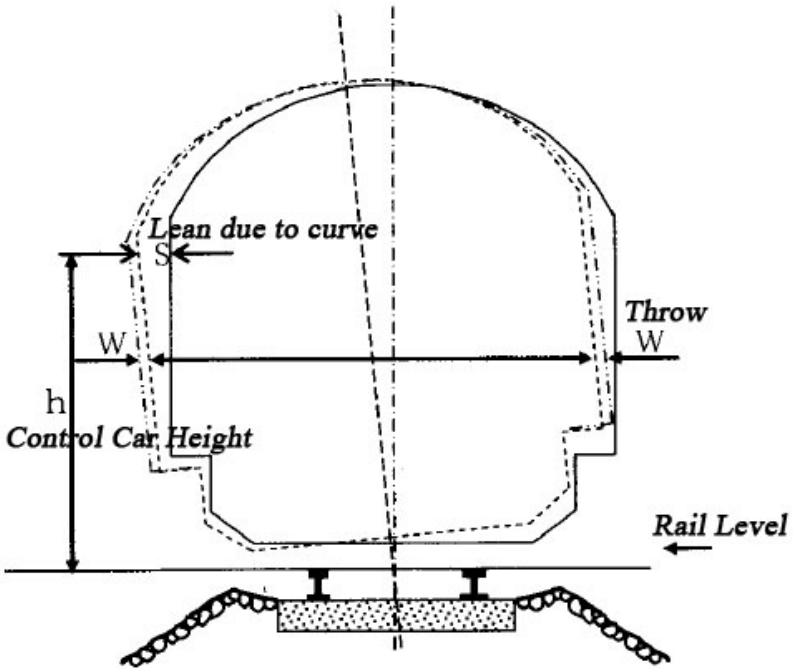
$W=W_1=R - [R^2-(L_1^2 + L_0^2)/4]^{0.5} \fallingdotseq (L_0^2 + L_1^2)/8/R = 24{,}400/R$

Where; R: Curve Radius (m)
L_1: Distance between bogies= 13.8m
L_0: Rigid wheel base= 2.1m
W: Throw in curve sections (mm)

As the minimum curve radius in the main lines of KCR is 200 m, the maximum throw is computed as 122 mm.

(2) Lean due to Curvature

When a train runs in a curve section, the cars incline due to curvature and need another space to safely run without bumping something as shown in Figure 4.1.5.



Source; JICA Study Team

Figure 4.1.5 Lean due to Curvature

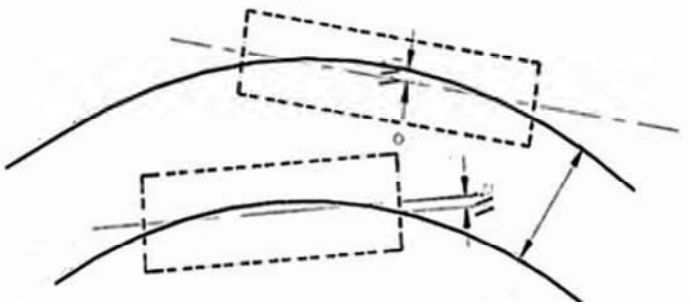
S is calculated using the following formula, where S is lean due to curvature, h is the control height of a car, C is the super elevation (cant) set in a curve and G is the track gauge.

$$S=h \times C/G$$

As h is less than 3,500 mm in case of a car to be introduced to KCR, the maximum cant is 150 mm and G is 1,435 mm, the maximum value of S is 366 mm.

(3) Examination of Distance between Track Centers

The minimum necessary distance between track centers is examined on the critical situation when two trains pass each other as shown in Figure 4.1.6.



Source; Civil, Technical Standards of Railways in Japan supervised by Ministry of Land, Transport, Infrastructure and Tourism

Figure 4.1.6 Critical Situation for Examination of Track Centers

In this case the additional required distance between track centers D is calculated using the following formula.

$D=A + W_1+W_2$

Where; A: Differences of lean due to differences of cants
W_1: Over Throw of one of the lines concerned
W_2: End Throw of another line concerned

As the cants set for Up line and Down line are same, the leans of Up line and Down line are same. As W_1 is larger than W_2, W_1 is used instead of W_2 for the safety side design. Therefore,

$D= W_1 + W_1'$

In a curve section, the concentric curves are used as the alignments of Up line and Down line. According to the technical standards applied to KCR shown in Table 4.1.1, the minimum curve radius is 200 m which is used as the radius of the inward curve and the radius of outward curve is about 204 m. As the maximum permissible cant is 150 mm, D is calculated as follows.

D=24,400/200+ 24,400/204=122 + 120=242 mm

As the construction gauge applied to KCR is 3,400 mm, the required minimum distance between track centers is 3400 + 242 = 3642 mm, say 3,700 mm.

(4) Conclusion

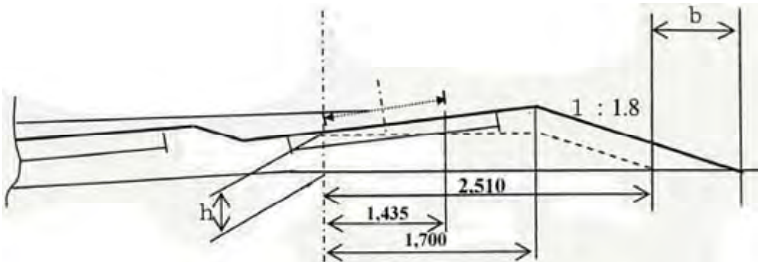
KCR is a circular line and inevitably has many curves. In curve sections the distance between track centers has to be expanded due to over throw and end throw of cars. When the distances between track centers are frequently expanded and reduced, the lands outside ROWs are not good for utilization. Therefore, the distances between track centers are desirable to be constant for KCR.

JICA Study Team proposed KUTC the constant distance between track centers of KCR of 3.7 m for the entire sections regardless of curve or straight alignment and KUTC accepted this proposal. It is concluded that the distance between track centers of KCR is decided at 3.7 m.

4.1.6 Width of Formation

The structures of KCR basically consist of three types, that is; ground sections with ballasted track, viaduct sections with solid-bed track and culvert or U-shape sections with solid-bed track. As explained in the preceding section, the space for train running in curve sections must be expanded. Accordingly, the width of formation also needs to be expanded.

Moreover, in the curve sections of ballasted track, the space for stability of increased height of ballast as shown in Figure 4.1.7 is required.



Source; Civil, Technical Standards of Railways in Japan supervised by Ministry of Land, Transport, Infrastructure and Tourism

Figure 4.1.7 Expansion of Formation due to Cant Increase in Outer Parts in Ballasted Section

Taking into account over throw & end throw, lean and space for protection of ballast due to cant, the proposed formation width with no need for expansion regardless of curve in ballasted track sections is shown in Table 4.1.3.

Table 4.1.3 Proposed Formation Width in Ballasted Sections

Item of Breakdown	Width required by technical matters (m)	Width required by ballasted structure (m)	Remark
Width of construction gauge	3.4	3.4	3.4m /2 x2 lines
Distance between track centers	3.7	3.7	
Over throw	0.244	0.244	0.122m x2 lines
Lean of car	0.704	0.704	0.352m x2 lines
Allowance	0.7		0.35m x2 lines
Space of maintenance pathway	1.4	1.4	0.7m x2 lines
Basic width of ballast	-	5.02	2.51m x2 lines
Total	10.148	11.038	
Proposed width of formation for ballasted section including reinforced embankment		11.1	No need of expansion of formation due to curvature
Space for electric pole	1.5	1.5	0.75m for each side
Proposed width at pole section		12.6	No need of expansion of formation due to curvature

Source; JICA Study Team

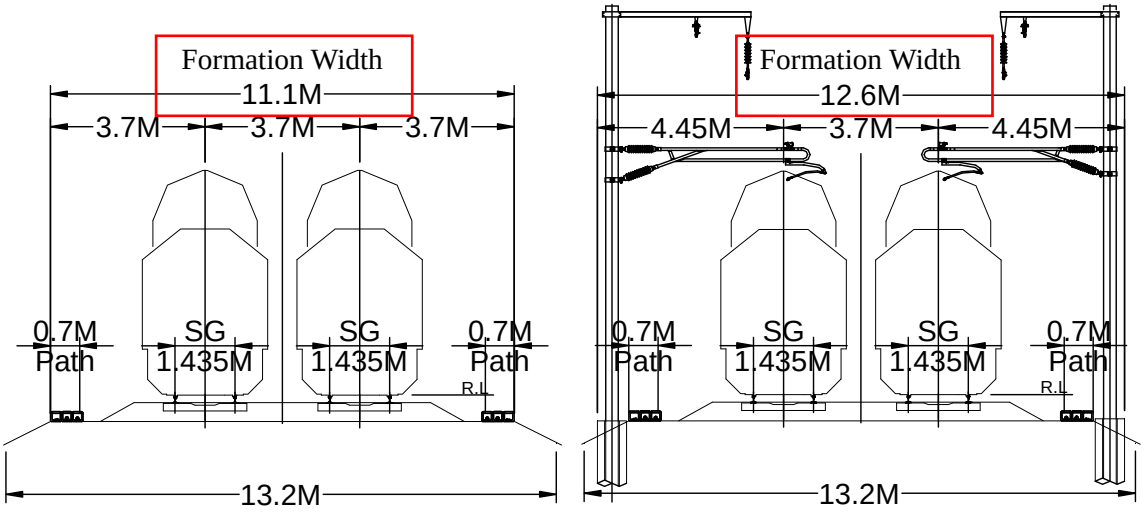
The formation width without need for expansion in viaduct sections and culvert or U-shape sections was proposed as shown in Table 4.1.4 as well.

Table 4.1.4 Proposed Formation Width in Viaduct and Culvert or U-shape Sections

Item of Breakdown	Required Width (m)	Remark
Basic width of construction gauge	3.4	3.4m /2 x2 lines
Distance between track centers	3.7	
Over throw	0.244	0.122m x2 lines
Lean of car	0.704	0.352m x2 lines
Space of maintenance pathway	1.4	0.7m x2 lines
Width of wall	0.4	0.2m x2 lines
Allowance for both sides	0.7	0.35m for each side
Total	10.548	
Proposed width of viaduct or reinforced embankment	10.6	No need of expansion regardless to curve section or not
Space for electric pole	1.5	0.75m for each side
Proposed width of viaduct or reinforced embankment width at pole section	12.1	No need of expansion regardless to curve section or not

Source; JICA Study Team

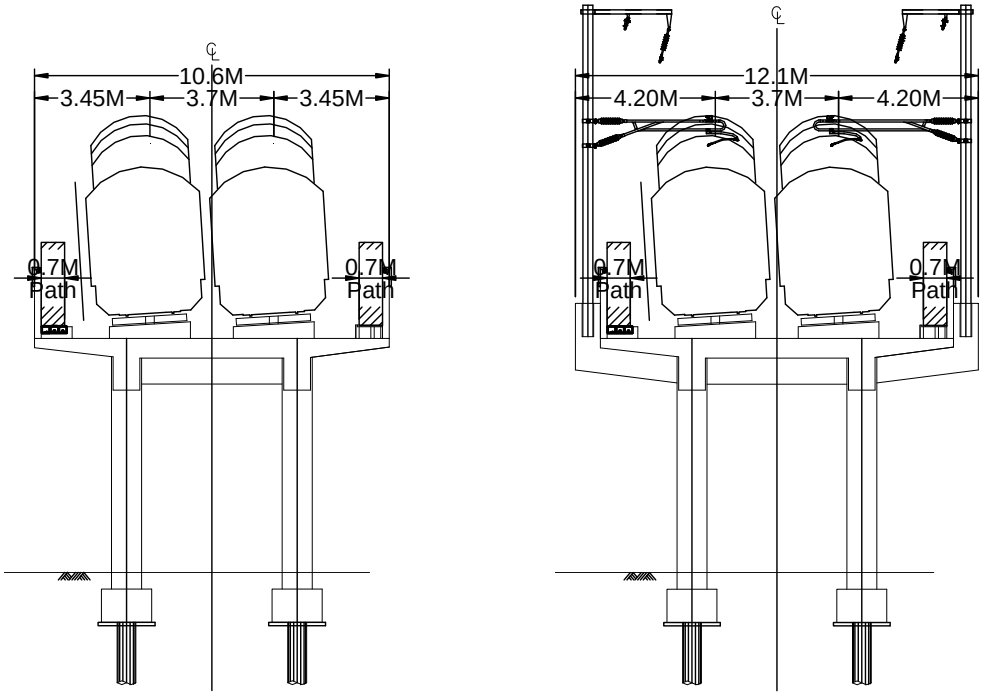
KUTC agreed with all the formation widths proposed by the JICA Study Team and decided as shown in Figure 4.1.8 and Figure 4.1.9.



(a) Normal Section **(b) Section at Pole**

Source; JICA Study Team

Figure 4.1.8 Formation Width of KCR at Ground Section



Formation Width 10.6m **Formation Width 12.1m**

(a) Normal Section **(b) Section at Pole**

Source; JICA Study Team

Figure 4.1.9 Formation Width of KCR at Viaduct Section

4.2 Basic Policy of Station Design

This section gives the comprehensive station plan including type of station, platform design and intermodal facility.

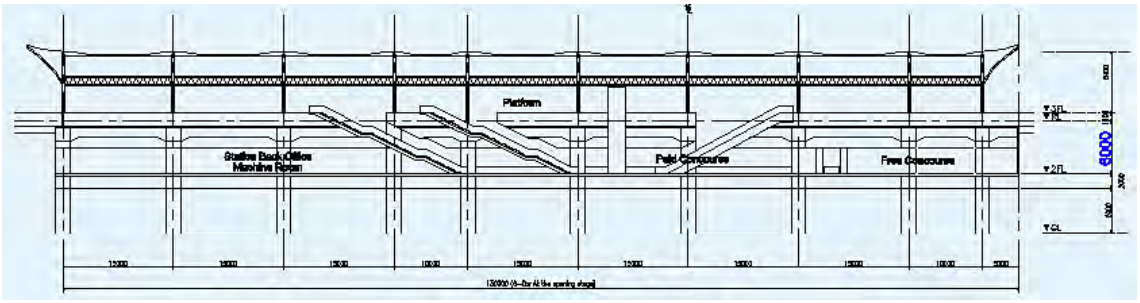
4.2.1 Type of Station

The Karachi Circular Railway (KCR) to be revived is planned based on no level crossing concept so as not to affect the road traffic.

In the sections where many roads densely cross the KCR route, viaduct structures are adopted and therefore viaduct stations are planned. In the sections where existing roads currently cross over the KCR route or existing level crossings can be economically eliminated by ROB or RUB, the on-ground alignment is planned and the on-ground platforms and over-track stations are planned to access easily and safely to both sides of track facility. Furthermore, in the trench section according to the topographic conditions, underground or semi-underground stations are designed.

(1) Viaduct Station in Elevated Sections

In the elevated sections, platform is placed along elevated track on viaducts. Passengers who get off trains go down to ground level where ticket gates are located as shown in Figure 4.2.1. In a viaduct station, the station facilities such as ticket vending machines, staff office and information counter are placed in ground level of viaduct structure.



Source; JICA Study Team

Entrance of Viaduct Station

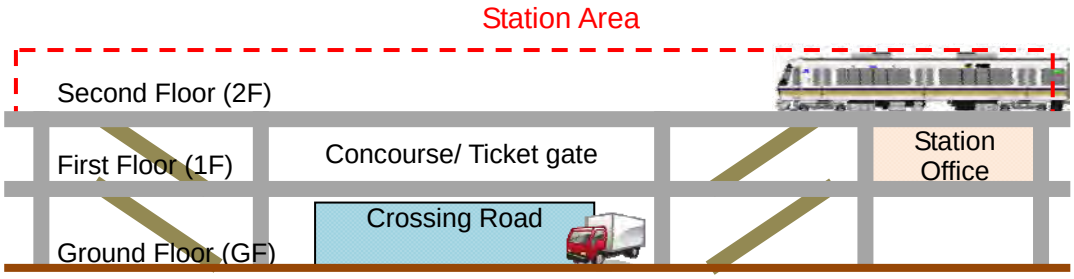
Ticket Gates on Ground Floor

Platform on Station Viaduct

Source; Internet web-site

Figure 4.2.1 Example of Viaduct Station

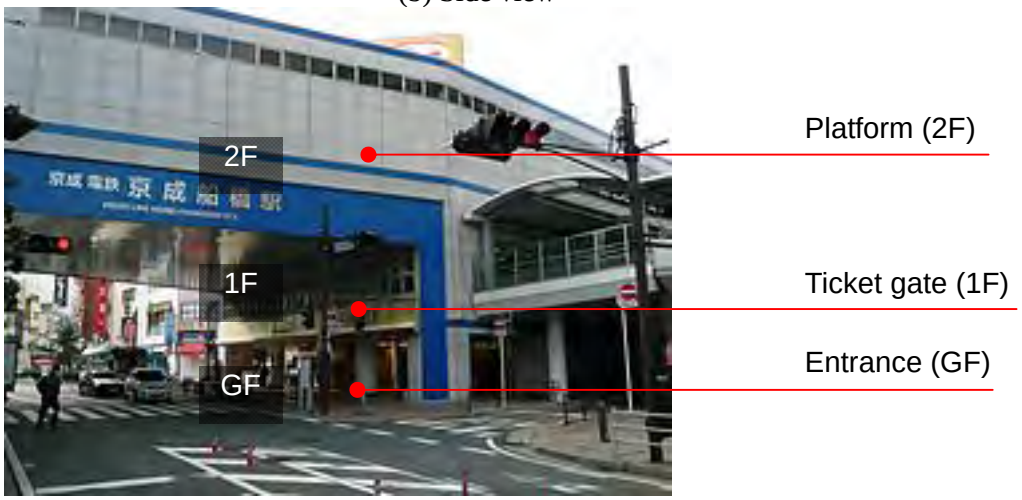
When a viaduct station is planned on a busy road and it is required that passengers should avoid crossing the road for easy and safe access to the other side of the road, the station is planned as three-story structure and the station facilities such as ticket gates and station staff rooms can be designed on the first floor as shown in Figure 4.2.2



Source; JICA Study Team

(a) Conceptual diagram

(b) Side view



(c) Focus on the entrance

Source; Internet web-site

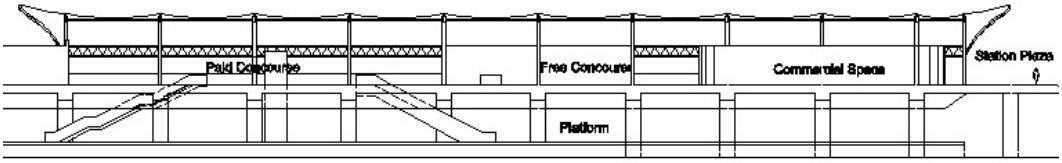
Figure 4.2.2 Example of Three-story Viaduct Station

(2) Over-track Station in On-ground Sections

In on-ground track sections, platforms are also placed on ground level along the track and stations are designed as over-track station to avoid dangerous track crossing by passengers and disturbance against train operations. Passengers who get off trains go up to the first floor where ticket gates are placed. In

the over-track station, station facilities such as ticket gates, ticket vending machines and station staff office are planned on the first floor and passengers easily and safely access to the roads toward both sides of railway track.

An example of the over-track station is shown in Figure 4.2.3.



Source; JICA Study Team

Source; Internet web-site

Figure 4.2.3 Example of Over-track Station

(3) Underground or Semi-underground Station in Trench Section

Along a hilly landform lies in the section from Depot Hill up to Nipa, trench structures are adopted for KCR to reduce the railway gradient for efficient operation and economize the construction cost. The platforms are placed in the trench along the track and station facilities are planned over track by using box culvert structures. Passengers who get off trains go up to ground level where station facilities such as ticket gates and station staff office are located.

Figure 4.2.4 shows the perspective of Johar Station and example of semi-underground station is shown in Figure 4.2.5.

Source; JICA Study team

Figure 4.2.4 Image of Johar Station (Semi-underground Station)

Entrance on ground level

Platform on underground level

Source; Internet web-site

Figure 4.2.5 Example of Semi-underground Station

(4) KCR Station Plan by Type

The type of 24 stations of KCR is listed in Table 4.2.1.

Table 4.2.1 Type of KCR Station

No	Station	Type	Remark
1	Drigh Road	Elevated and Viaduct	Three-level due to available land
2	Johar	Semi-underground	
3	Alladin Park	Underground	
4	Nipa	Over-track	
5	Gilani	Elevated and Viaduct	Two-level
6	Yasinabad	Elevated and Viaduct	Three-level due to insufficient clearance from Lyari Express Road structures
7	Liaquatbad	Over-track	
8	North Nazimabad	Over-track	Possible change to viaduct stataion due to road improvement project
9	Orangi	Elevated and Viaduct	Two-level
10	HBL	Over-track	
11	Manhopir	Elevated and Viaduct	Three-level
12	Site	Elevated and Viaduct	Three-level
13	Shah Abdul Ratif	Elevated and Viaduct	Three-level
14	Baldia	Elevated and Viaduct	Two-level
15	Lyari	Elevated and Viaduct	Two-level
16	Wazir Mansion	Over-track	
17	Tower	Over-track	
18	Karachi City	Elevated and Viaduct	Changed from over-track to viaduct stataion due to insufficient clearance with an existing ROB
19	DCOS	Over-track	
20	Karachi Cantt	Elevated and Viaduct	Three-level due to use of space over existing PR line
21	Naval	Over-track	
22	Chanesar	Over-track	
23	Shaeed-e-Millat	Over-track	
24	Karzas Halt	Over-track	

Source; JICA Study Team

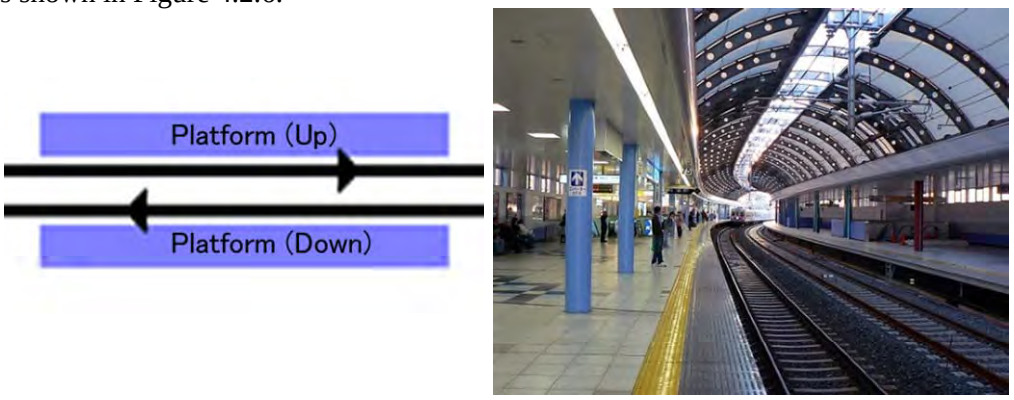
4.2.2 Platform Design

(1) Platform Type

There are two types of platforms, side platform and island platform.

1) Side Platform

A side platform places separate platforms for respective up and down lines outside the tracks as shown in Figure 4.2.6.



Source; Internet web-site

Figure 4.2.6 Side Platform

Side platforms have the following features:

A) The good track alignment near platforms can be maintained.
B) Future improvement such as expansion of platform length is easier and less expensive than island platforms.
C) When passing tracks are installed in the center between both normal tracks, passengers on platforms can avoid risks by passing trains.
D) However, side platforms require wider ROW in station sections.

2) Island Platform

An island platform places single platform between up and down lines as shown in Figure 4.2.7.

Island platforms have the following features:

A) They can economize station space and can be installed in narrower width of ROW.
B) In the case that two different lines meet at a station, island platforms enable such arrangement that passengers can transfer from one line to the other line at the same platform.
C) For a station where shuttle operation is planned, island platform is convenient for passengers because single platform is used for both getting off and getting on.
D) However, an island platform with insufficient width against passenger volume will endanger passengers on platforms, may cause suspension of ticket gate operations for getting-on passengers, and furthermore, may disturb train operations.
E) Platform improvement after opening of a line is very difficult and more expensive.

Source: JICA Study Team

Figure 4.2.7 Island Platform

JICA Study Team examined appropriate platform types from the viewpoint of available land and train operations such as pendulum operation. The results of application of platform types to KCR stations are as shown in Table 4.2.3.

(2) Platform Width

The width of platform is very important for safe and on-time train operations, and is closely concerned with the required land for the station. However, since no precise topographic map was available at the stage of SAPROF-I Study, the platform widths of KCR stations were not discussed at that time.

This SAPROF-II Study includes elaboration of a 1/2000 topographic map with a required accuracy for the entire route and 1/1000 maps of the premise of all KCR stations and the review of route alignment of KCR was conducted using these maps.

Before conducting a review of KCR alignments, the technical standards for adequate width of platform to be applied to KCR stations are needed to be examined and decided.

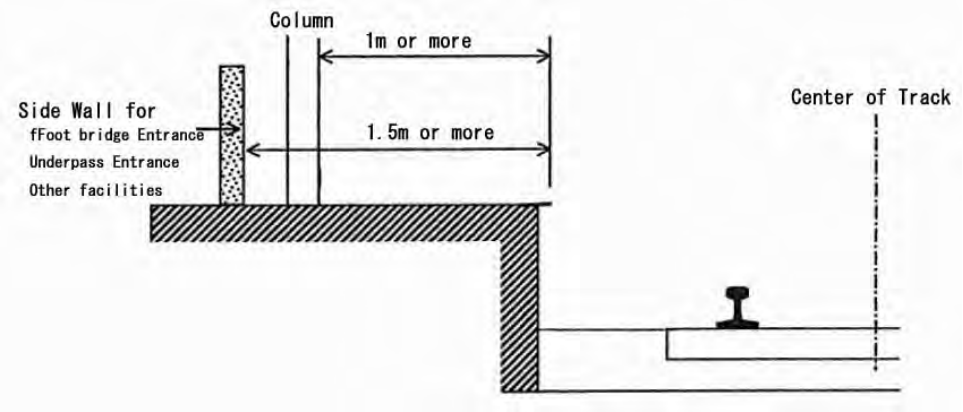
Escalators and/or elevators are generally installed on platforms in a modern urban railway. Moreover, safety clearance between the walls of staircases or escalators and platform edges is required for passengers so as to avoid contact with trains or falling into track. The required width for accommodating such facilities and ensuring safety clearance is generally wider than width required for passengers' flow on platforms.

Also, the stations of KCR are required to be arranged within the given land in accordance with the former KCR's ROW and RAP.

Although width of platforms of a commuter railway to be newly constructed in Japan is 10 m in general, that for KCR stations was at first examined on the required width for staircases, escalators and safety clearance between walls and platform edge (called as 'physically required width') and then the physically required width will be checked from the viewpoint of proper passenger flow capacity.

1) Physically Required Width of Platforms

To secure safety for passengers on platforms against trains, it is necessary to consider the safety clearance against various facilities on a platform such as columns, staircase entrance, escalators and elevators. These minimum safety distances are provided as shown in Figure 4.2.8 according to Japanese Railway Technical Standards.



Source; Japanese Technical Standards for Railways supervised by Land, Infrastructure, Transport and Tourism

Figure 4.2.8 Minimum Safety Clearance from Edge of Platform

However, taking into account two Pakistan passengers who aren't accustomed to train operations with high frequency, JICA Study Team decided to recommend KUTC to **expand the clearance between platform edge and obstacle such as staircase wall from 1.5m to 1.8m**.

Therefore, the minimum widths of platforms are required to be '1.8m + width of staircase' for side platforms and '2 x 1.8m + width of staircase' for island platforms respectively.

As to width of staircase, escalators for 2 persons are planned for both up and down directions whose capacity of an escalator for 2 persons is **6750 persons/hour**. The dimension of a standard escalator for 2 persons is 1004 mm for width of step, 1200 mm between balustrades and 1600 mm up to 9.5 m height and 1700 mm above 9.5 m height respectively for width required for installing. Therefore, in case where two escalators for both up and down are placed in a staircase, width of staircase is 2 x 1700 + stair step width + 2 x 200 (width of stair wall) = **3800mm + stair step width is required**.

The passengers flow speed in a stair is estimated to be about 1.3 persons/m/sec. The width required for one person moving and an allowance for passengers not to touch passengers coming from the opposite direction are 0.7 m and 0.1 m respectively in Pakistan taking into consideration average Pakistani build and has a capacity of **3276 passengers/0.7m/hour** for up or down. An allowance for moving passengers not to touch the staircase wall is 0.1 m. Considering the above-mentioned matters, **the minimum width of stair is 0.7 m x 2+ 0.1 m x 3 = 1.7 m.** Therefore, **the total minimum width of a staircase with two escalators is 3.8 m + 1.7 m = 5.5 m.**

Consequently, the minimum width of platform is 5.5 m + 1.8 m = **7.3 m for a side platform** and 5.5 m + 2 x 1.8 m = **9.1 m for an island platform** respectively.

In case that there is not enough land in a station section, such a way that a staircase and escalators are separately placed is recommended. With this method, the minimum width of platform is decided by width required for escalators space. It needs 1.6 m + 3.8 m = 5.6 m, **say 6m for a side platform** and 1.8 m x 2 + 3.8 m = 7.4 m ≈ **7.5 m for an island platform**. In addition, in this case the passenger flow capacity also becomes larger because the width of the staircase can be expanded up to the width for escalators space. Table 4.2.2 shows the relation between width of platform by type and passenger flow capacity based on the above-mentioned matters.

Table 4.2.2 Platform Type, Width of Platform and Total Passenger Inflow/Evacuation Capacity

Platform Type	Side Platform		Island Platform	
Item	Minimum Width (m)	Passenger Flow Capacity (Passengers/h)	Minimum Width (m)	Passenger Flow Capacity (Passengers/h)
1 Staircase with 2 Escalators	7.3	20,052	9.1	20,052
1 Staircase with 2 Escalators + One simple Staircase	7.3	33,156	9.1	33,156
1 Staircase and 2 separate Escalators	6	20,052	7.5	26,604
2 Staircase and 2 separate Escalators	6	26,604	7.5	39,708

Source; JICA Study Team

Based on Table 4.2.2, JICA Study Team recommends staircase and escalators separate type taking into consideration the situations of available land for KCR. Consequently, tentative platform plan of KCR stations are proposed as shown in Table 4.2.3.

Table 4.2.3 Tentative Platform Plan of KCR Stations

No.	Station	Side Platform		Island Platform (m)				Remark
				One island		Two Island		
		one staircase with 2 Escaltors	1 staircase and escalators separate	staircase with 2 escalators	2 staircases and 2 escalators separate	1 staircase with 2 escalators	2 staircase and 2 escalators separatre	
1	Drigh Road						7.5+7.5	2 island platforms
2	Johar		6.0+6.0					2 side platforms
3	Alladin Park		6.0+6.0					2 side platforms
4	NIPA			12				1 island platforms
5	Gilani						7.5+7.5	2 island platforms
6	Yasinabad		6.0+6.0					2 side platforms
7	Liaquatabad		6.0+6.0					2 side platforms
8	North-Nazimabad		6.0+6.0					2 side platforms
9	Orangi		6.0+6.0					2 side platforms
10	HBL		6.0+6.0					2 side platforms
11	Manghopir		6.0+6.0					2 side platforms
12	SITE		6.0+6.0					2 side platforms
13	Shah-Abdul-Latif				7.5			1island platform
14	Baldia		6.0+6.0					2 side platforms
15	Liyari						7.5+7.5	2 island platforms
16	Wazir Mansion				7.5			1 island platform
17	Tower				7.5			1 island platform
18	Karachi City				7.5			1 island platform
19	DCOS				7.5			1 island platform
20	Karachi Kanttt.			12				1 island platform
21	Naval				7.5			1 island platform
22	Chanesar				7.5			1 island platform
23	Shaheed-e-Millat		6.0+6.0					2 side platforms
24	Karzas Halt				7.5			1 island platform

Source; JICA Study Team

2) Examination from the Viewpoint of Passenger Flow Capacity

Based on the results of 2051demand of N-A1 case (Case whose demand is supposed maximum), the platforms of KCR Station Plan was examined as follows;

A) Platform width required for forecast passenger volume 2051 of N-A1 Case

The following is a Japanese formula to calculate an adequate platform width for urban railways. This formula was developed based on collection and analysis of broad data of factual investigations on almost all urban stations in Tokyo of former Japanese National Railways (JNR).

$W=W_1+W_2+\gamma$

W; Required width of a platform for urban railways

W_1; Width occupied by passengers crowded in front of a vehicle door to get on a train during peak hours

In the case of multiple unit trains,

$W1=0.2 \times (Pa/N)^{0.5}$

Pa; Average boarding passengers of a train during 30 minutes of peak hours

N; Number of cars of a train formation, N=8 supposed in 2051 of N-A1 case

W_2; Width for alighting passengers to move on a platform

In the case of multiple unit trains,

If $P_b/N < 6.4 \times LN$, $W2=2/3 \times P_b/(LN)$

If $P_b/N > 6.4 \times LN$, $W2=13/3 \times N$

P_b; Average alighting passengers of a train during 30 minutes of peak hours

L ; Length of a car L=20m in case of KCR (also, L=20m in Japan)

γ; Allowance caused by columns and distance for taking shelter against running trains

Allowance for taking shelter against running trains; 0.8 m

Allowance for a column; 0.3 m

Allowance for benches;

Side home not facing a station building 1.1-1.4 m

Side home facing a station building 2 m

KCR adopts over-track station type or viaduct station type and there is no platform facing station buildings. Therefore;

γ = 0.3+1.4 = 1.7 m for a side platform

γ= 0.8+0.3+1.4 = 2.5 m for an island platform

Table 4.2.4 shows the forecast demand in 2051 (30 years after commencement of operation) for calculating the required widths of platforms of KCR stations and Table 4.2.5 shows the required widths calculated using the above-mentioned formula.

Table 4.2.4 Forecast Demand Data in 2051

Station	Daily Demand in 2051				Peak Hour Demand in 2051			
	Counterclockwise (Up)		Clockwise (Down)		Counterclockwise (Up)		Clockwise (Down)	
	Alight	Board	Akight	Board	Alight	Board	Akight	Board
Drigh Road	141222	277492	162120	57140	10309	20257	11835	4171
Johar	5730	5209	3742	4330	418	380	273	316
Alladin Park	6125	4541	3914	5788	447	331	286	423
NiPA	8779	31741	29520	8951	641	2317	2155	653
Gilani	25366	27493	20325	24589	1852	2007	1484	1795
Yasinabad	11673	14153	10660	8161	852	1033	778	596
Liaquatabad	18944	25763	24077	19671	1383	1881	1758	1436
North-Nazimabad	20613	27890	25277	20299	1505	2036	1845	1482
Orangi	6244	8024	7802	8687	456	586	570	634
HBL	10501	2478	2144	8480	767	181	157	619
Manghopir	12146	3244	3985	9732	887	237	291	710
SITE	23435	11643	8614	14953	1711	850	629	1092
Shah-Abdul-Latif	18304	9112	10329	13415	1336	665	754	979
Baldia	72750	48850	43644	51366	5311	3566	3186	3750
Liyari	12228	93572	121441	40864	893	6831	8865	2983
Wazir Mansion	4370	28989	39377	6628	319	2116	2874	484
Tower	13008	37202	30540	16403	950	2716	2229	1197
Karachi City	10651	63548	80212	17781	778	4639	5856	1298
DCOS	10780	37866	41995	12653	787	2764	3066	924
Karachi Kanttt.	9625	22005	21152	10181	703	1606	1544	743
Naval	50509	18450	15186	56482	3687	1347	1109	4123
Chanesar	16900	40655	38433	22369	1234	2968	2806	1633
Shaheed-e-Millat	35691	28472	21672	24467	2605	2078	1582	1786
Karzas Halt	21106	15540	6446	19710	1541	1134	471	1439

Source; JICA Study Team

Table 4.2.5 Required Width of Platform of KCR Stations Obtained from Passenger Flow Capacity on Platform

Station	Peak Hour Demand 2051				Values 2051calcurated												γ (Platform		Platform				
	Counterclockwise		Clockwise		Upward						Downward								Platform Type				
	Alight	Board	Akight	Board	Pa	Pb	Pa/N	(Pa/N)^0.5	W_1	W_2	Pa	Pb	Pa/N	(Pa/N)^0.5	W_1	W_2	Side	Island	Side Upward	Side Downward	One Island	Island (Upward)	Island (Downward)
Drigh Road	10309	20257	11835	4171	1350	687	168.8	12.99	2.6	2.9	278	789	34.8	5.90	1.2	3.3	1.7	2.2	–	–	–	7.7	6.7
Johar	418	380	273	316	25	28	3.2	1.78	0.4	0.1	21	18	2.6	1.62	0.3	0.1	1.7	2.2	2.2	2.1	–	–	–
Alladin Park	447	331	286	423	22	30	2.8	1.66	0.3	0.1	28	19	3.5	1.88	0.4	0.1	1.7	2.2	2.2	2.2	–	–	–
NiPA	641	2317	2155	653	154	43	19.3	4.39	0.9	0.2	44	144	5.4	2.33	0.5	0.6	1.7	2.2	–	–	4.3	–	–
Gilani	1852	2007	1484	1795	134	123	16.7	4.09	0.8	0.5	120	99	15.0	3.87	0.8	0.4	1.7	2.2	–	–	–	3.5	3.4
Yasinabad	852	1033	778	596	69	57	8.6	2.93	0.6	0.2	40	52	5.0	2.23	0.4	0.2	1.7	2.2	2.5	2.4	–	–	–
Liaquatabad	1383	1881	1758	1436	125	92	15.7	3.96	0.8	0.4	96	117	12.0	3.46	0.7	0.5	1.7	2.2	2.9	2.9	–	–	–
North-Nazimabad	1505	2036	1845	1482	136	100	17.0	4.12	0.8	0.4	99	123	12.3	3.51	0.7	0.5	1.7	2.2	2.9	2.9	–	–	–
Orangi	456	586	570	634	39	30	4.9	2.21	0.4	0.1	42	38	5.3	2.30	0.5	0.2	1.7	2.2	–	–	3.4	–	–
HBL	767	181	157	619	12	51	1.5	1.23	0.2	0.2	41	10	5.2	2.27	0.5	0.0	1.7	2.2	2.2	2.2	–	–	–
Manghopir	887	237	291	710	16	59	2.0	1.40	0.3	0.2	47	19	5.9	2.43	0.5	0.1	1.7	2.2	2.2	2.3	–	–	–
SITE	1711	850	629	1092	57	114	7.1	2.66	0.5	0.5	73	42	9.1	3.02	0.6	0.2	1.7	2.2	2.7	2.5	–	–	–
Shah-Abdul-Latif	1336	665	754	979	44	89	5.5	2.35	0.5	0.4	65	50	8.2	2.86	0.6	0.2	1.7	2.2	–	–	3.8	–	–
Baldia	5311	3566	3186	3750	238	354	29.7	5.45	1.1	1.5	250	212	31.2	5.59	1.1	0.9	1.7	2.2	4.3	3.7	–	–	–
Liyari	893	6831	8865	2983	455	60	56.9	7.54	1.5	0.2	199	591	24.9	4.99	1.0	2.5	1.7	2.2	–	–	–	4.0	5.7
Wazir Mansion	319	2116	2874	484	141	21	17.6	4.20	0.8	0.1	32	192	4.0	2.01	0.4	0.8	1.7	2.2	–	–	4.3	–	–
Tower	950	2716	2229	1197	181	63	22.6	4.76	1.0	0.3	80	149	10.0	3.16	0.6	0.6	1.7	2.2	–	–	4.7	–	–
Karachi City	778	4639	5856	1298	309	52	38.7	6.22	1.2	0.2	87	390	10.8	3.29	0.7	1.6	1.7	2.2	–	–	5.9	–	–
DCOS	787	2764	3066	924	184	52	23.0	4.80	1.0	0.2	62	204	7.7	2.77	0.6	0.9	1.7	2.2	–	–	4.8	–	–
Karachi Kanttt.	703	1606	1544	743	107	47	13.4	3.66	0.7	0.2	50	103	6.2	2.49	0.5	0.4	1.7	2.2	–	–	4.1	–	–
Naval	3687	1347	1109	4123	90	246	11.2	3.35	0.7	1.0	275	74	34.4	5.86	1.2	0.3	1.7	2.2	–	–	5.4	–	–
Chanesar	1234	2968	2806	1633	198	82	24.7	4.97	1.0	0.3	109	187	13.6	3.69	0.7	0.8	1.7	2.2	–	–	5.1	–	–
Shaheed-e-Millat	2605	2078	1582	1786	139	174	17.3	4.16	0.8	0.7	119	105	14.9	3.86	0.8	0.4	1.7	2.2	3.3	2.9	–	–	–
Karzas Halt	1541	1134	471	1439	76	103	9.5	3.07	0.6	0.4	96	31	12.0	3.46	0.7	0.1	1.7	2.2	–	–	4.1	–	–

Source; JICA Study Team

Normally demand of up line and down line at the station is almost same and the platform width of up line should be same as that of down line. The required widths calculated above are different between up-platform and down-platform due to the nature of demand forecast model. JICA Study Team takes larger values as the proper width of platforms at each KCR stations in Table 4.2.5. **According to Table 4.2.5, the revised platform widths of KCR stations are proposed as shown in**

Table 4.2.6, where only platform width of Drigh Road is changed from 7.5 m to 7.7 m or more.

Table 4.2.6 Final Platform Types and Width of KCR Stations

No.	Station	Side Platform		Island Platform (m)				Remark
				One island		Two Island		
		one staircase with 2 Escaltors	1 staircase and escalators separate	staircase with 2 escalators	2 staircases and 2 escalators separate	1 staircase with 2 escalators	2 staircase and 2 escalators separatre	
1	Drigh Road						7.7+7.7	2 island platforms
2	Johar		6.0+6.0					2 side platforms
3	Alladin Park		6.0+6.0					2 side platforms
4	NIPA			12				1 island platforms
5	Gilani						7.5+7.5	2 island platforms
6	Yasinabad		6.0+6.0					2 side platforms
7	Liaquatabad		6.0+6.0					2 side platforms
8	North-Nazimabad		6.0+6.0					2 side platforms
9	Orangi		6.0+6.0					2 side platforms
10	HBL		6.0+6.0					2 side platforms
11	Manghopir		6.0+6.0					2 side platforms
12	SITE		6.0+6.0					2 side platforms
13	Shah-Abdul-Latif				7.5			1island platform
14	Baldia		6.0+6.0					2 side platforms
15	Liyari						7.5+7.5	2 island platforms
16	Wazir Mansion				7.5			1 island platform
17	Tower				7.5			1 island platform
18	Karachi City				7.5			1 island platform
19	DCOS				7.5			1 island platform
20	Karachi Kanttt.			12				1 island platform
21	Naval				7.5			1 island platform
22	Chanesar				7.5			1 island platform
23	Shaheed-e-Millat		6.0+6.0					2 side platforms
24	Karzas Halt				7.5			1 island platform

Source; JICA Study Team

B) Passenger Inflow/Evacuation Capacity of Platform by Station

A platform should have a capacity of inflow/evacuation capacity which satisfies the condition that the passengers of preceding train can be evacuated from platform before next train arrives and passengers for next train can inflow into the platform. If such capacity is insufficient, passengers who get off preceding trains and get on next trains pile up and the dangerous big mess can arise and at last may causes suspension of train operations. To avoid such mess passenger, the inflow/evacuation capacity should be larger than the total of peak hour alighting and boarding passengers of the platform. The relation between total forecast alighting and boarding passengers in 2051 and passenger inflow/evacuation capacity by platform by station is as shown in Table 4.2.7.

Table 4.2.7 Relation between Alighting/Boarding Passengers and Passenger Inflow/Evacuation Capacity by Platform at Each Station

Station	Peak Hour Demand in 2051									
	Counterclockwise		Clockwise		Total Alight and Board			Passenger Inflow/Evacuation Capacity		
	Alight A	Board B	Alight C	Board D	A+B	C+D	A+B+C+D	Platform for A+B	Platform for C+D	Platform for A+B+C+D
Drigh Road	10,309	20,257	11,835	4,171	30,566	16,006	46,572	39,708	39,708	–
Johar	418	380	273	316	799	589	1,388	20,052	20,052	–
Alladin Park	447	331	286	423	779	708	1,487	20,052	20,052	–
NiPA	641	2,317	2,155	653	2,958	2,808	5,766	–	–	39,708
Gilani	1,852	2,007	1,484	1,795	3,859	3,279	7,137	26,604	26,604	–
Yasinabad	852	1,033	778	596	1,885	1,374	3,259	20,052	20,052	–
Liaquatabad	1,383	1,881	1,758	1,436	3,264	3,194	6,457	20,052	20,052	–
North-Nazimabad	1,505	2,036	1,845	1,482	3,541	3,327	6,868	20,052	20,052	–
Orangi	456	586	570	634	1,042	1,204	2,245	20,052	20,052	
HBL	767	181	157	619	947	776	1,723	20,052	20,052	
Manghopir	887	237	291	710	1,123	1,001	2,125	20,052	20,052	
SITE	1,711	850	629	1,092	2,561	1,720	4,281	20,052	20,052	
Shah-Abdul-Latif	1,336	665	754	979	2,001	1,733	3,735			39,708
Baldia	5,311	3,566	3,186	3,750	8,877	6,936	15,813	20,052	20,052	
Liyari	893	6,831	8,865	2,983	7,723	11,848	19,572	39,708	39,708	
Wazir Mansion	319	2,116	2,874	484	2,435	3,358	5,794			39,708
Tower	950	2,716	2,229	1,197	3,665	3,427	7,092			39,708
Karachi City	778	4,639	5,856	1,298	5,417	7,153	12,570			39,708
DCOS	787	2,764	3,066	924	3,551	3,989	7,541			39,708
Karachi Kanttt.	703	1,606	1,544	743	2,309	2,287	4,596			39,708
Naval	3,687	1,347	1,109	4,123	5,034	5,232	10,266			39,708
Chanesar	1,234	2,968	2,806	1,633	4,202	4,439	8,640			39,708
Shaheed-e-Millat	2,605	2,078	1,582	1,786	4,684	3,368	8,052	20,052	20,052	
Karzas Halt	1,541	1,134	471	1,439	2,675	1,909	4,585			39,708

Source; JICA Study Teeam

As the result of comparison between total alighting and boarding passengers and platform inflow/evacuation capacity, it is confirmed that capacity of all the KCR stations is sufficient.

4.2.3 Intermodal Facility Plan

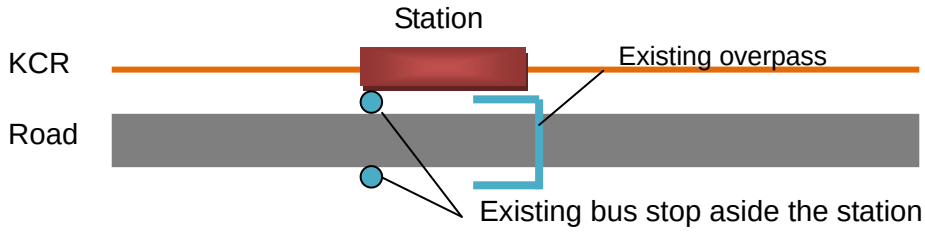
(1) Basic Policy

Actually minibuses and coaches cover public transport in Karachi. When KCR starts to operate, the passengers who go to CBD by minibus or coaches are expected to transfer to KCR at the KCR stations. However, if transfers from road transport to KCR are inconvenient or unsafe, most of bus users do not want to transfer to KCR and as the result, the number of transfers remains a few. Consequently, it is very important to provide good intermodal facilities which can facilitate passengers' willingness to transfer to KCR.

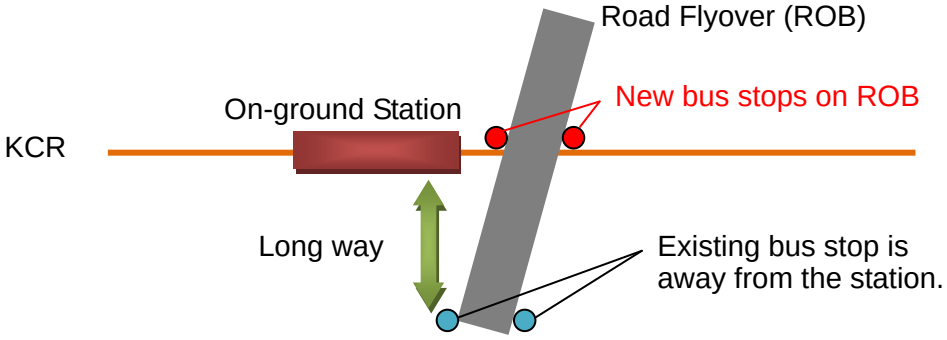
On the other hand, cost reduction is required for the project and limitation of available land to former KCR ROW arranged by RAP is expected.

Taking into account such requirements, JICA Study Team suggests the following policy on intermodal facility plan:

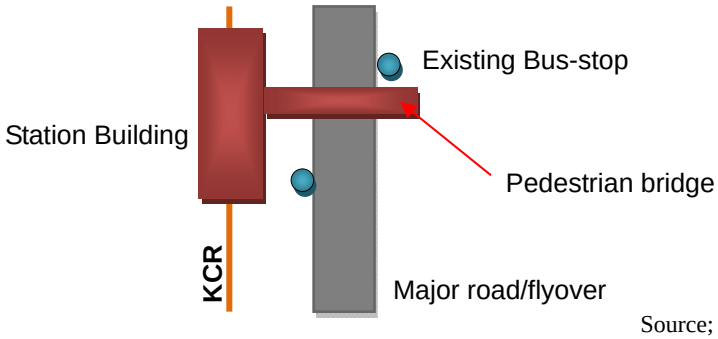
A) As for station plaza, desirable plaza space at each station is planned as a future plan which is described in Appendix 4-1. However, the provisional station plaza plan to be prepared up to the commencement of the KCR operations will be provided within available land in this study.
B) Existing pedestrian overpasses or underpasses will be optimized as shown in Figure 4.2.9 (a).
C) In the case that main road ROB is very near a KCR over-track station, a connecting footbridge and bus stop facility will be provided as shown in Figure 4.2.9 (b). However, the details of the facilities of foot bridges and bus stops will be examined in the basic design study.
D) In the case that a KCR viaduct station is very near a main road which crosses KCR, an access facility to the road and bus stop facility will be provided.
E) In the case that an underground/semi-underground station is very near a main road which crosses KCR, a pedestrian underpass and bus stop facility will be provided.
F) In case of few access routes to existing bus stops from a KCR station, a ground pathway or footbridge will be provided to access from the station to the existing bus stops as shown in Figure 4.2.9 (c), (d).



(a) Utilizing existing facilities



(b) Installation of new facilities



Source; JICA Study Teeam

(c) Pedestrian bridge to access to the station/bus stop

Source; Google

(d) Image of pedestrian bridge directly connecting station building

Figure 4.2.9 Basic Concept of Intermodal Facility

(2) Provisional Station Plaza Plan to be provided up to Opening of KCR

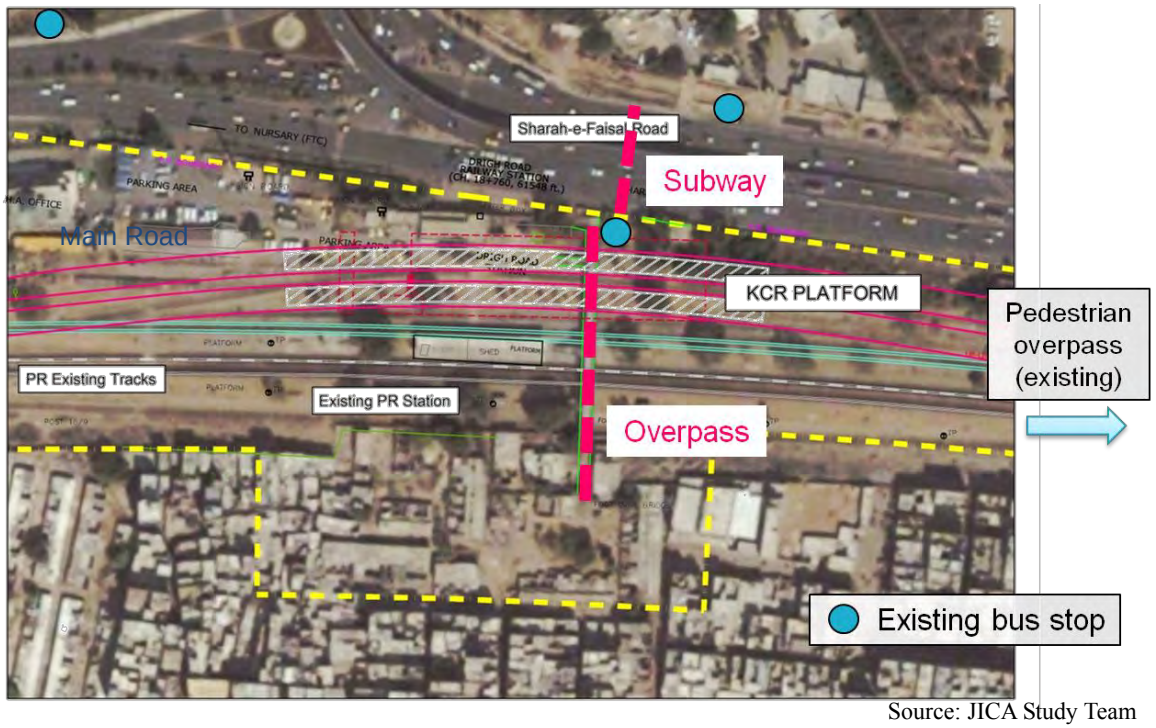
The followings are the provisional station plaza plan based on the results of land survey, utilizing existing cross roads and intermodal facilities such as bus stops.

The summary of intermodal facilities at each station is shown in Table 4.2.8.

Table 4.2.8 Summary of Intermodal Facility at Each Station

No.	Station Name	Type	Planning Intermodal Facility except Station Square
1	Drigh Road	Elevated	Pedestrian overpass and subway
2	Johar	Trench	Pedestrian deck with bus stop
3	Alladin Park	Trench	No available bus nearby
4	Nipa	On-ground	Pedestrian deck with bus stop
5	Giliani	Elevated	
6	Yasinabad	Elevated	
7	Liaquatabad	On-ground	Pedestrian deck with bus stop
8	North Nazimabad	On-ground	Pedestrian deck with bus stop
9	Orangi	Elevated	
10	HBL	On-ground	Pedestrian deck with bus stop
11	Manghopir	Elevated	
12	SITE	Elevated	
13	Shah-Abdul-Latif	Elevated	
14	Baldia	Elevated	Pedestrian overpass
15	Liyari	Elevated	
16	Wazir Mansion	On-ground	Pedestrian deck
17	Tower	On-ground	Pedestrian deck
18	Karachi City	Elevated	
19	DCOS	Elevated	
20	Karachi Cantt.	Elevated	
21	Naval	On-ground	
22	Chanesar	On-ground	
23	Shaheed-e-Millat	On-ground	Pedestrian deck with bus stop
24	Karsaz Halt	On-ground	

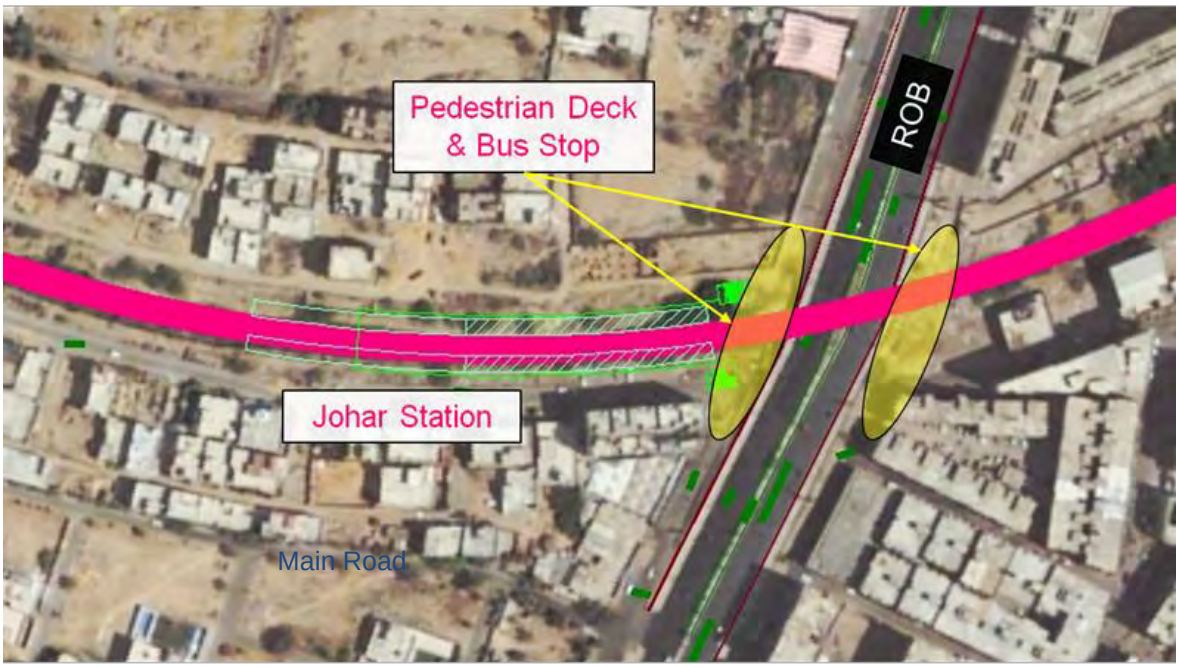
Source; JICA Study Teeam



Source: JICA Study Team

a) Drigh Road

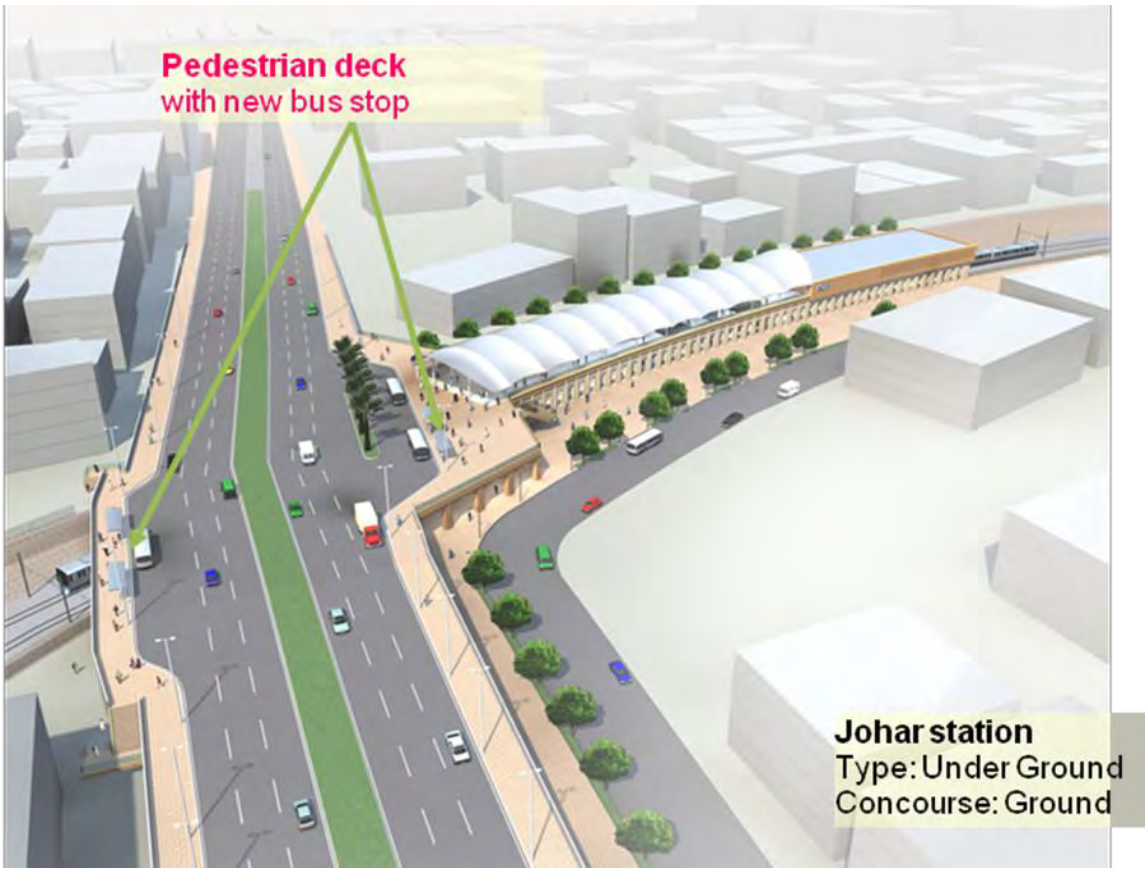
Figure 4.2.10 Provisional Station Plaza Plan (1/15)



b) Johar

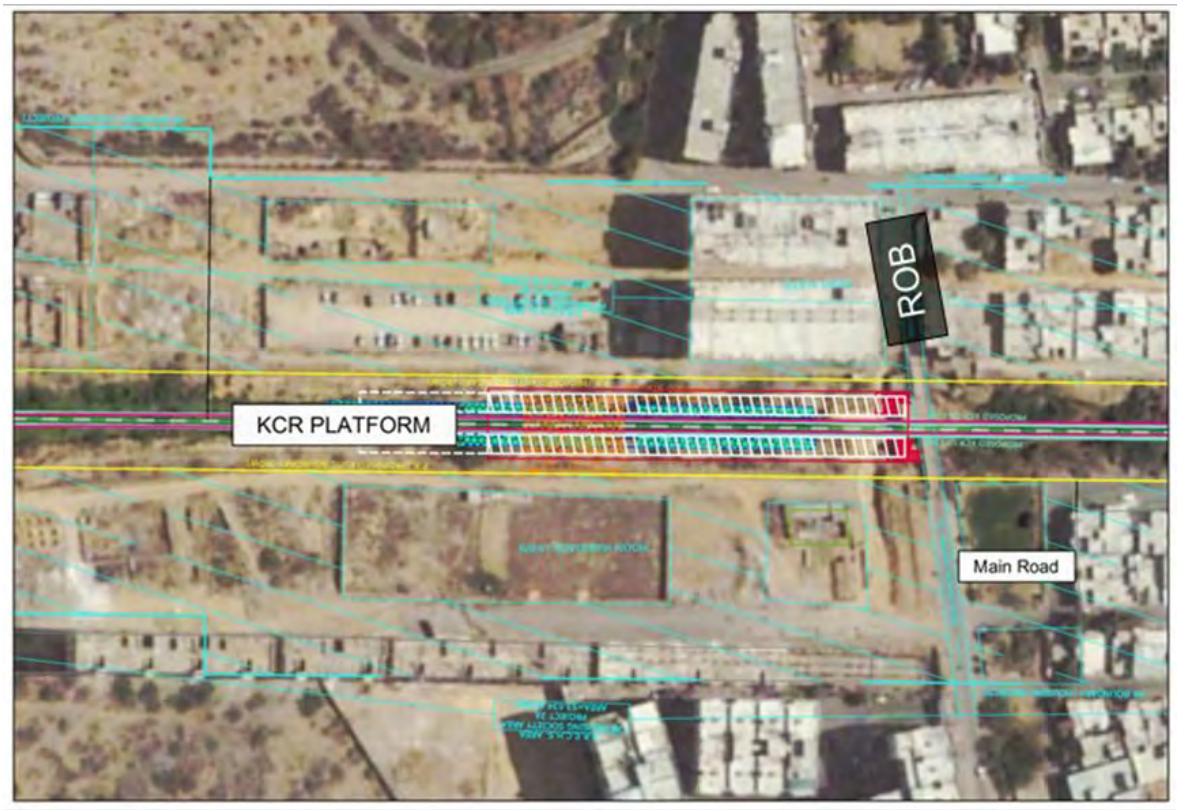
Source: JICA Study Team

Figure 4.2.11 Provisional Station Plaza Plan (2/15)

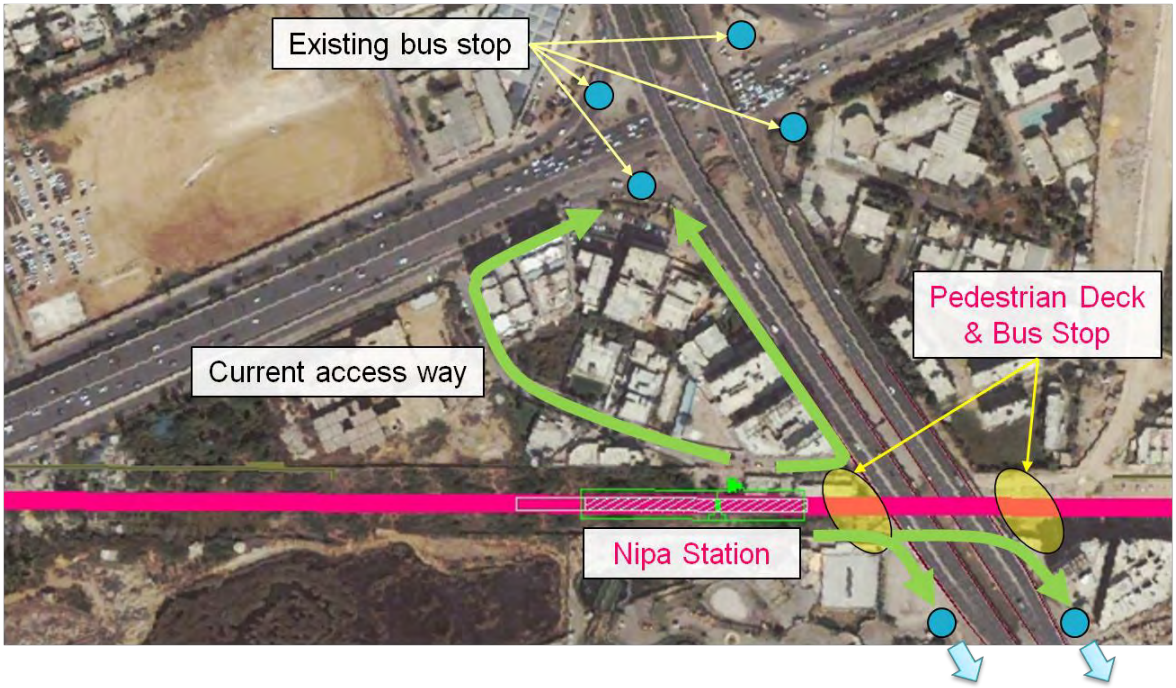


Source: JICA Study Team

Figure 4.2.12 Intermodal Facility Image of Johar Station



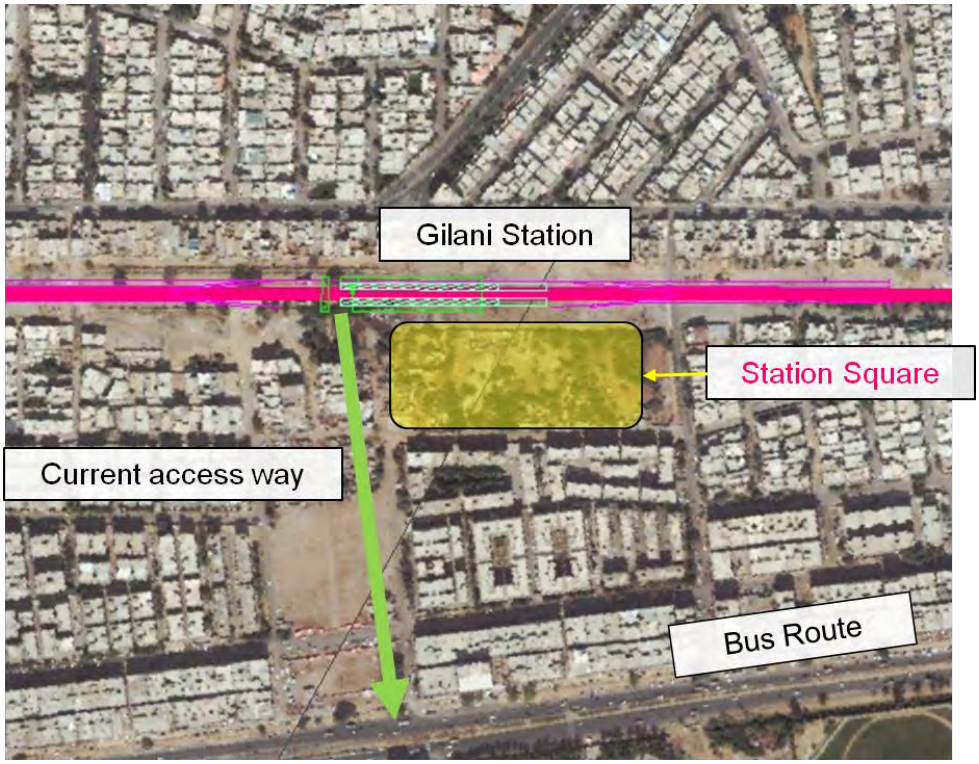
c) Alladin Park



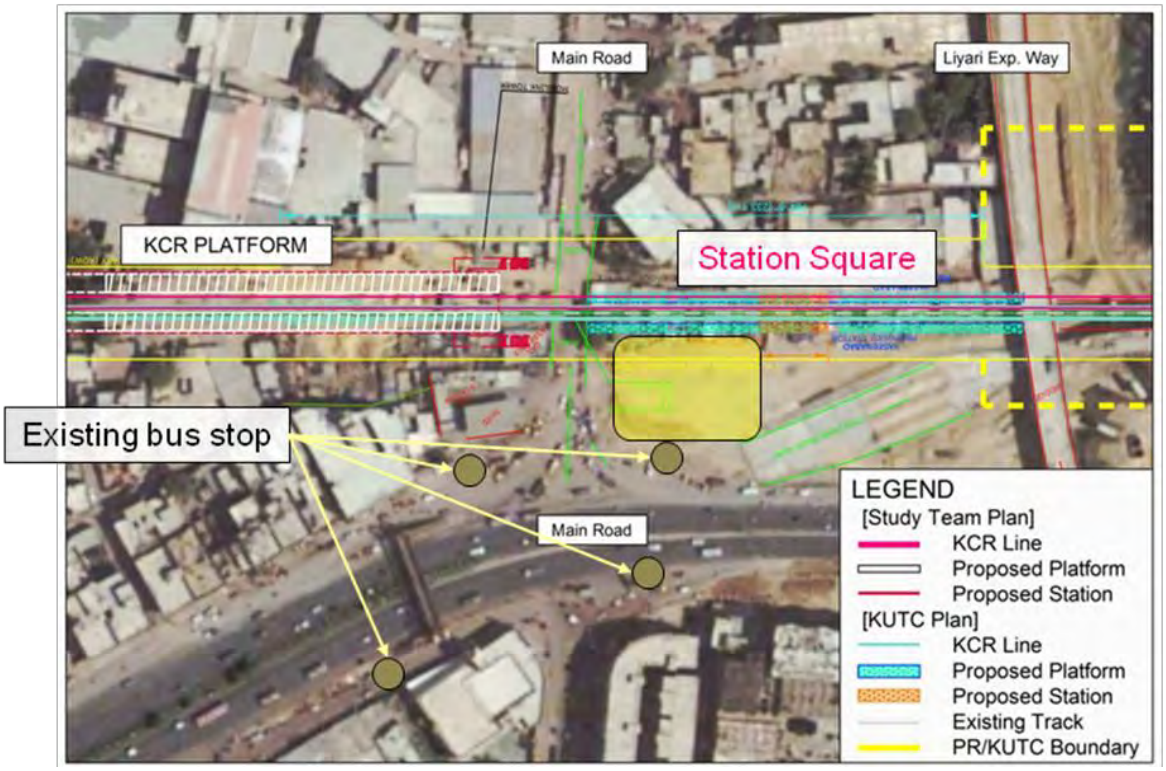
d) Nipa

Source: JICA Study Team

Figure 4.2.13 Provisional Station Plaza Plan (3/15)



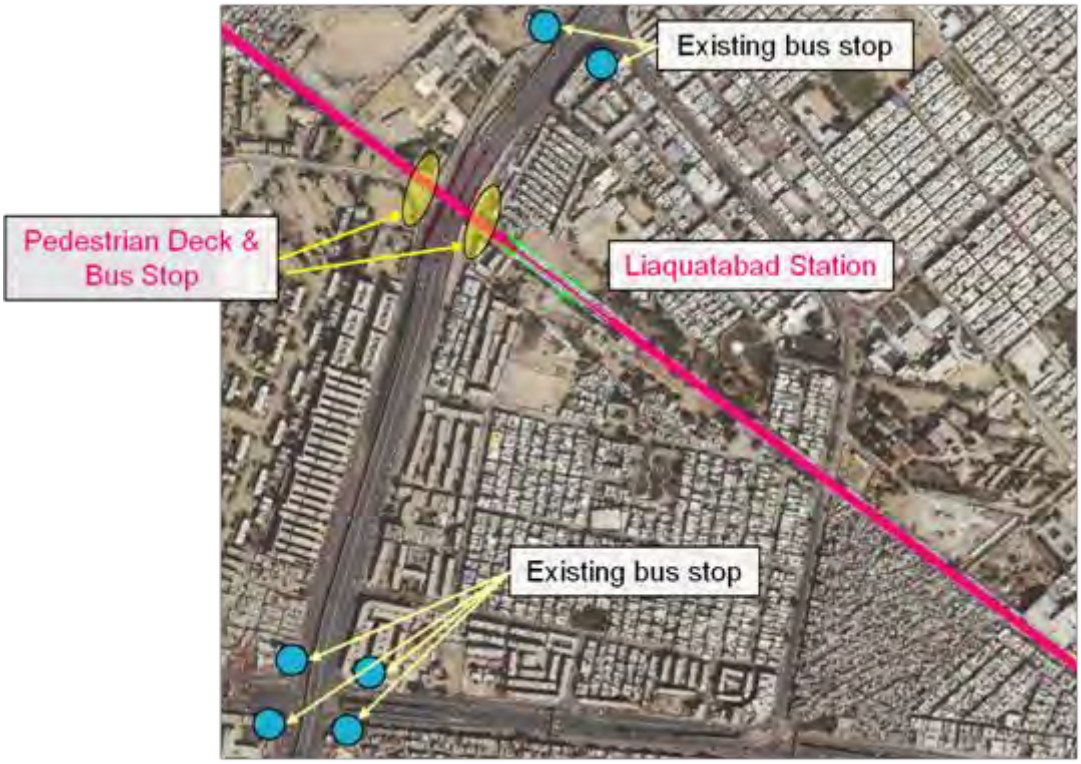
e) Giliani



f) Yasinabad

Source: JICA Study Team

Figure 4.2.14 Provisional Station Plaza Plan (4/15)

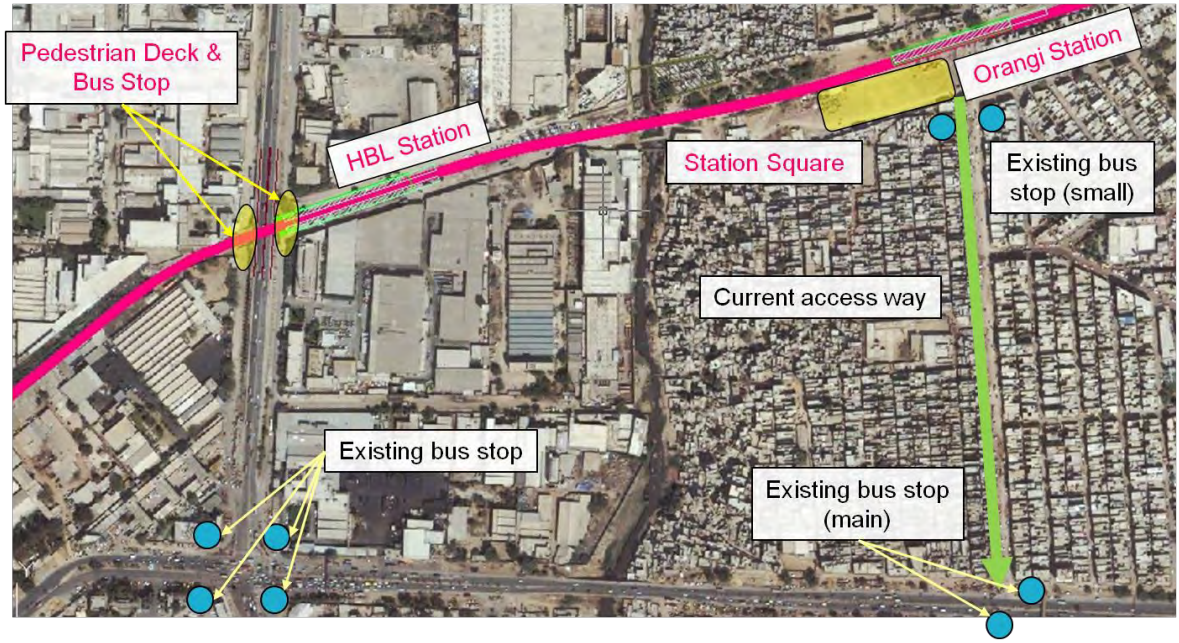


g) Liaquatabad

h) North Nazimabad

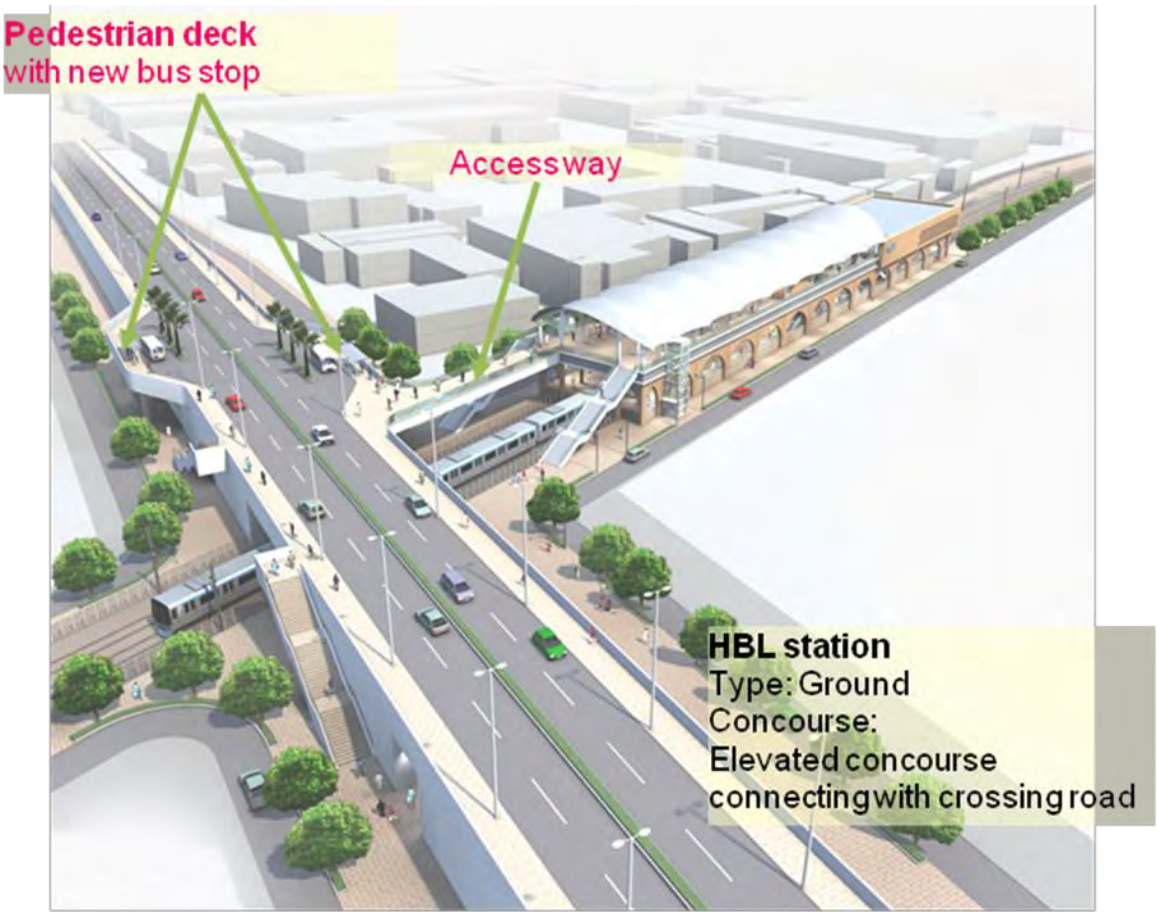
Source: JICA Study Team

Figure 4.2.15 Provisional Station Plaza Plan (5/15)



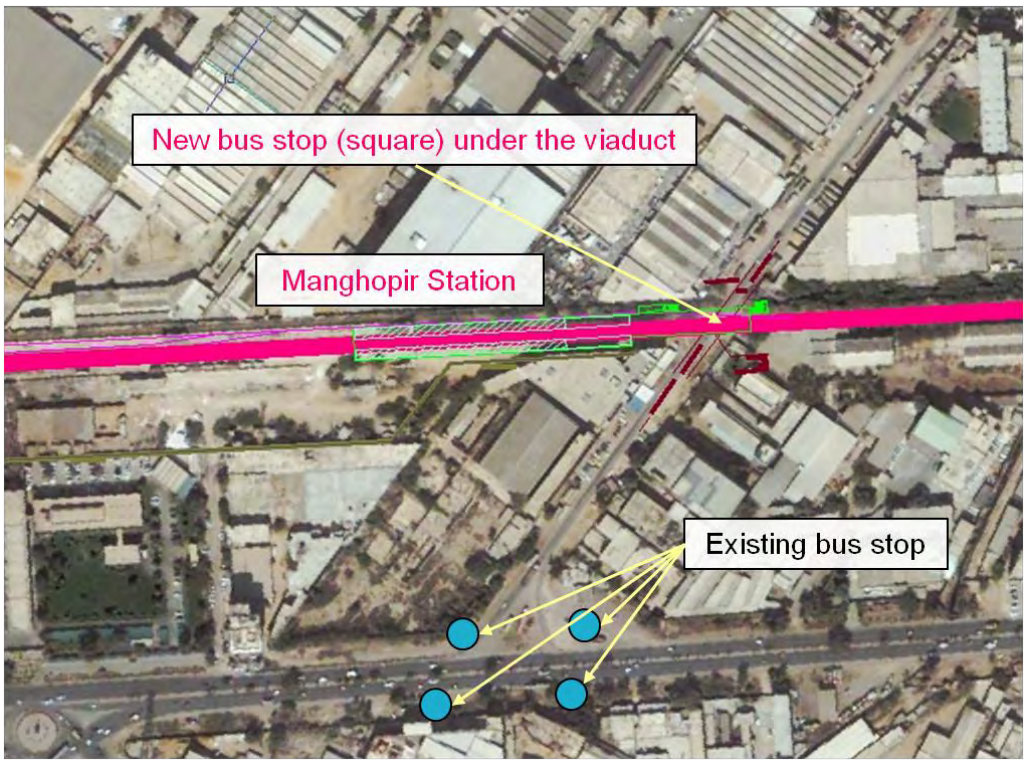
i) Orangi & HBL

Figure 4.2.16 Provisional Station Plaza Plan (6/15)



Source: JICA Study Team

Figure 4.2.17 Intermodal Facility Image of HBL station



j) Manghopir

Figure 4.2.18 Provisional Station Plaza Plan (7/15)

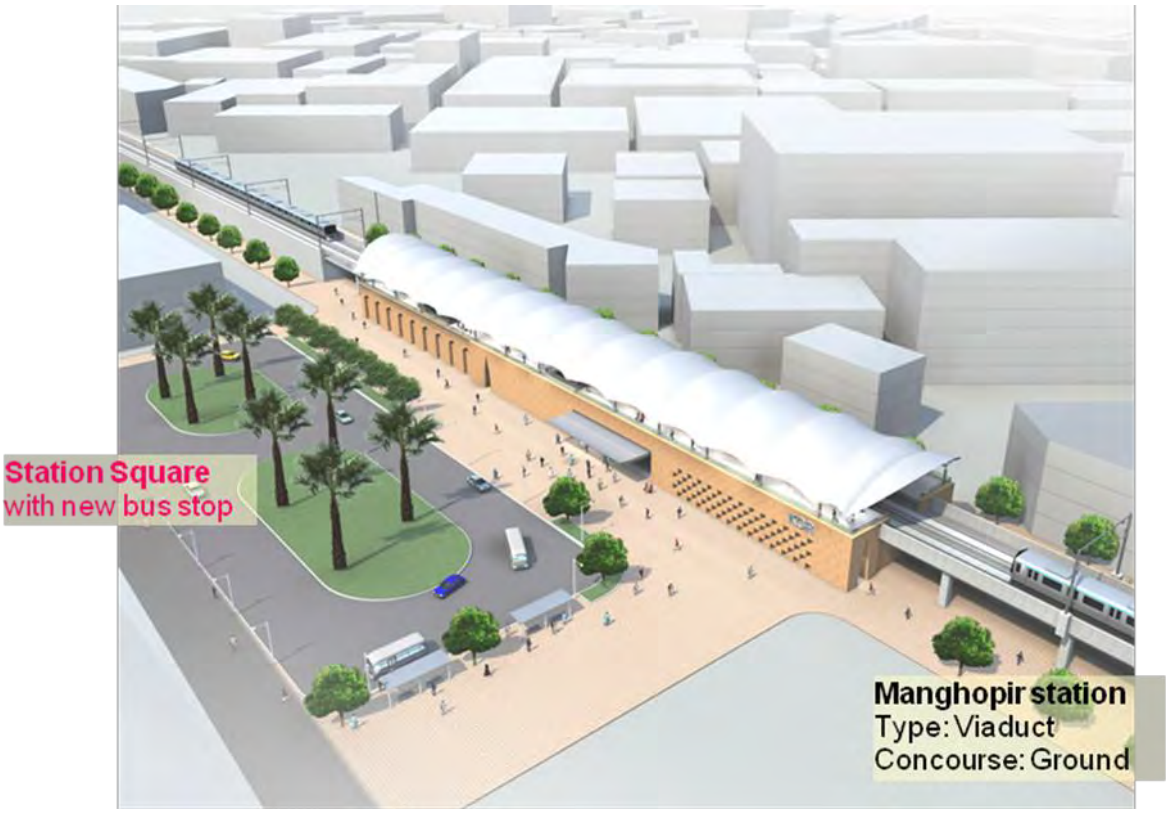
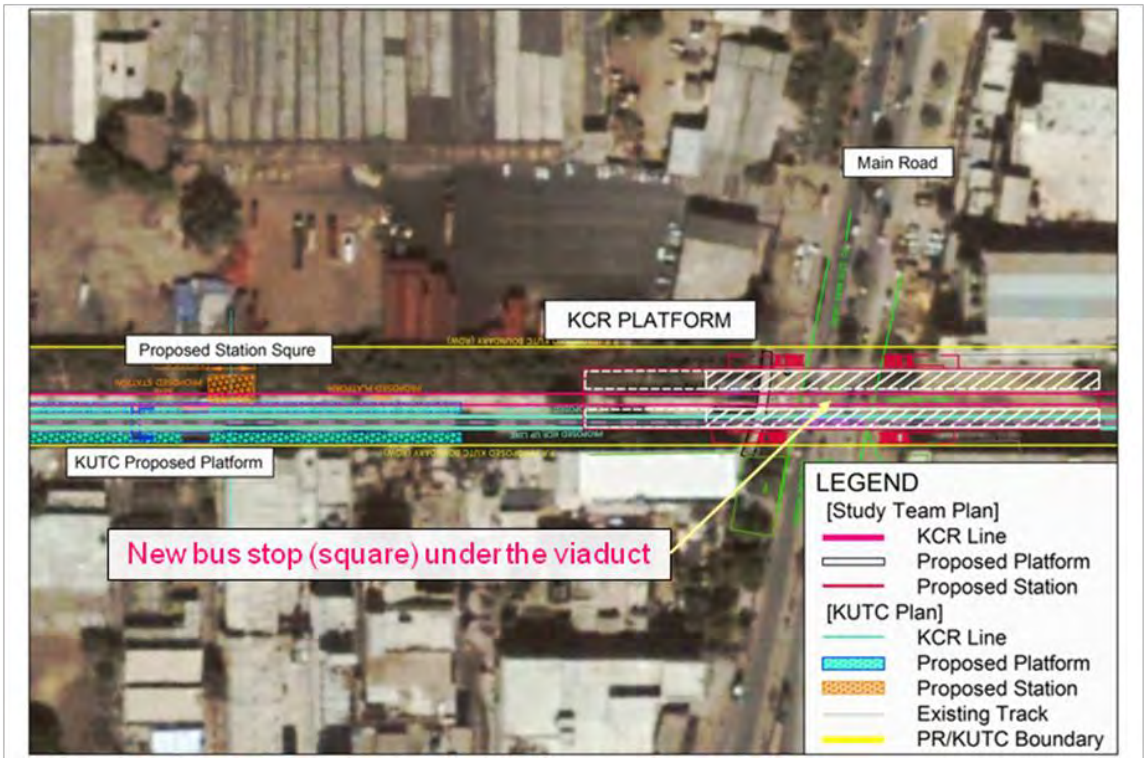
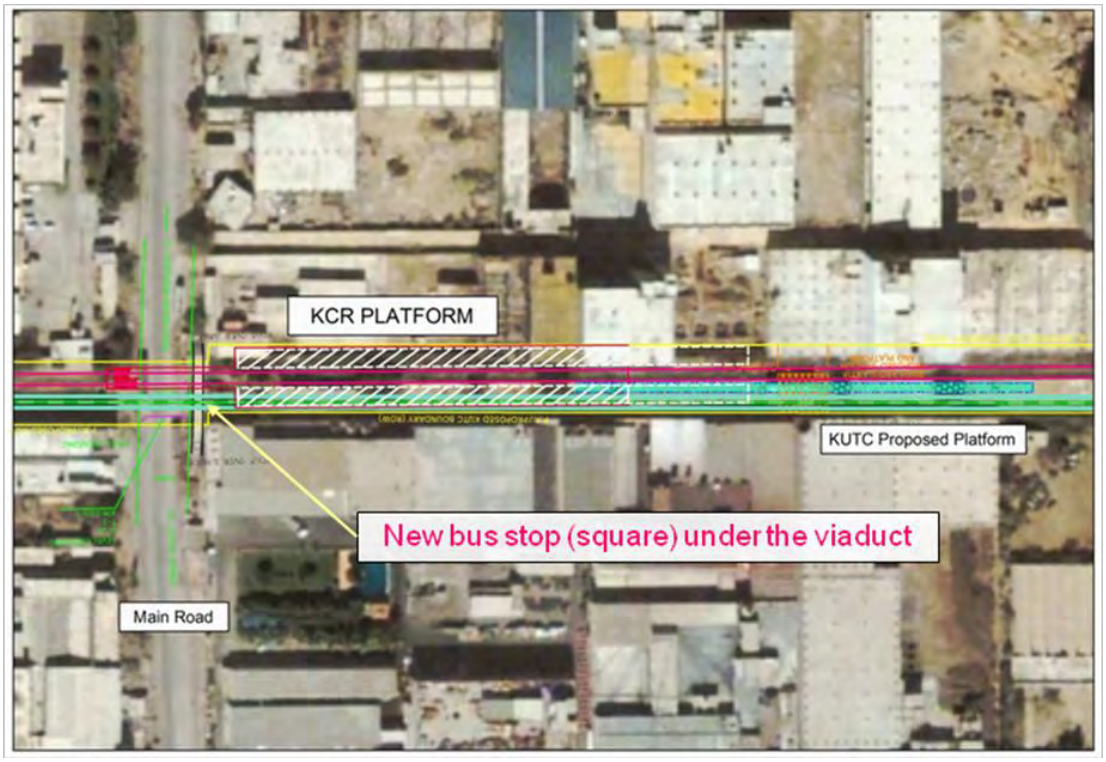


Figure 4.2.19 Intermodal Facility Image of Manghopir Station



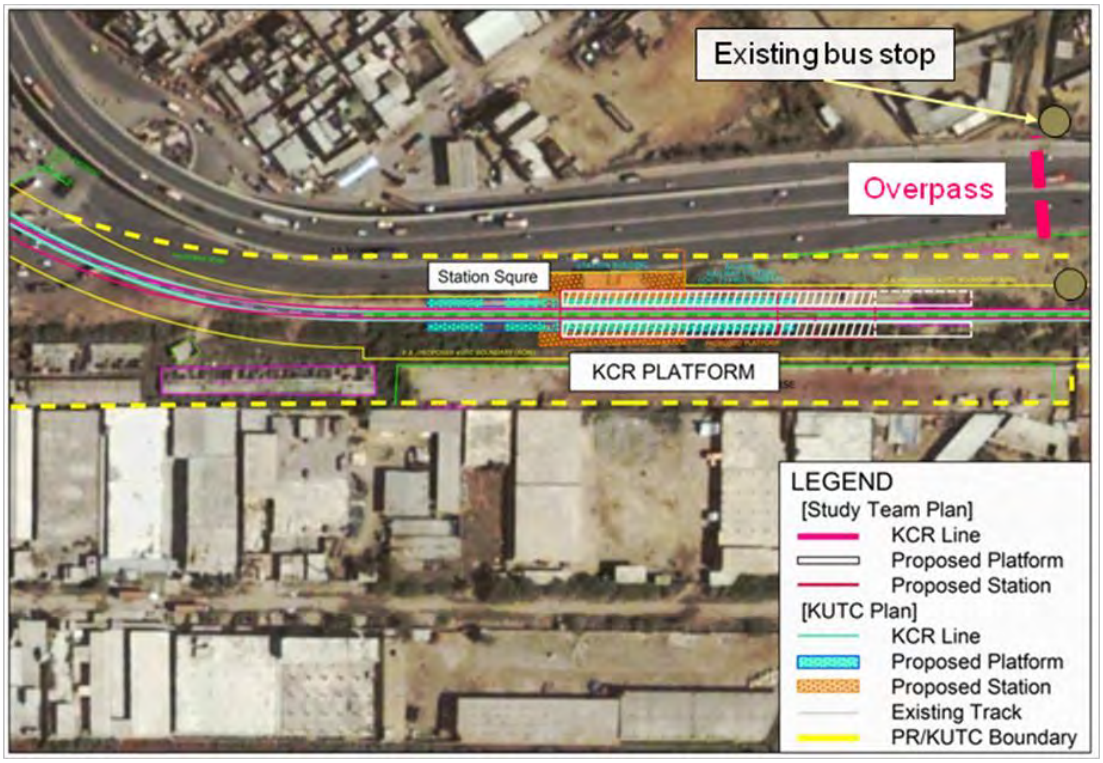
k) SITE



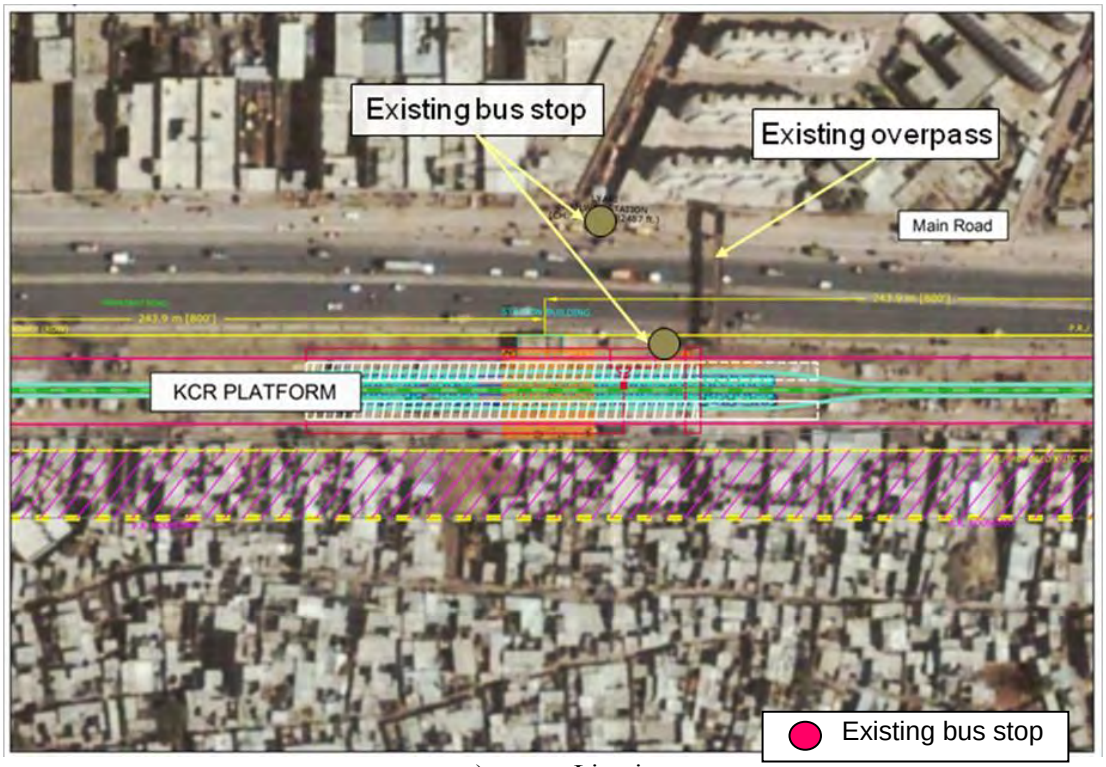
l) Shah Abdul Latif

Source: JICA Study Team

Figure 4.2.20 Provisional Station Plaza Plan (8/15)



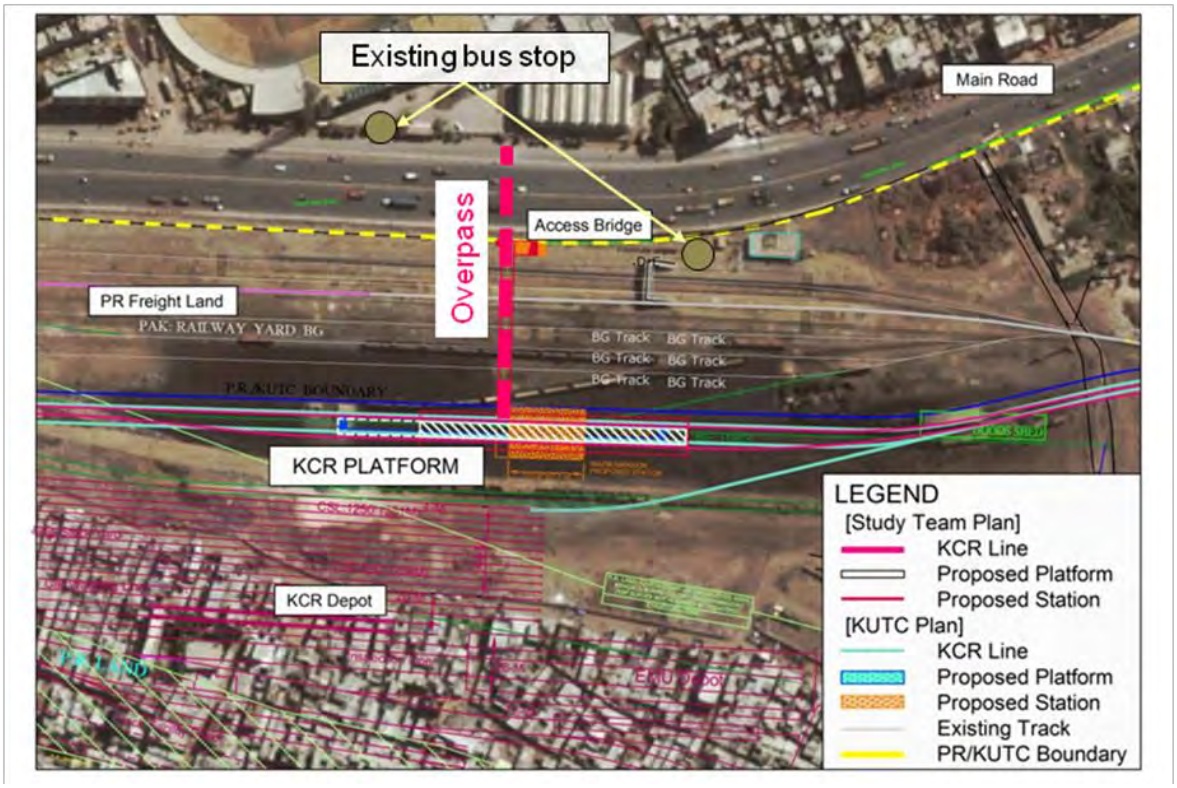
m) Baldia



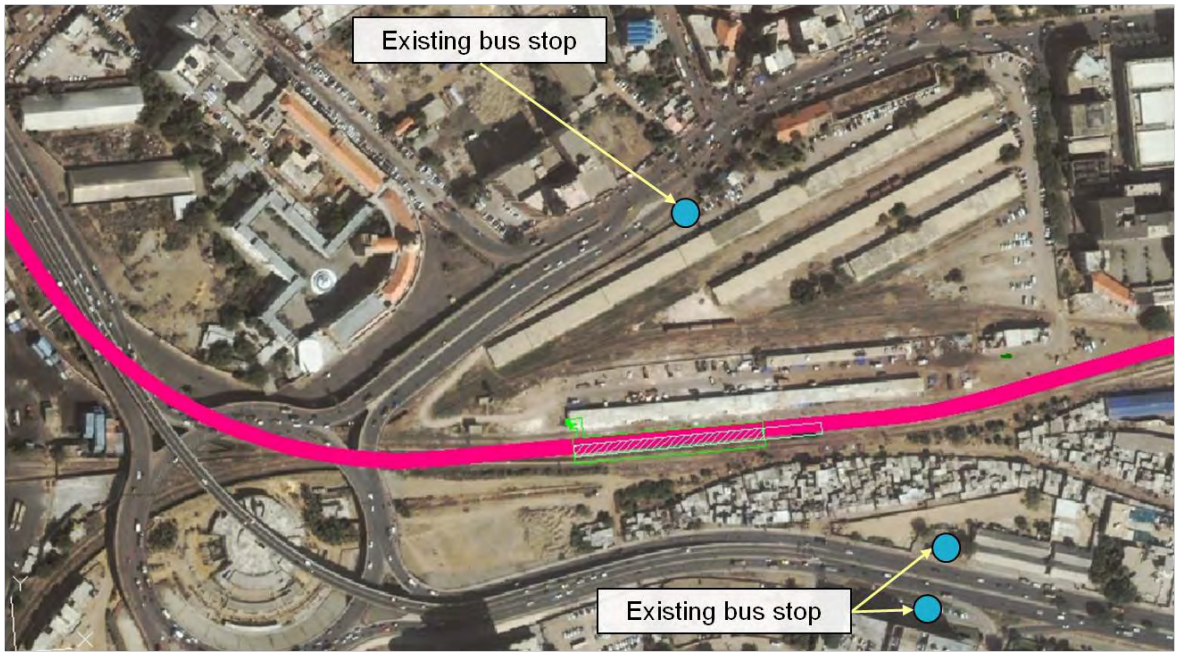
n) Liyari

Source: JICA Study Team

Figure 4.2.21 Provisional Station Plaza Plan (9/15)



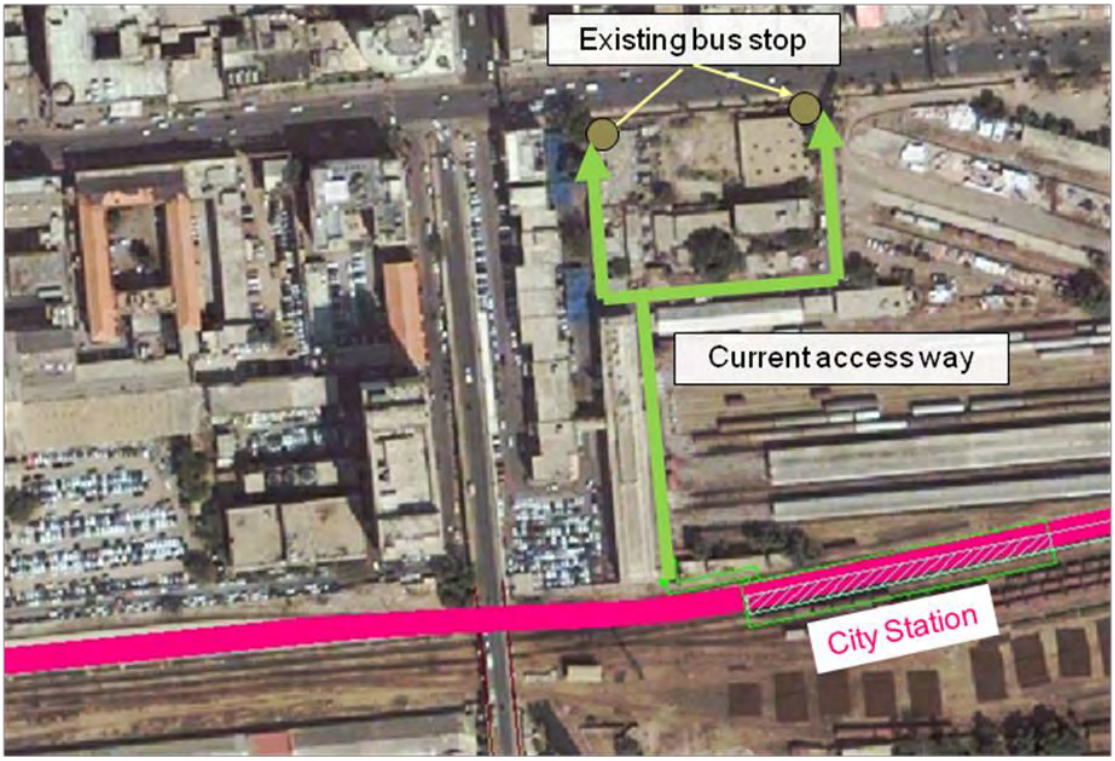
o) Wazir Mansion



p) Tower

Source: JICA Study Team

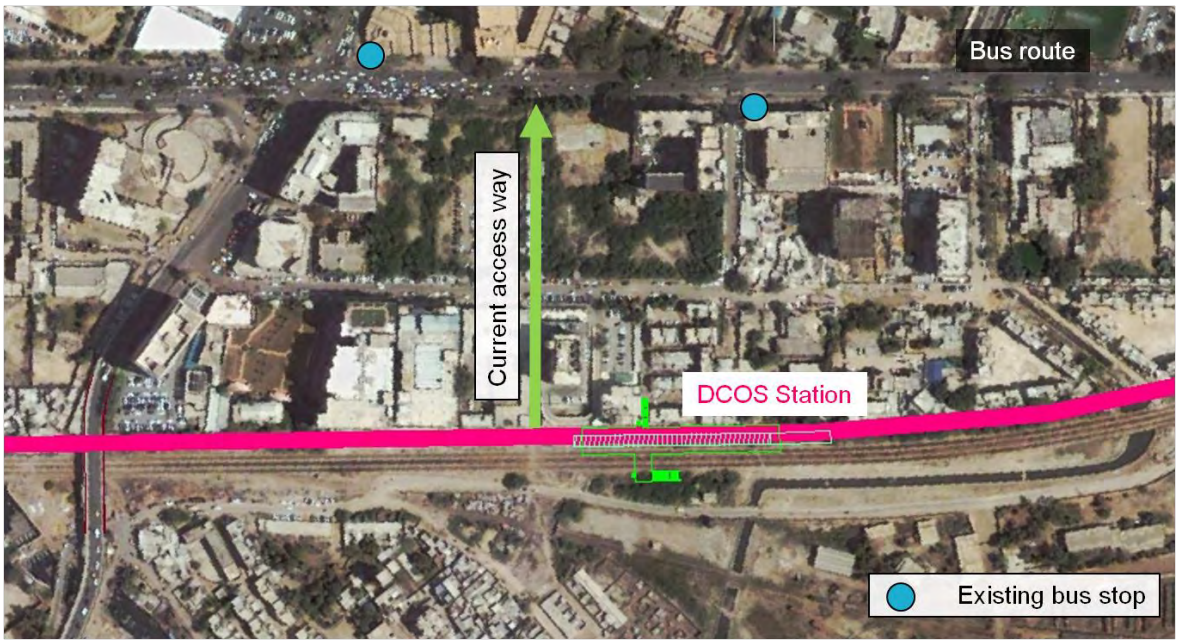
Figure 4.2.22 Provisional Station Plaza Plan (10/15)



q) Karachi City

Source: JICA Study Team

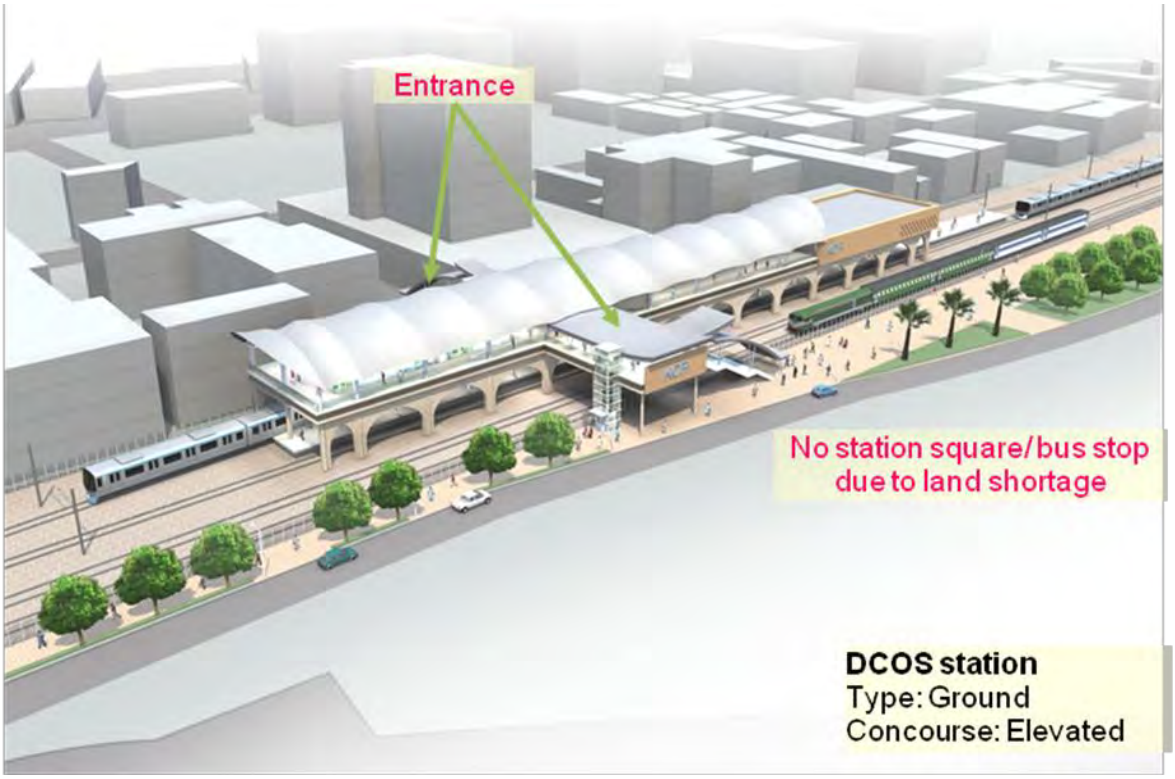
Figure 4.2.23 Provisional Station Plaza Plan (11/15)



r) DCOS

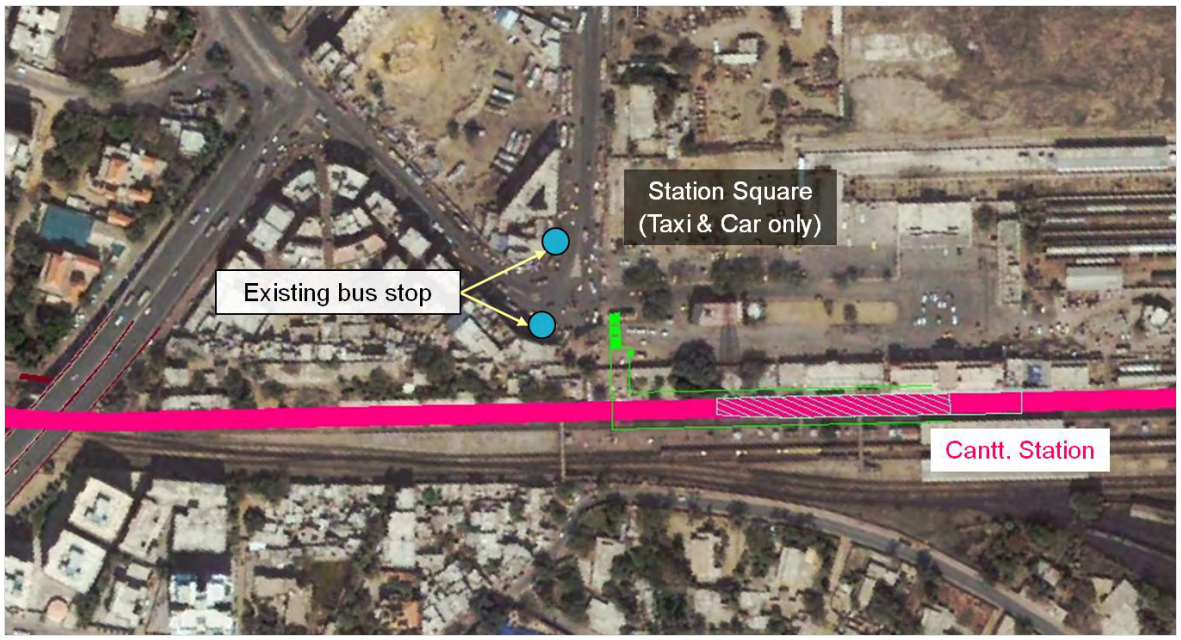
Source: JICA Study Team

Figure 4.2.24 Provisional Station Plaza Plan (12/15)



Source: JICA Study Team

Figure 4.2.25 Intermodal Facility Image of DCOS Station



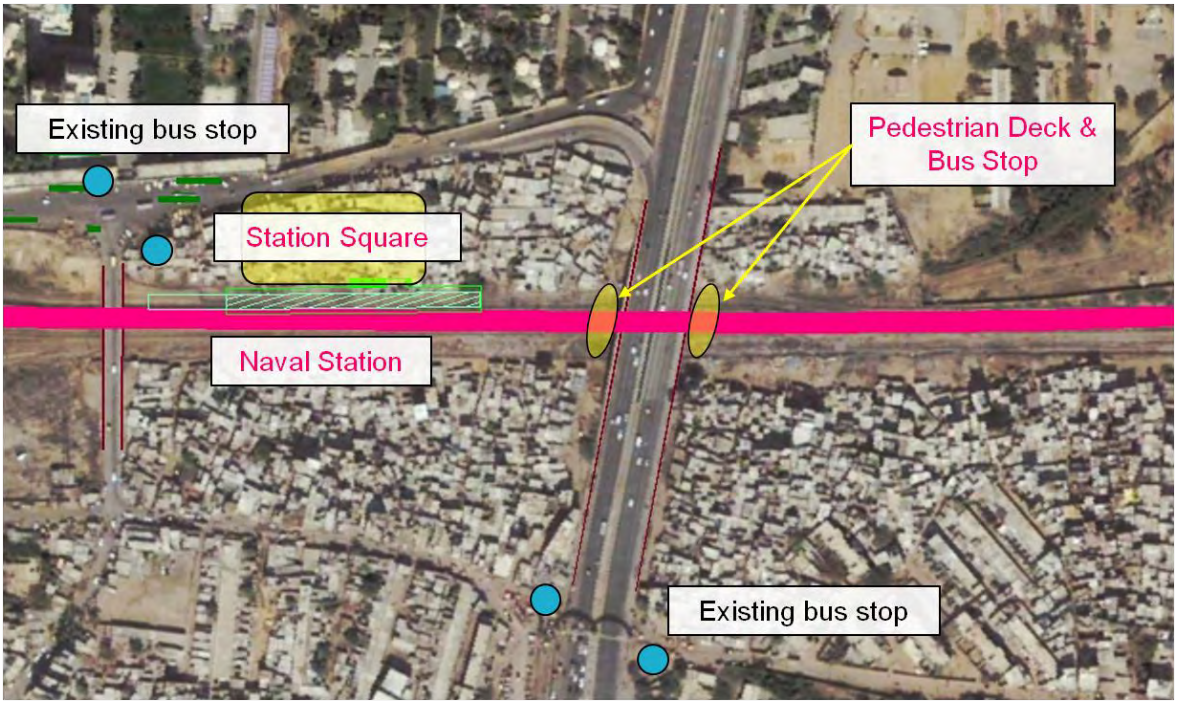
s) Karachi Cantt.

Source: JICA Study Team

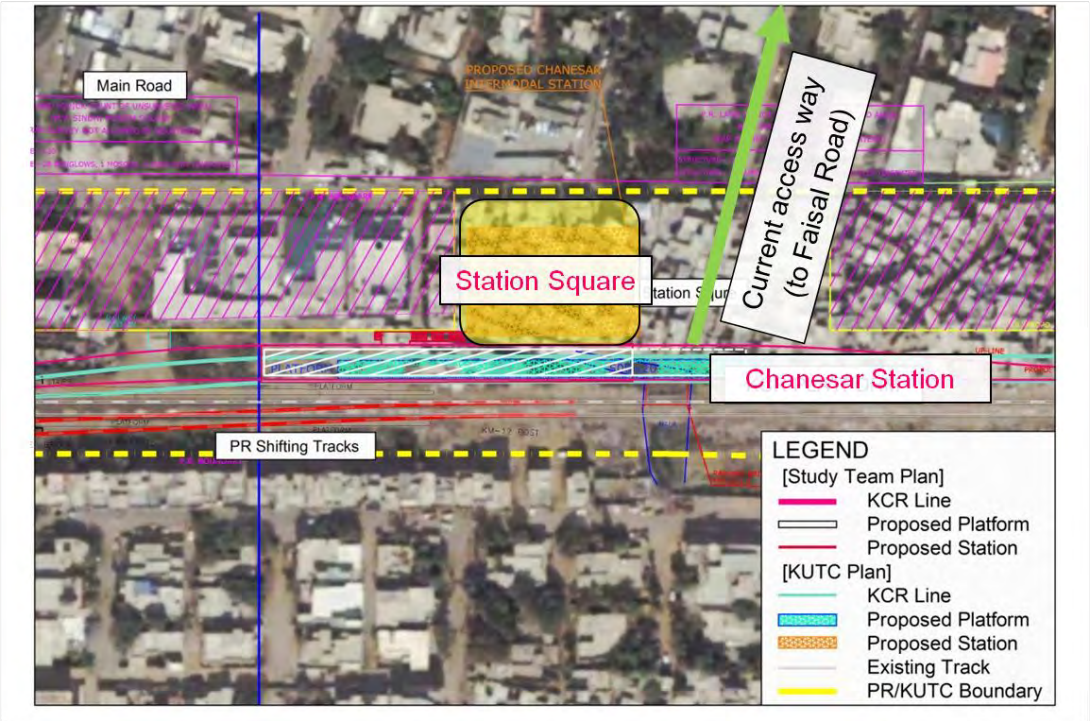
Figure 4.2.26 Provisional Station Plaza Plan (13/15)

Source: JICA Study Team

Figure 4.2.27 Intermodal Facility Image of Karachi Cantt. Station



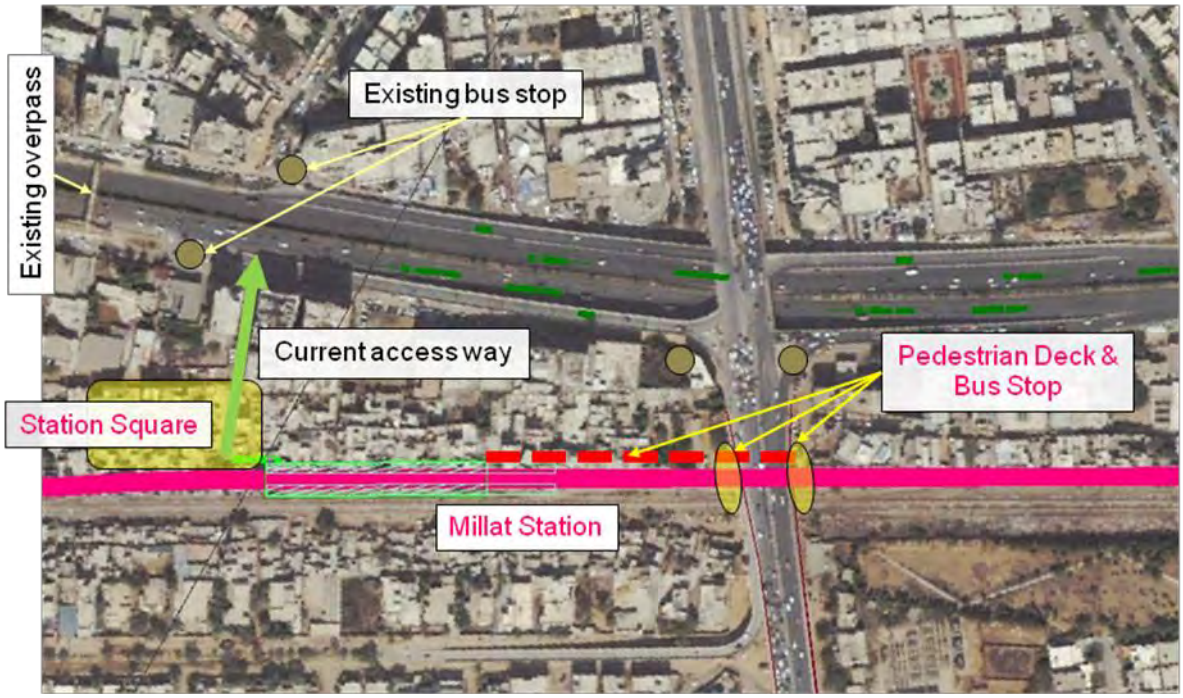
t) Naval



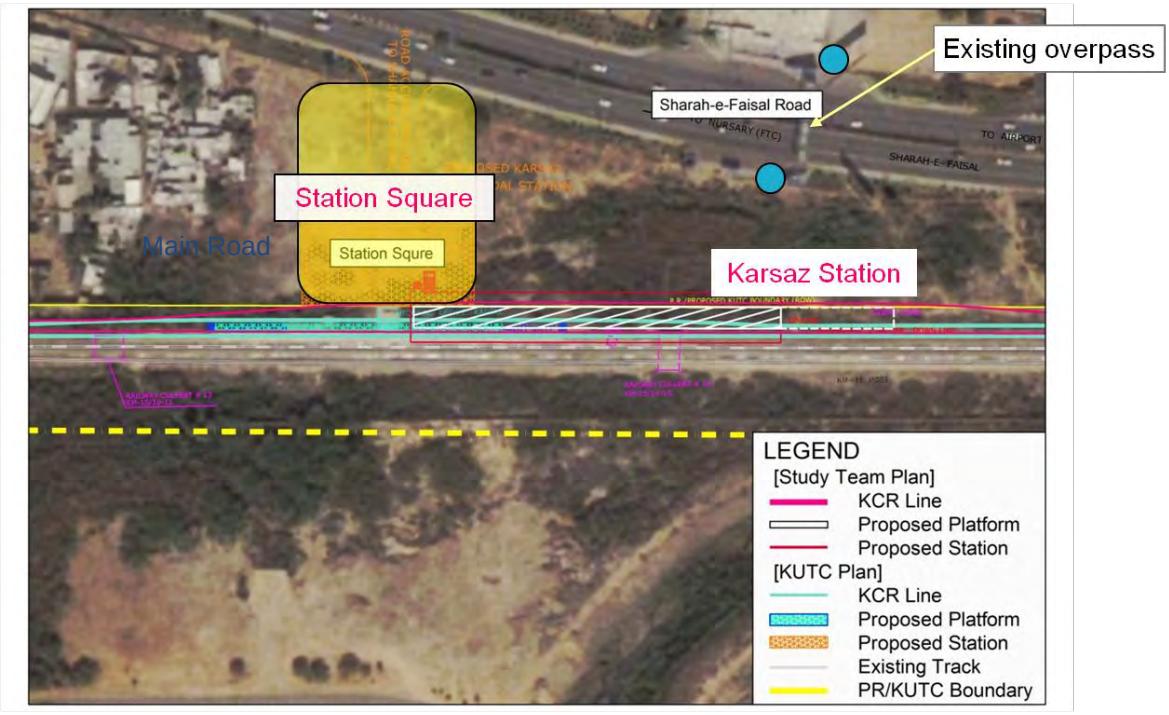
u) Chanesar

Source: JICA Study Team

Figure 4.2.28 Provisional Station Plaza Plan (14/15)



v) Shaheed-e-Millat



w) Karsaz Halt

Source: JICA Study Team

Figure 4.2.29 Provisional Station Plaza Plan (15/15)