

Republic of Turkey
Traffic Demand Management of
Historical Area in Istanbul
(ISTDM)

Final Report
Vol.2

July, 2014

JAPAN INTERNATIONAL COOPERATION AGENCY(JICA)

ALMEC Corporation
PADECO Co., Ltd.

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List of Abbreviations

Bimtař	Bosphorus Construction Consulting Company
CP	Counterpart
İDO	Istanbul Sea Bus Company
İETT	IETT General Directorate Istanbul Electric, Tram and Tunnel Authority
İMM	Istanbul Metropolitan Municipality
İMP	Metropolitan Planning and Urban Design Center
İSBAK	Istanbul Transportation Maintenance Company
İSPARK	Istanbul Parking Trade company
Istanbul Ulařım	Istanbul Transportation Company
İSTDM	Istanbul TDM Management Project
IUAP	Istanbul Ulařım Ana Planı Istanbul Transport Master Plan
JCC	Joint Coordination Committee
JICA	Japan International Cooperation Agency
Otobüs	Public Bus
PDM	Project Design Matrix
PO	Plan of Operation
TDM	Traffic Demand Management
UKOME	Coordination of Transportation Department
UNESCO	United Nations Educational, Scientific and Cultural Organization
UTK	Transportation Traffic Management Board

1. Characteristics of the Study Area

1.1 Socio-economic Characteristics

(1) Nighttime Population

The Historical Peninsula of Istanbul is allowed to discuss its population in a long range of 2,000 years. In the light of widespread vehicular traffic in the peninsula, however, recent 50 years' duration is mostly meaningful for analysis. At a glance, the district population reached a peak in 1975 and then it has shown a downward trend. The 2012 population was 428,857, decreased by 32 percent from 1975 while the downward trend has become slow in recent years.

Area-wisely, Eminönü has drastically decreased its population by around 60 percent since 1965. On the other hand, it is observed that Fatih has decreased its population by around 20 percent during the same period. The population density of the Historical Peninsula was 275 inhabitants per hectare, still showing a densely inhabited feature. Since there are many one-person households, an average household scale is 3.2 persons.

While the population of Istanbul increased from 2.3 million in 1965 to 14.2 million in 2012, the share of the Historical Peninsula adversely decreased from 21% in 1965 to 3.4% in 2012, respectively.

In the future, downward trend of population is likely to continue without urban redevelopment for massive residential units.

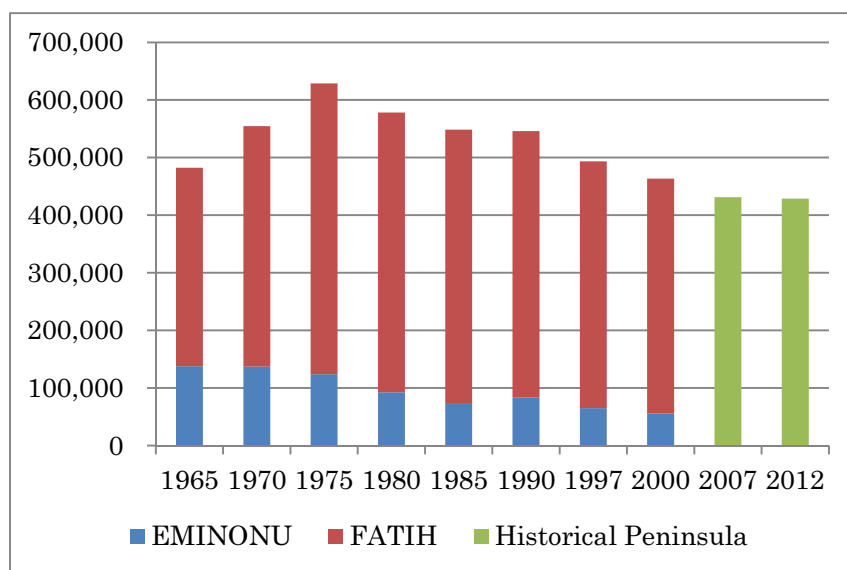


Figure 1.1 Population Change in the Historical Peninsula

Table 1.1 Population Change in the Historical Peninsula

	1965	1970	1975	1980	1985	1990	1997	2000	2007	2012
EMINONU	137,849	136,997	124,126	92,672	74,037	83,444	65,256	55,548	-	-
FATIH	344,602	417,662	504,691	485,398	474,428	462,464	428,335	407,991	-	-
Historical Peninsula	482,451	554,659	628,817	578,070	548,465	545,908	493,591	463,539	431,147	428,857

Source: Population Census and others

(2) Employment

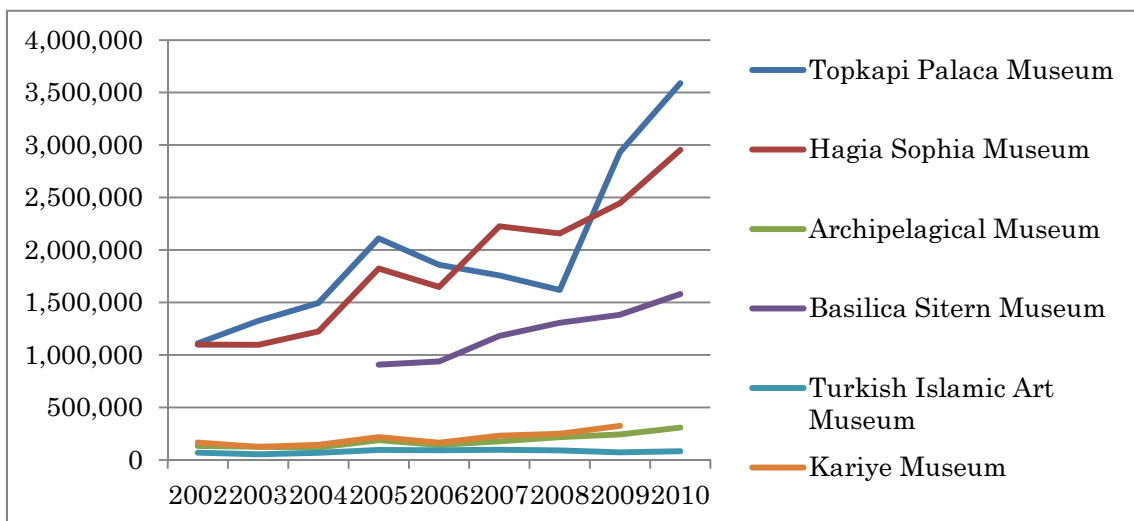
The magnitude of employment in the Historical Peninsula was 287 thousand in 2005. Contrary to nighttime population, Eminönü (171 thousand) had larger employment than Fatih (116 thousand). The peninsula provided many employment opportunities for wholesale, retail sale and manufacturing in terms of industry type. The areas of Sultanahmet and Grand Bazaar had large employment. Compared with Istanbul's employment scale, i.e. 3.86 million in 2005, the peninsula accounted for 7.4 percent of the city total.

Historically, the peninsula's employment scale shrank like nighttime population. Between 1996 and 2005, the peninsula experienced a decrease rate of 36 percent from the situation where 446 thousand worked in 1996.

(3) Tourist

The trend in the tourists to the Historical Peninsula is analyzed based on the statistical data of museums which require admission fees. Among them, the most popular museums are Topkapı Museum and Hagia Sophia Museum located in the Sultanahmet Archaeology Park. In 2010, they received 3.59 million visitors and 2.95 million visitors, respectively.

Notably, the statistics show sharp growth rates of the two museums. In 2002, they received more or less 1.1 million visitors and thus the number of visitors increased by three times until 2010. Although the Historical Peninsula is a world-wide famous tourism destination, recent tourist increase is remarkable.



Source: Istanbul Historical Peninsula Site Management Plan 2011

Figure 1.2 Trend in Museum Visitors in the Historical Peninsula

Hotels are intensively located in the Historical Peninsula. As of 2009, 182 hotel facilities with 20,916 beds were reported. The accumulated hotels account for 49 percent in terms of facilities as well as 34 percent in terms of beds. Five-star and four-star hotels are observed around the Sultanahmet Archaeology Park and along Ordu Street. Many other-class hotels are observed at Laleli and Sirkeci.

Regardless of class, hotels are concentrated in Eminönü where the capacity of hotel facilities is expanding in line with increased tourist arrivals. Since the district has a population of around 40 thousand, the difference between the numbers of hotel stayers and residents becomes narrow.



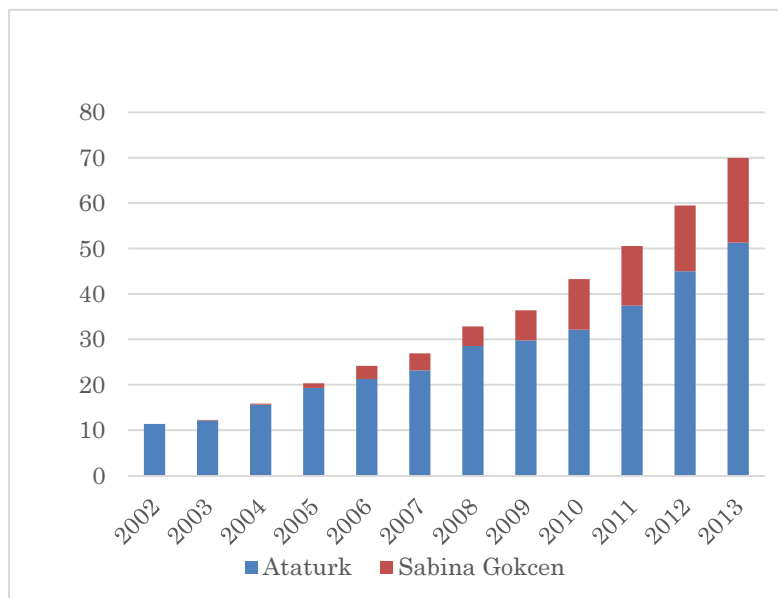
Source: Istanbul Historical Peninsula Site Management Plan 2011

Figure 1.3 Hotel Facilities in the Historical Peninsula

(4) Airport Passengers

Increased people movement is not limited to the Historical Peninsula. It is a phenomenon of the Istanbul Metropolis in an accelerated pace. For instance, the European gateway of Ataturk Airport has sharply increased its patronage by over three times, i.e. from 11.4 million in 2002 to 51.3 million in 2013. International flight passengers of which have a share of 67 percent. The Asian gateway of Sabiha Gökçen Airport started its operation in 2003 and handled 18.6 million passengers in 2013 with less international flight passengers (36 percent).

The central government as well as IMM has made continuous efforts for tourism development as an important pillar of city economy, resulting in accelerating tourist arrivals. However, the Historical Peninsula is not spacious to receive unlimited numbers. There is a danger to give negative impact to the traffic environment due to saturated and outgrown tourist movement.



Unit: Million Passengers

Source : General Directorate of State Airports Authority

Figure 1.4 Passenger Growth at Istanbul Airports

1.2 Land Use Conditions

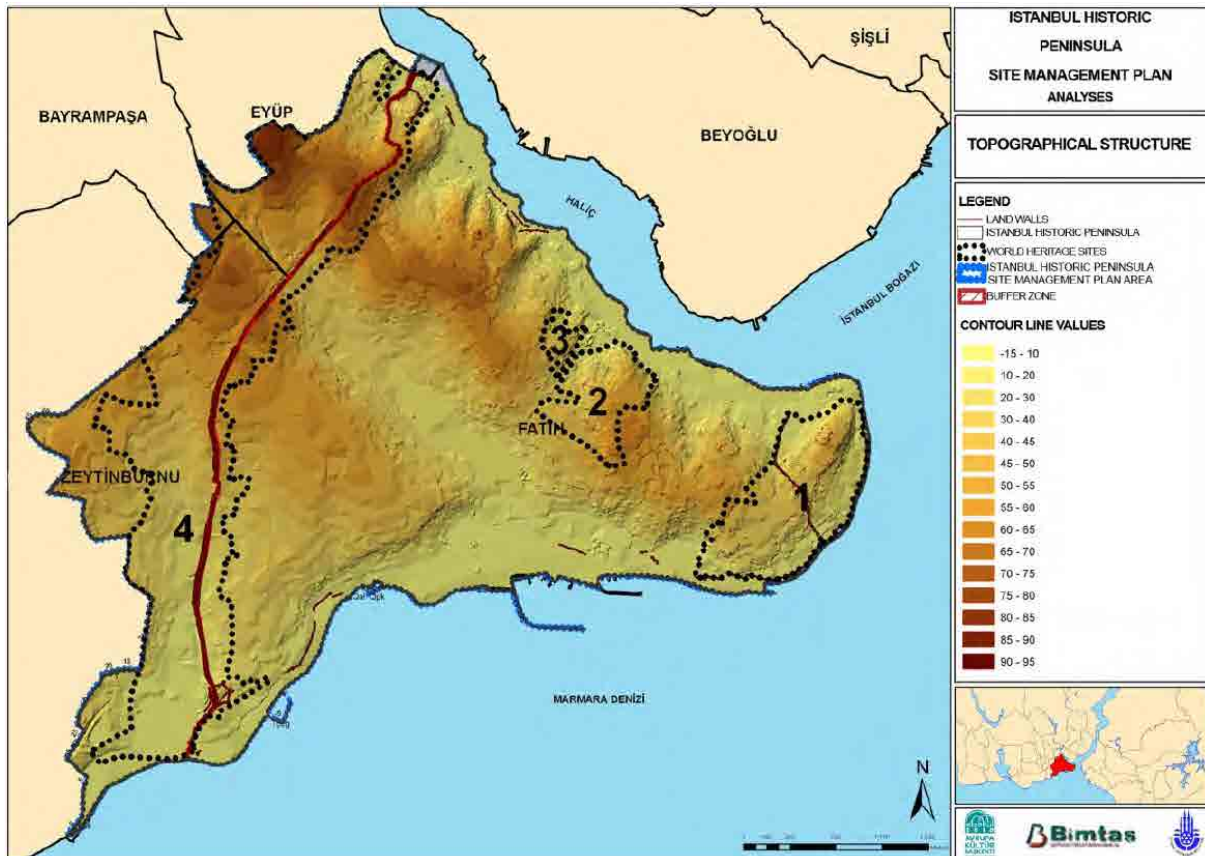
(1) Topography and UNESCO World Heritage Sites

The topographic characteristics of the Historical Peninsula lie on a combination of three seas and seven hills. It is surrounded by three unique waters, the Marmara Sea, the Golden Horn Bay and the Bosphorus Strait, providing different peninsula views. Seven hills, ranging from 55 to 65 meters at each hilltop, are scenic landmarks of the peninsula.

It is a walled city with a long fortified wall of 6,650 meters. There are some historical walled cities listed on the UNESCO World Heritage such as Vienna in Austria (371 ha) and Lahore in Pakistan (256 ha). The Historical Peninsula has the largest inside space as a historical walled city.

In 1985, four sites were listed in the UNESCO World Heritage, covering Sultanahmet Archeological Park, Süleymaniye Mosque and its associated area, Zeyrek Mosque and its associated area and the Land Walls which amount to 678 hectare.

The Historical Peninsula is composed of the Land Walls and inside lands, 1,562 hectare in total. In 2010, the Directorate of Istanbul Natural and Cultural Sites Management set the Site Management Plan Area which adds the buffer zone (548 ha) to the Historical Peninsula. Subsequently, it was approved by the Ministry of Culture and Tourism.

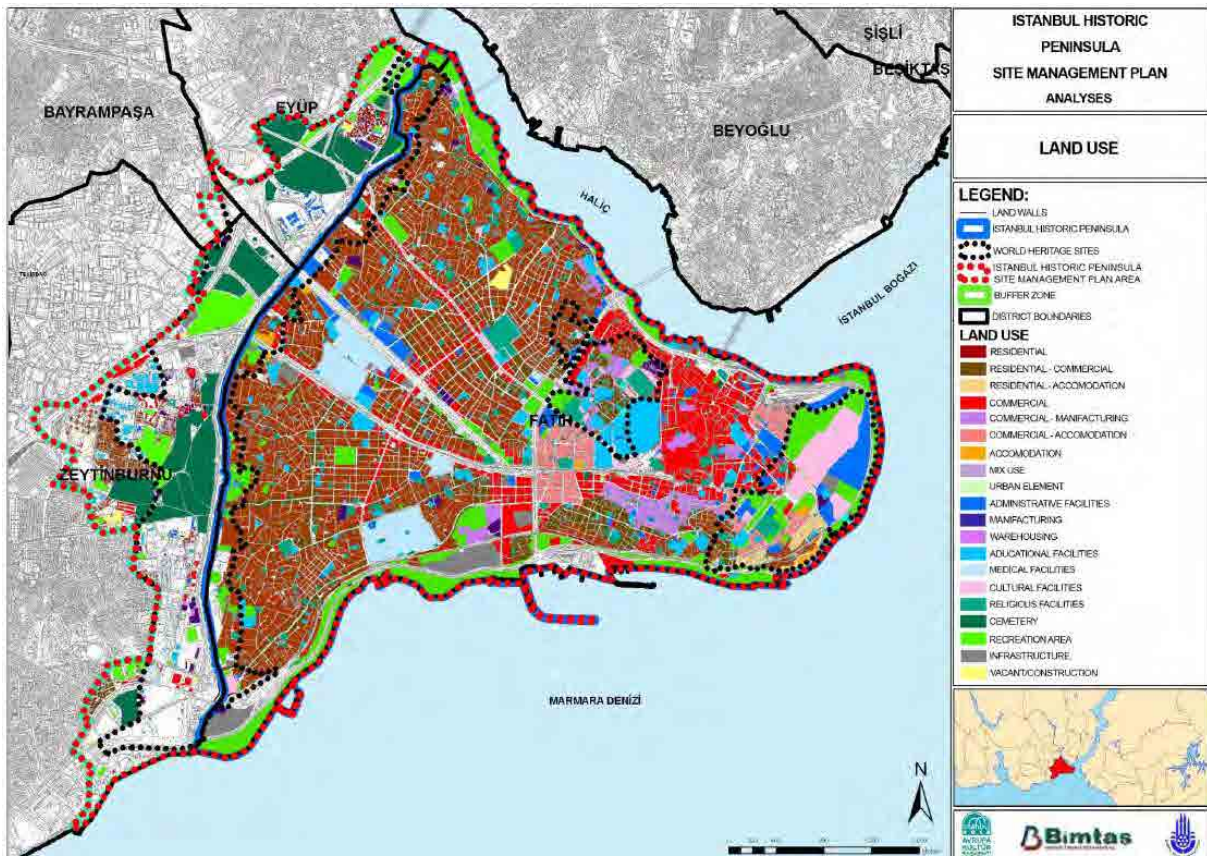


Source : Istanbul Historical Peninsula Site Management Plan

Figure 1.5 Topography and UNESCO World Heritage Sites

(2) Land Use

Although the largest land use is residential use in the Historical Peninsula, its share is modestly around 30 percent even including mixed residential use with commercial and others. Other major land uses are roads and park (29%), greenery and cemetery (10%) and commercial (7%). As a unique feature of the peninsula, education, religion, culture and medical care are important land use categories with considerably allocated lands. However, dedicate lands for manufacturing are marginal.



Source : Istanbul Historical Peninsula Site Management Plan

Figure 1.6 Existing Land Use

1.3 Transport Infrastructure and Facilities

(1) Transport Node

There are seven transport nodes of different public transport routes and means in the Historical Peninsula. The table below shows available transport services at every node. Topkapı is located at the fringe of the Land Walls where abundant land is available. Previously, Yenikapı had ferry terminal and TCDD station. Now it becomes the largest transport node in the peninsula where Marmaray Line, Metro Line 1 for airport access and Line 2 for CBD access are connected.

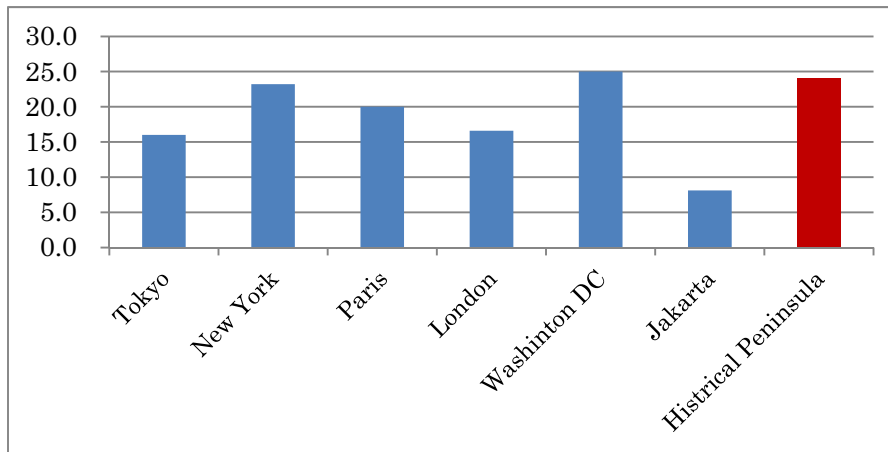
Table 1.2 Transport Nodes in the Historical Peninsula

	TCDD	Tram	Metro Line 1	Metro Line 2	Marmaray	Ferry	Bus	Dolmuş/ Minibus
Sirkeci	✓	✓			✓		✓	✓
Eminönü		✓				✓	✓	✓
Beyazıt		✓					✓	✓
Aksaray		✓	✓				✓	✓
Yenikapı	✓		✓	✓	✓	✓	✓	✓
Topkapı		✓					✓	✓
Edirnekapı		✓					✓	✓

Source: JICA Study Team

(2) Road

Roads in the Historical Peninsula are composed of artery roads, collector roads and block roads. The total road area amounts to 375.4 hectare or 24.0 percent of the total peninsula lands. It compares favorably with the cities which were developed after the Industrial Revolution and superior to Asian cities.



Source: JICA Study Team

Figure 1.7 Road Area Ratios among Major Cities in the World

As a whole, the aggregated road areas in the peninsula are at a satisfactory level. But there are inherent problems in relation with road network and road classification. They are specified below in the lights of the table and figure prepared by IMM.

Arterial Roads (1st rank roads, cream color in the figure): They are well developed. If the peninsula were physically isolated by the Land Walls, they must be satisfied with traffic. As a matter of fact, they serve for considerable through traffic in Istanbul. More precisely, there are five roads across the Land Walls but only two bridges across the Golden Horn Bay. As results, the meeting areas such as Aksaray and Atatürk Boulevard become daily congested areas. In addition, there is no interior artery at Eminönü. Therefore, Ordu Street connecting with Aksaray is always congested.

Collector Roads (2nd rank roads, yellow in the figure): They are quite insufficient compared with arterial roads and block roads. It is largely attributed to the history because the road network in the peninsula was developed longtime before motorization. Existing collectors are mostly narrow and steep where roadside parking worsens the situations. Traffic signal control

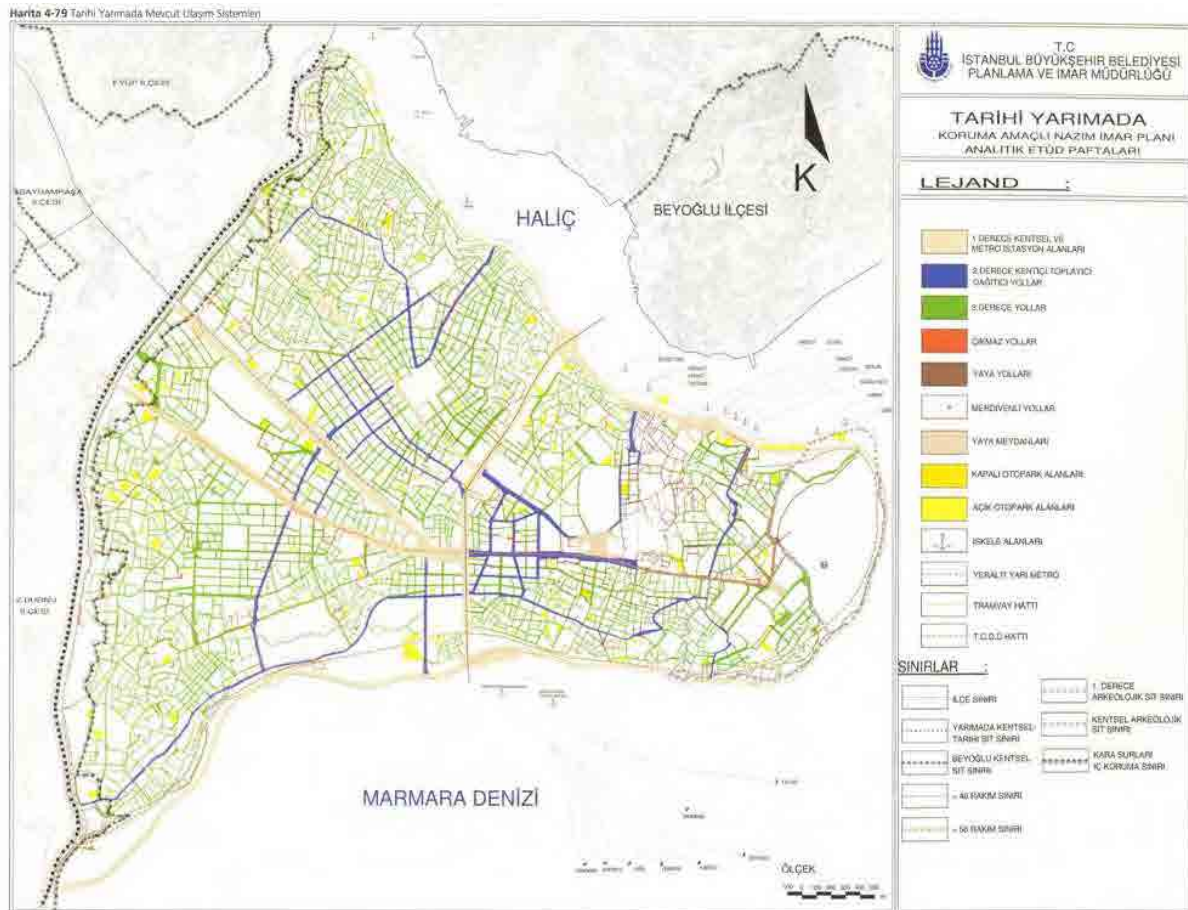
is also inadequate and turning vehicles at intersections are likely hampered by roadside parking. For local traffic improvement, it is important to depict how to strengthen weak collectors' function in the network.

Block Roads (3rd rank roads, green color in the figure): Due to insufficient collector roads, many vehicles for passing through only may enter into block roads. Since roadsides are mostly parked, vehicles not related to blocks may cause traffic congestions, resulting in degraded living and commercial business environments. To address the situations, in recent years, traffic demand control measures have been introduced along block roads such as pedestrianization, traffic ban during daytime and so on.

Table 1.3 Roads and Transport Lands in the Historical Peninsula

Category	EMİNÖNÜ			FATİH			Historical Peninsula		
	No	Area (ha)	Share (%)	No	Area (ha)	Share (%)	No	Area (ha)	Share (%)
1st Rank Road		32.5	24.8		71.1	25.3		103.6	25.0
2nd Rank Road		15.2	11.6		16.6	5.9		31.8	10.1
3rd Rank Road		52.8	40.3		169.5	60.3		222.3	53.2
Dead End Roads		2.2	1.7		5.2	1.9		7.4	1.7
Pedestrian Walk		10.1	7.7		0.2	0.1		10.3	2.4
Open Car Park	113	11.9	9.1	116	17.3	6.2	229	29.2	5.6
Indoor Car Park	5	0.8	0.6	15	1.3	0.4	21	2.1	0.7
Open Space	6	5.6	4.3		-	-	6	5.6	0.0
TOTAL		131.1	100.0		281.2	100.0		412.3	100.0

Source: Planning and Protection Management 2003



Source: IMM, 2003

Figure 1.8 Hierarchical Road Network in the Historical Peninsula

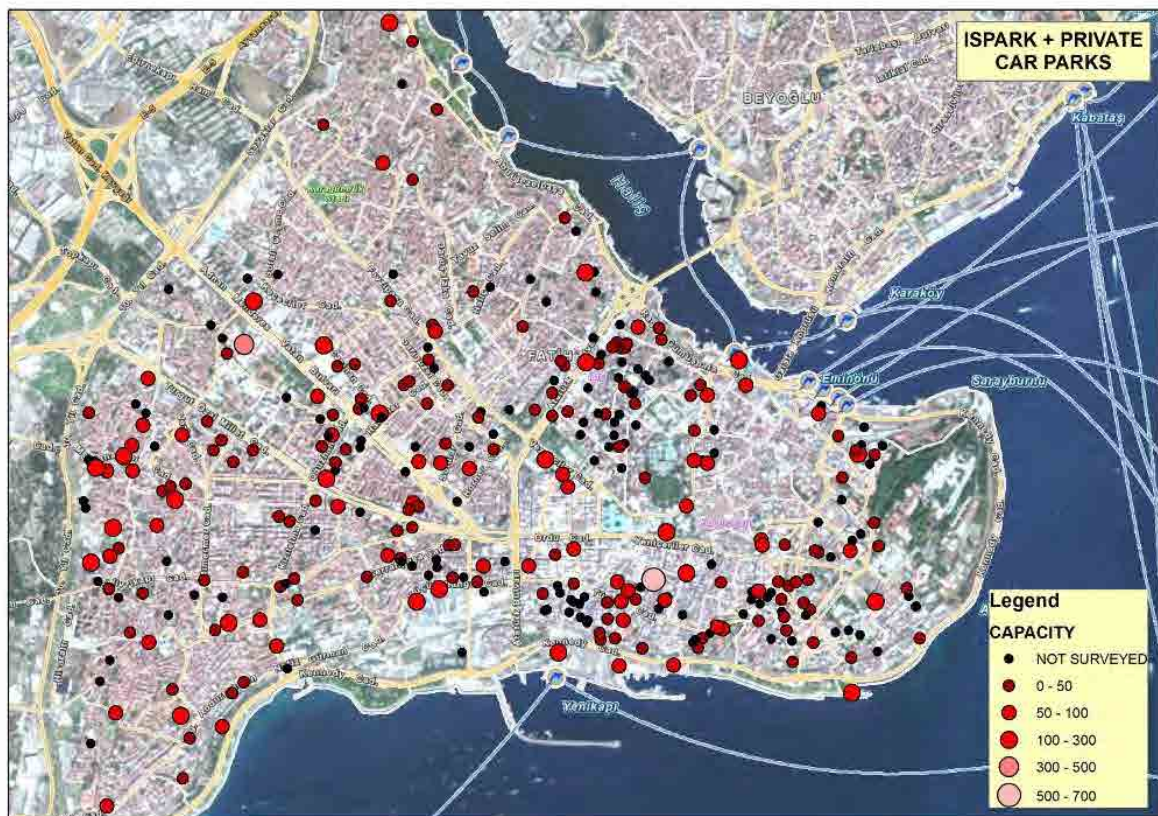
(3) Parking Facilities

According to the İSTDM Parking Facility Survey, there are 202 parking facilities and areas with 12,176 vehicles in capacity. İSPARK manages 63 sites. They are mostly small including 51 on-street parking. There are 114 off-street parking sites without roof and 20 sites with roof. Only 16 parking buildings are observed in the Historical Peninsula.

The number of necessary parking slots in the peninsula has not been analyzed taking nighttime population, employment and tourists into account. IMM once estimated an all block roads parking capacity of 53,720 vehicles in the peninsula on condition that one vehicle could be parked per a block road surface of 25 square meters (IMM, 2004). It assumes that all block roads serve for roadside parking.

In order to improve traffic congestion and upgrade urban environment, roadside parking must be controlled together with more off-street parking facilities. Vertical use of the existing off-street at-grade parking sites (134 sites) is one solution. However, only 10 sites of which are under İSPARK's control. Therefore, it is important to encourage private parking site operators to invest additional parking capacity. At the same time, it is also imperative that sufficient parking space should be secured at every large-scale urban redevelopment and transport terminal development.

It is worth noting that TAV, Atatürk Airport's terminal operator, extends its business to parking using their experience of airport parking service. TAV operates two underground parking facilities in the peninsula which participated in the social experiment for smart parking system in the JICA project.



Source: iSDM Parking Survey, 2012

Figure 1.9 Distribution of Parking Sites in the Historical Peninsula

Table 1.4 Summary of Parking Facilities in the Historical Peninsula

	No. of Car Parks	Capacity	Daily Users	No. of Subscribed Users
iSPARK	63	4,289	9,264	783
Private	139	7,878	No data	No data
Total	202	12,167	-	-

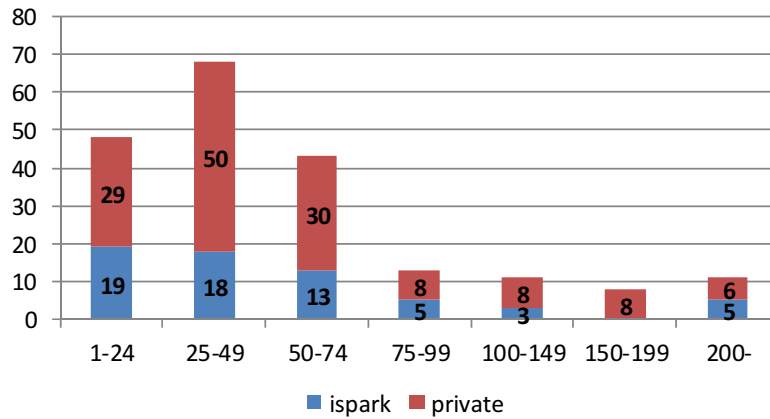
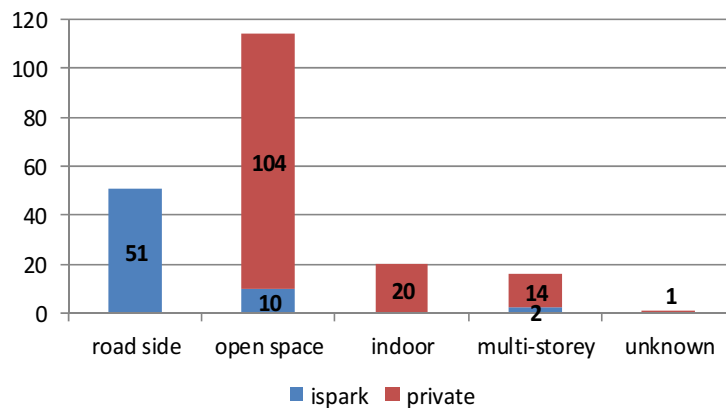


Figure 1.10 The Number of Parking Facilities by Size



Source: iSTDM Parking Survey, 2012

Figure 1.11 The Number of Parking Facilities by Type

1.4 Transport Projects

(1) Urban Rail Projects

In recent years, three urban railway projects have been implemented and partly still under construction where Yenikapı is a terminal station for them in the Historical Peninsula. The urban rail projects are profiled as follows:

Marmaray Line: The submarine and underground section across the Bosphorus Strait was open in October 2013. There are two stations, Sirkeci and Yenikapı, in the peninsula. The Marmaray Line will be able to transport 1.5 million passengers daily by 10 train coaches at 2-minute intervals during peak hours. As of May 2014, the line carries 120 thousand

passengers by 5 train coaches at loose intervals.

Metro No.2 Line: The line was extended to Yenikapı in February 2014. There are three stations, Haliç (located above the Golden Horn Bay), Vezneciler and Yenikapı, in the peninsula. The operation is done by five train coaches at five-minute intervals during the peak hours.

Metro No.1 Line: The line is scheduled to reach Yenikapı from Aksaray in 2014.

Those huge urban rail investments can strengthen public transport services within the Historical Peninsula. To make it happen, improved convenience of Yenikapı station is strategically important by way of smooth transfer among the three lines and better access of passenger cars, dolmuş and buses to the station.



Source: JICA Study Team

Figure 1.12 Urban Rail Lines in the Historical Peninsula

(2) Road Projects

There is only one new road project – the Eurasia Tunnel Project which is designed to construct a two-layer tunnel of 5.4 km and improve and expand its access roads, 9.2 km in total. The ground-breaking ceremony was held in 2011 while the tunnel construction commencement ceremony was done in April 2014 where Prime Minister and other related ministers attended.

There is growing apprehension that the Eurasia Tunnel would attract considerable passing through traffic and make arterial roads congested in the Historical Peninsula. Therefore, adequate traffic guidance must be a critical issue.



Source: <http://www.avrasyatuneli.com/>

Figure 1.13 Alignment of Eurasia Tunnel Project

(3) Traffic Demand Management Projects

For traffic environment improvement in the Historical Peninsula, IMM has made large efforts to rail-based public transport services. IMM have also examined some traffic demand management measures such as road pricing, control of roadside parking, utilization of public parking facilities, conversion to pedestrian paths, etc.

Lately, IMM and Fatih Municipality have undertaken traffic calming measures such as conversion to pedestrian paths, traffic ban during daytime and widening of sidewalks. For instance, UKOME made 16 decisions for traffic calming in the peninsula during the period 2005 – 2012. Fatih Municipality implemented numerous traffic calming projects covering 256 block roads between 2010 and 2012. Some representative projects are outlined below:

Table 1.5 Representative Traffic Calming Projects in the Historical Peninsula

Project Site	Eminönü	Laleli	Hocapaşa
No. of Roads subject to Traffic Calming	23	23	15
Project Year	2011	2011-2012	2012
Implementing Body	IMM, Fatih Municipality, Istanbul 2010 European Capital of Cultural Agency	Fatih Municipality, Laleli Businessmen Association	Fatih Municipality
Project Contents	<ul style="list-style-type: none"> ▪ Road improvement ▪ New car parks for tourist buses ▪ Control of roadside parking ▪ Traffic ban (8am-11pm during summer time) 	<ul style="list-style-type: none"> ▪ Rehabilitation of streetlights and water tanks ▪ Hydraulic vehicle stopping barriers: 240sites 	<ul style="list-style-type: none"> ▪ Hydraulic vehicle stopping barriers: 18 sites ▪ Control of roadside parking ▪ Traffic ban (10am-6pm)
Project Cost	YTL 3.35million	YTL 11.95million	YTL 90 Thousand
Associated Project	<ul style="list-style-type: none"> ▪ Sultanahmet Square pavement rehabilitation and landscape improvement project 		

Source: www.embarqturkiye.org



Source: JICA Study Team

Figure 1.14 Traffic Calming Measures in the Historical Peninsula

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2. Transport Demand Changes by Rail-Transit Development

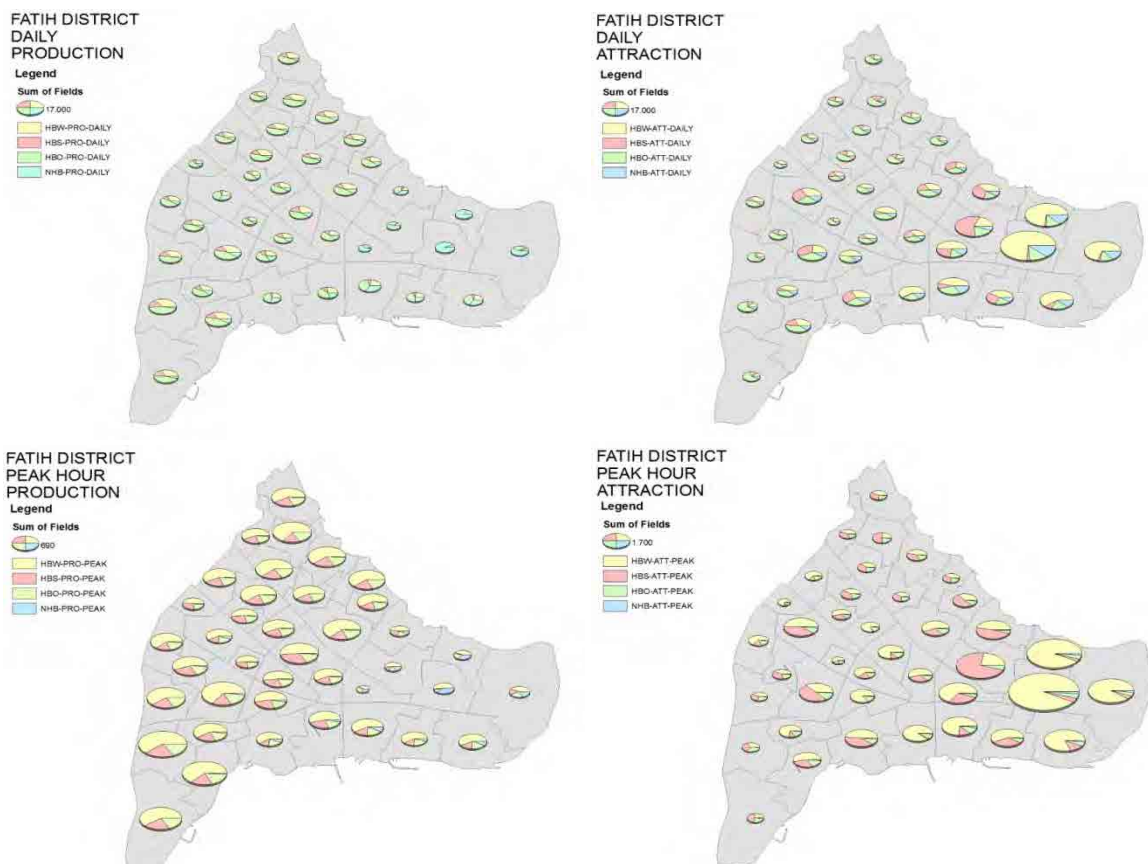
2.1 Transport Demand Structure in the Historical Area

The current numbers of daily produced trips in Istanbul are 7,045,000 trips on foot, 6,254,000 trips by car, 2,314,000 trips by service, 9,677,000 trips by public mode and total 25,290,000 trips. Public mode consists 38% of all trips. The numbers of daily produced trips in historical area are 561,000 trips on foot, 484,000 trips by car, 222,000 trips by service, 966,000 trips by public mode and total 2,233,000 trips. The public mode share in historical area is 43%. It is larger than the share in whole Istanbul.

Figure 2.1 shows the production and attraction trips in historical area by purpose. A large number of trips, particularly peak time trips, are produced from the west side which is a residential area. A large number of trips are attracted to the east side which is a commercial area. During peak term, work trips and school trips consists mostly of all trips.

Figure 2.2 shows the desired line of the public transportation trips in historical area. A large number of trips are produced from Beyazıt and Eminönü areas which have the bus terminal and the tram station.

The demand structure in Historical area is shown in Figure 2.3. Historical area was divided to old Eminönü district and old Fatih district in the figure. In addition, this figure did not show the intra trips. The 1.3 million persons are moving every day between historical area and other areas. Through trips connected to other areas are more than 0.5 million persons per day. The trips between old Eminönü district and old Fatih district are not large.



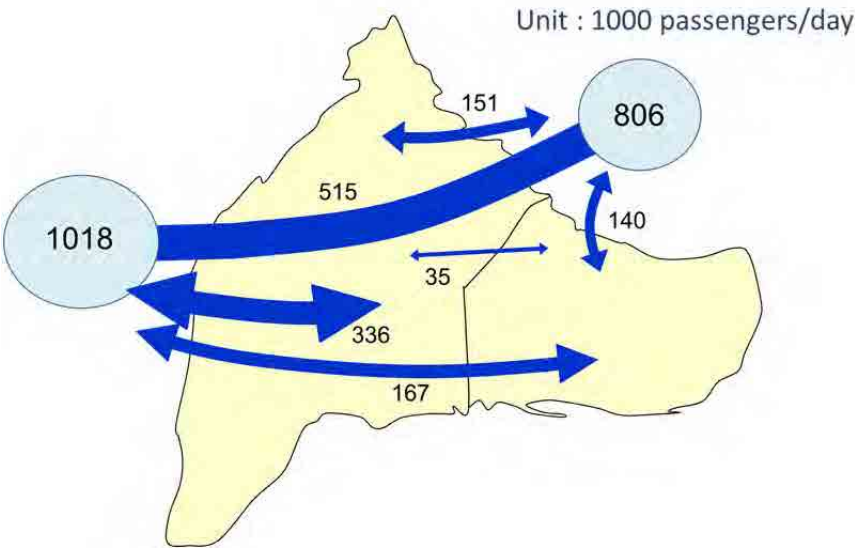
Source: JICA Study Team

Figure 2.1 Trip Production and Attraction by Purpose (day and peak time)



Source: JICA Study Team

Figure 2.2 Desired Line (Public Transportation)



Source: JICA Study Team

Figure 2.3 Demand Structure of Historical Area

2.2 Passenger Flow before/ after Rail Transit Opening

Before the opening of Marmaray railway in October 2013, MetroBus was the major public transport carrier, running through the city of Istanbul and carrying nearly one million passengers, as presented by the transit assignment result in Figure 2.4. In addition, other various mass transit modes such as subway, LRT, and tramway are functioning by complementing the public transport. Among others, ferry is also taking a significant role of public transport across the Bosphorus connecting the Asian and European sides of the city.

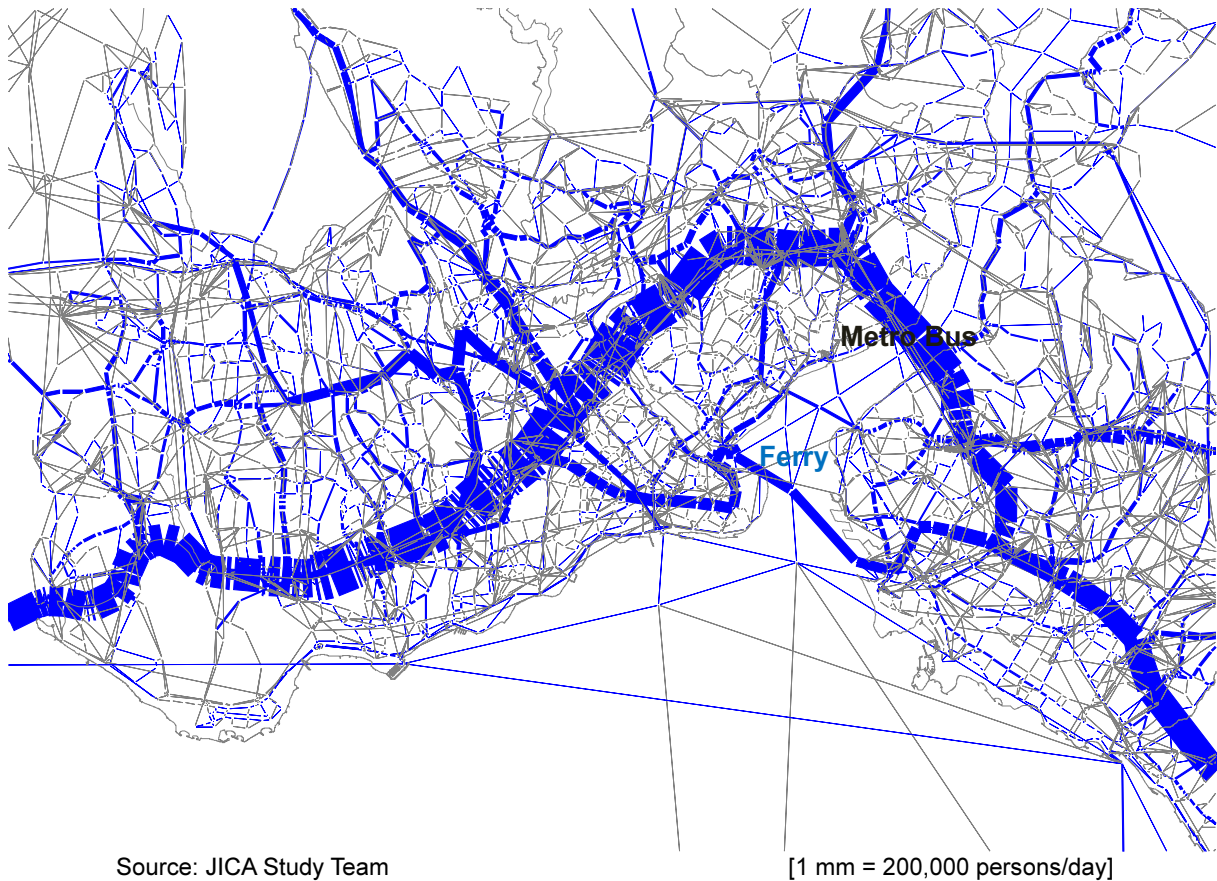


Figure 2.4 Trip Pattern of Public Transport before Opening of Marmaray

Then, since Marmaray railway, which is composed of five stations such as Yenikapı, Sirkeci, and Üsküdar, started its operation and Taksim Line (M2) was extended to Yenikapı Station in February 2014, there has been a significant change in the public transportation patterns in Istanbul. As explained later, focusing on the public transport across the Bosphorus, the transit assignment result in Table 2.1 shows a shift from MetroBus or ferry to Marmaray railway that is made nearly equally by the former MetroBus or ferry passengers. The table also consequently shows that most of the Marmaray rail passengers are crossing the Bosphorus.

Table 2.1 Changes in the Number of Passengers on Major Modes before and after Opening of Marmaray (and Extension of M2)

Case	No. of Boarding Passengers on Marmaray(/day)	No. of Passengers Crossing the Bosphorus (/day)		
		Marmaray	MetroBus	Ferry*
Before Opening of Marmaray (and Extension of Taksim Line (M2))	-	-	1,003,600	264,200
Present Case (After Opening of Marmaray and Extension of M2)	140,900	120,300	947,800	218,600

Note: *Ferry lines to/from Kadıköy only

Source: JICA Study Team

Furthermore, extension of Taksim Line (M2) to Yenikapı Station, which is nearly concurrent with opening of Marmaray rail, has enabled underground transfer between Marmaray and M2 and enhanced access to the new city, resulting in a significant increase in the number of passengers on M2 as well, as presented in Figure 2.5. In addition, the extension of M2 has also enabled transfer by walk between Yenikapı Station and Aksaray Station of Airport Line

(M1), resulting in an increase in the number of passengers on M1 as well.

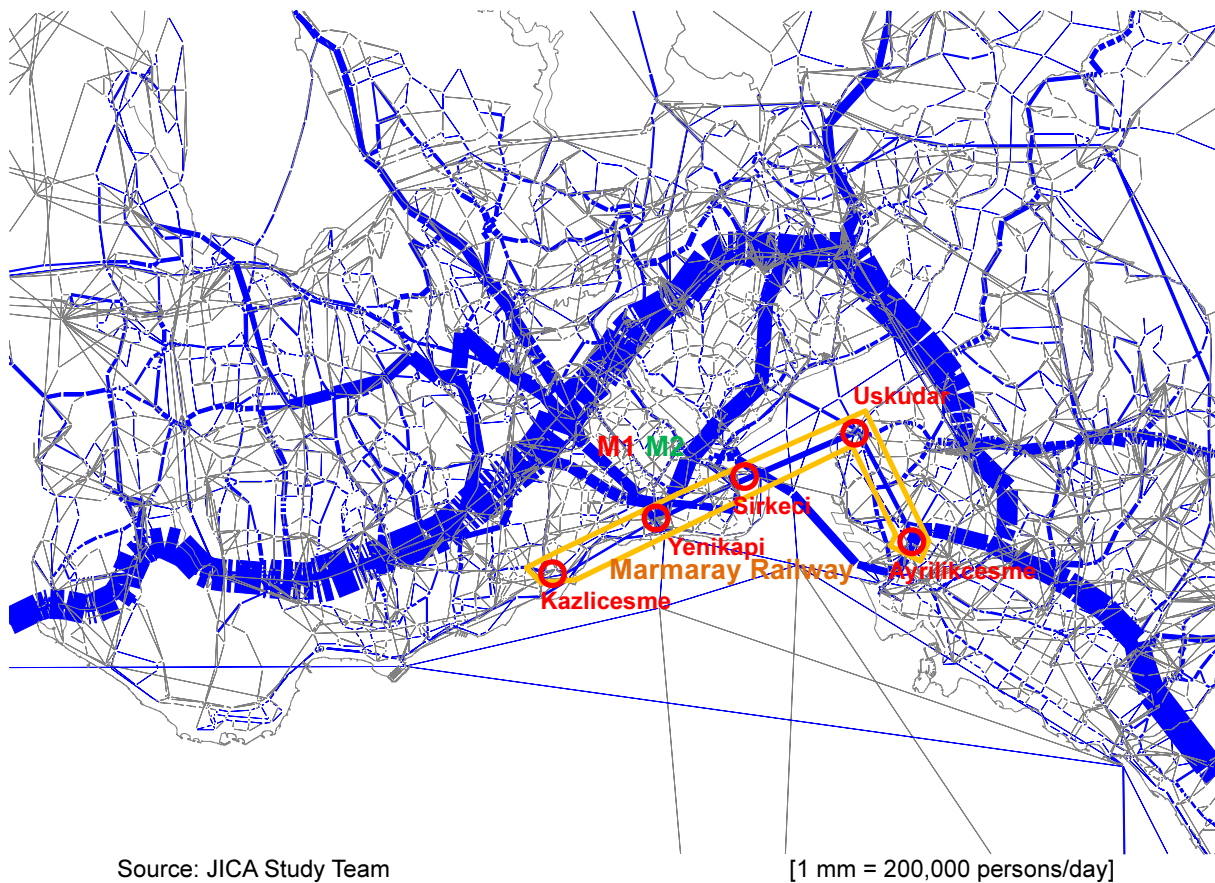


Figure 2.5 Changes by Rail Transit Development (by Transit Assignment) after Marmaray and Taksim Line (M2) Extension

Those changes in the passengers' travel patterns can also be confirmed through the trend of the statistical data of the number of boarding passengers by major mode of transport that are held by the city of Istanbul. There is an increase in the number of boarding passengers on Airport Line (M1) before and after the opening of Marmaray (Figure 2.6); particularly, the increase at Aksaray Station is remarkable, as shown in Figure 2.6.

As for the MetroBus passengers, the number should have decreased taking the above-mentioned shift to Marmaray into consideration; however, overall, an increase in the number of MetroBus passengers has been observed as shown in Figure 2.8, probably due to the continuing urban development and natural growth of the population along the MetroBus line. Meanwhile, as for the tramway (T1) that can be connected with Marmaray railway at Aksaray Station, no significant increase or decrease in the number of boarding passengers is observed on all the line in the historical area and at Aksaray Station (Figure 2.10). Likewise, no significant increase or decrease can be observed in terms of the number of boarding passengers on the buses serving the historical area (except for MetroBus lines) (Figure 2.11).

On the other hand, as for the numbers of boarding passengers at Eminönü ferry terminal (Figure 2.12), which is located close to Sirkeci Station, and at Yenikapi ferry terminal, which is located close to Yenikapi Station, a remarkable decrease can be observed before and after the opening of Marmaray railway. This is considered to be caused by the shift from ferry to Marmaray railway that has been made by passengers crossing the Bosphorus, as stated earlier.

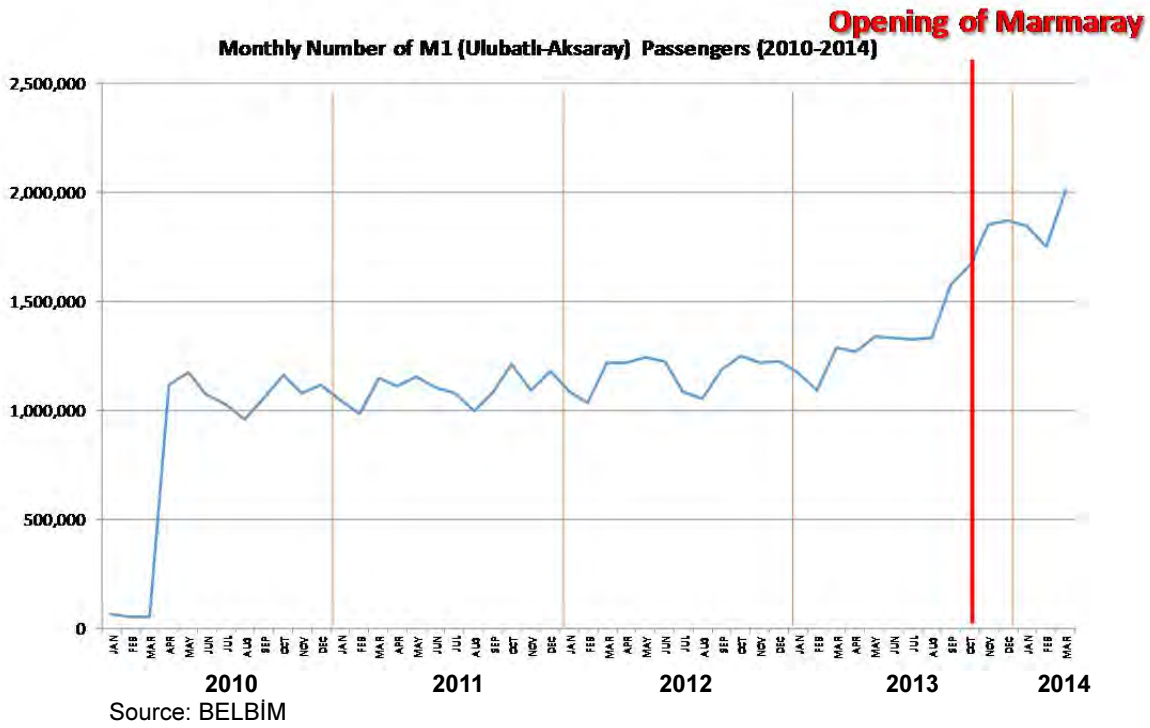


Figure 2.6 Trend in the Number of Passengers on Airport Line (M1) in the Historical Area

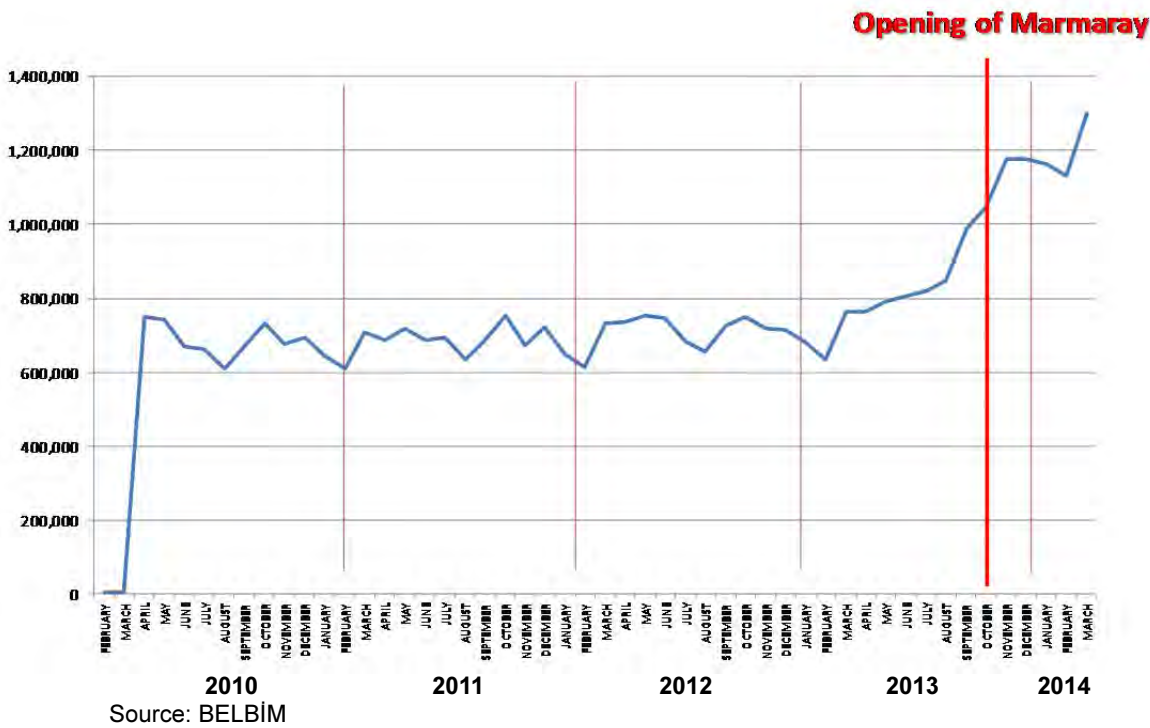


Figure 2.7 Trend in the Number of Passengers in M1 Aksaray Station

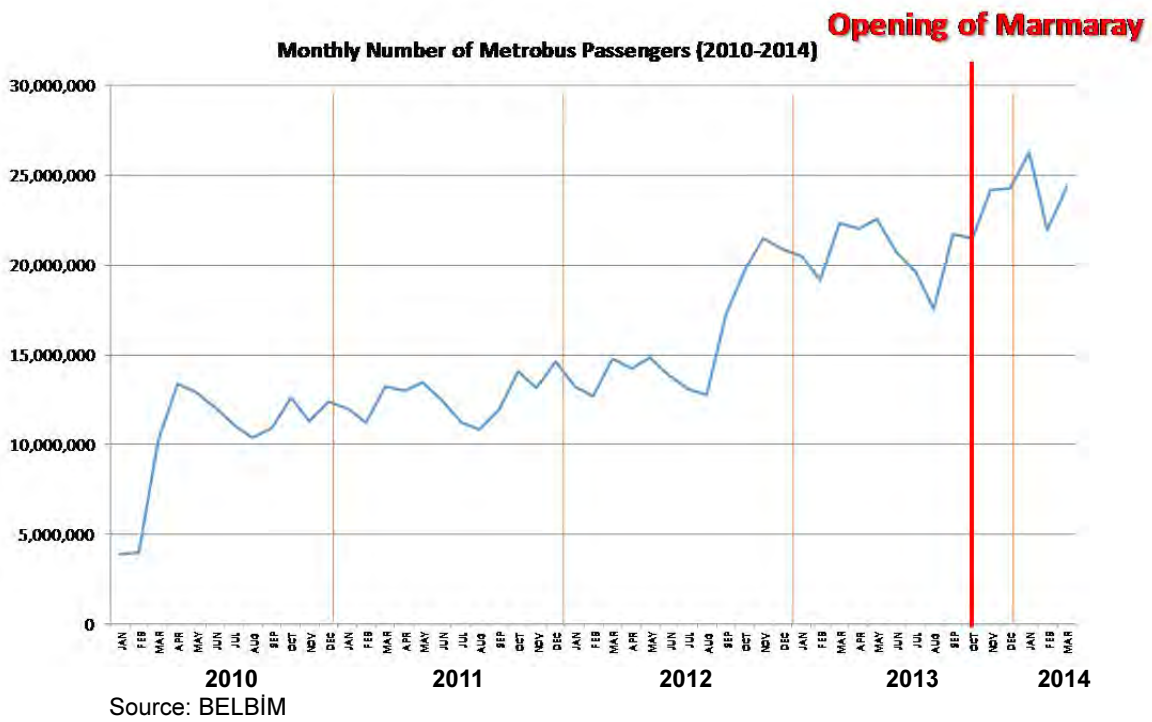


Figure 2.8 Trend in the Number of Passengers on MetroBus in the Historical Area

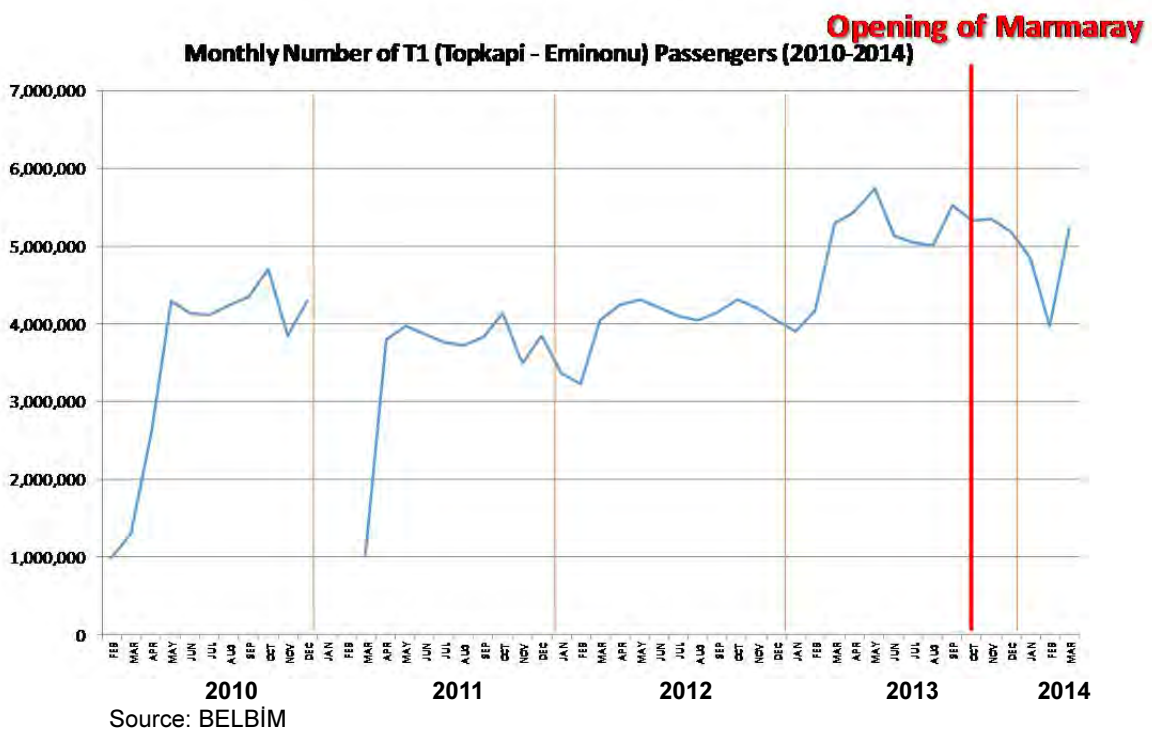


Figure 2.9 Trend in the Number of Passengers on Tramway (T1) in the Historical Area

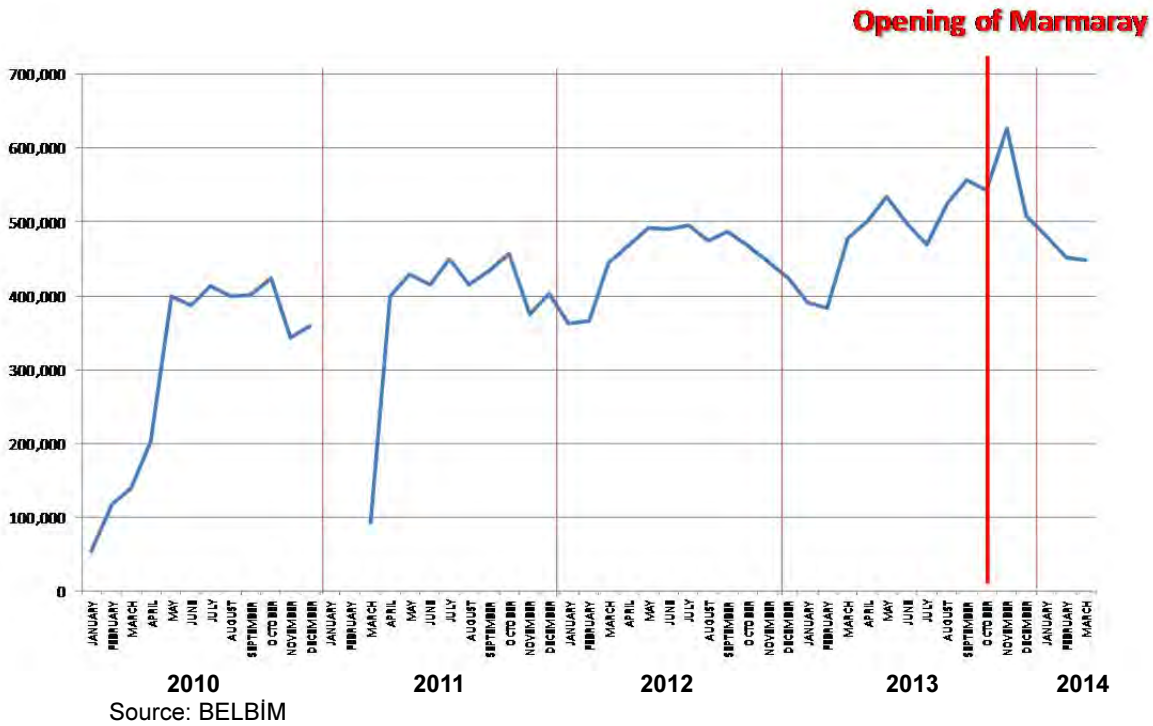


Figure 2.10 Trend in the Number of Passengers in T1 Aksaray Station

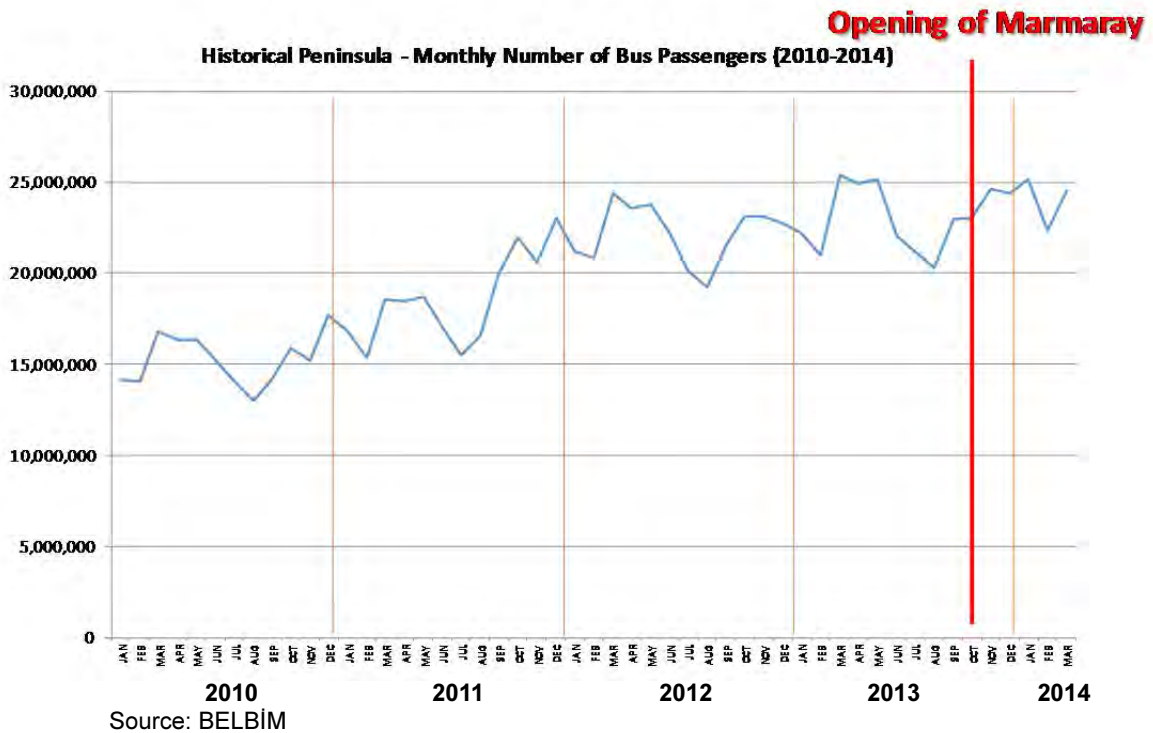


Figure 2.11 Trend in the Number of Passengers on Buses (excluding MetroBus) in the Historical Area

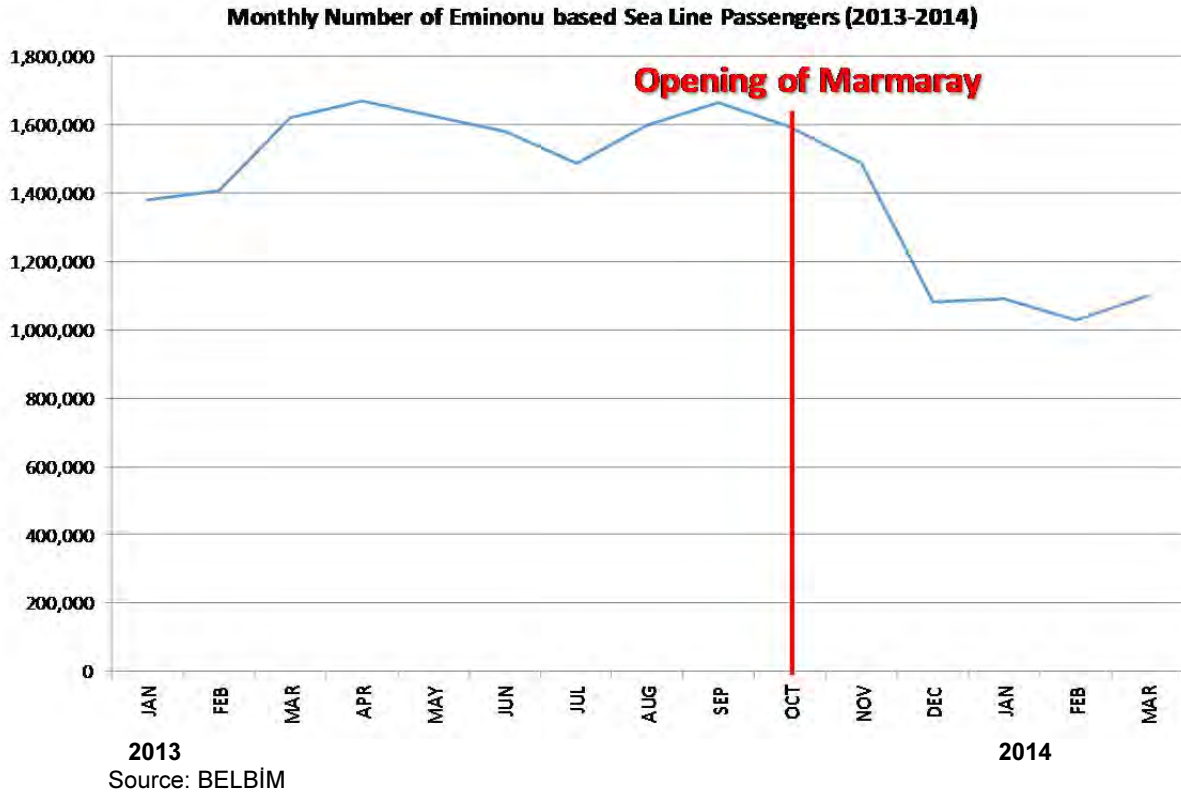


Figure 2.12 Trend in the Number of Passengers at Eminönü Ferry Terminal

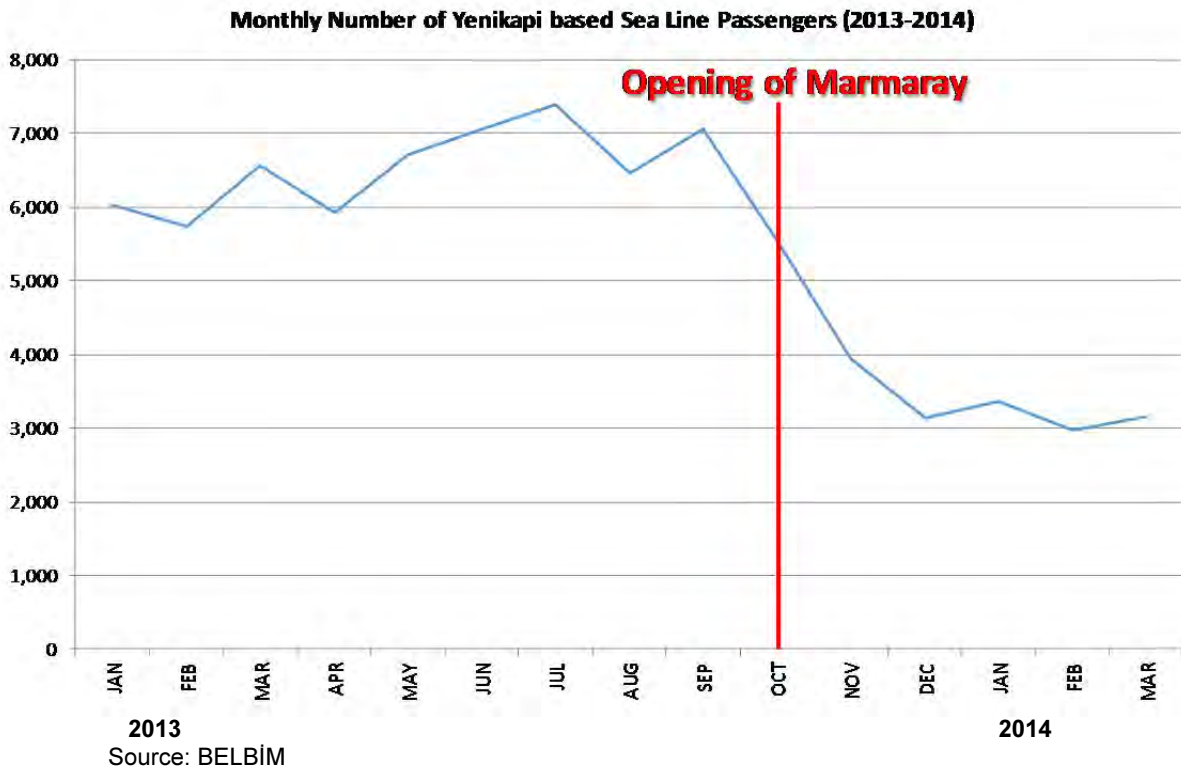


Figure 2.13 Trend in the Number of Passengers at Yenikapi Ferry Terminal

With respect to the number of boarding passengers at each station on Marmaray railway, though it may be still on the transitionally increasing trend due to some issues like a shortage of information such as promotion and guidance for connecting transit lines, the number of boarding passengers from the transit network assignment was compared with the one from the actual statistical data as presented in Table 2.2. Though the forecast number of passengers from the former is a little larger than the statistical data, it may be considered as reasonable taking the above into account. As for the balances of the number of passengers between the stations, while the one of Sirkeci Station was forecasted as smaller than the statistical figure, overall tendencies can be considered as similar between the forecast and the actual data; for example, it is commonly observed that Ayrılıkçeşme Station in the Asian side has the largest number of boarding passengers, followed by Üsküdar Station, and then Yenikapı Station in the European side.

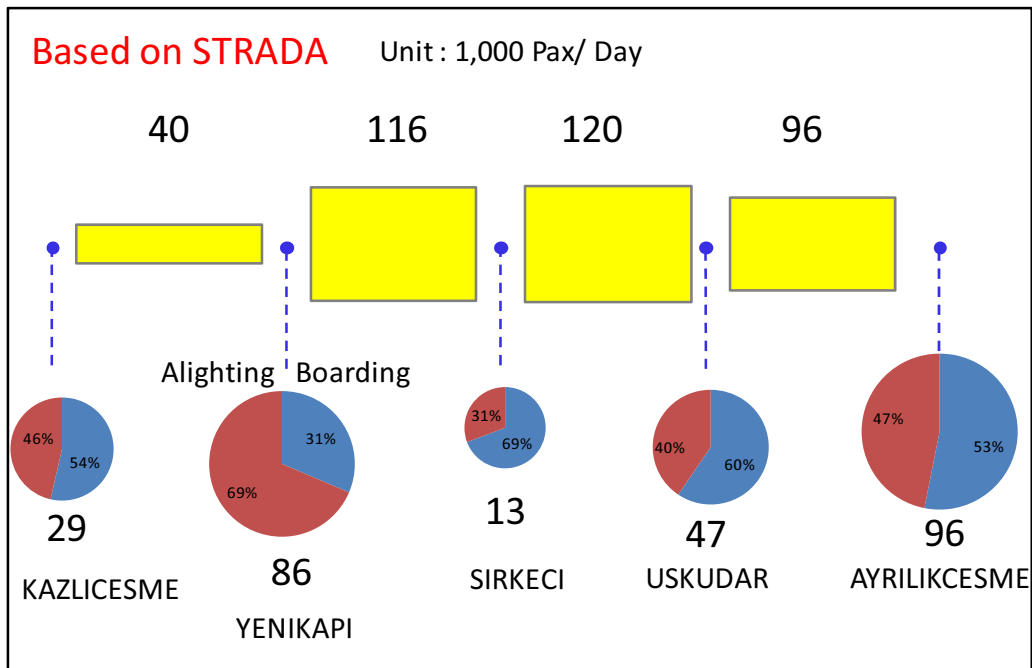
Table 2.2 Comparison between Transit Assignment Result and Statistical Data (No. of Boarding Passengers at Each Marmaray Station)

[unit: thousand persons / day]

	Kazlıçeşme	Yenikapı	Sirkeci	Üsküdar	Ayrılıkçeşme	Total
Transit Assignment Result (Present Case)	15.3	27.0	9.0	27.9	50.7	130.0
Statistical Data (as of Mar. 2014)	14.8	24.8	21.8	26.7	29.6	117.7

Source: JICA Study Team

The transportation network assignment presented in this study is originally based on the OD (origin- destination) matrices and the highway and transit network data created on a TransCAD platform by IMM, and has been converted to JICA STRADA and calibrated to adjust to the actual observations. Results from this JICA STRADA have been utilized for the subsequent forecasts and analyses. The numbers of boarding and alighting passengers at each station on Marmaray railway and the volumes of passengers carried between stations derived from the present transit assignment are depicted in Figure 2.14. The most heavily loaded section among the five stations on Marmaray railway is Sirkeci – Üsküdar, which crosses the Bosphorus, followed by Yenikapı – Sirkeci.



Source: JICA Study Team

Figure 2.14 Number of Boarding Passengers at Each Marmaray Station and Volume of Passengers Carried between Stations (Transit Assignment Result of Present Case)

In the above-mentioned transit network assignment, changes in the number of passengers on the major modes before and after Airport Line (M1) extension that is scheduled in December 2014 are shown in Table 2.3, and the overall flow of public transport passengers after the M1 extension is presented in Figure 2.15. The M1 extension is expected to add nearly 30,000 passengers per day to Marmaray railway. Focusing on the number of passengers crossing the Bosphorus, the increase in the number of passengers on Marmaray railway is expected to come from MetroBus rather than ferry. Meanwhile, as for the overall flow of public transport passengers, an increase in passengers particularly on M1 is notable.

Table 2.3 Changes in the Number of Passengers on Major Modes before and after Airport Line (M1) Extension

Case	No. of Boarding Passengers on Marmaray(/day)	No. of Passengers Crossing the Bosphorus (/day)		
		Marmaray	MetroBus	Ferry*
Present Case (After Opening of Marmaray and Extension of M2)	140,900	120,300	947,800	218,600
After Extension of M1	169,900	142,900	928,200	212,900

Note: *Ferry lines to/from Kadıköyonly

Source: JICA Study Team

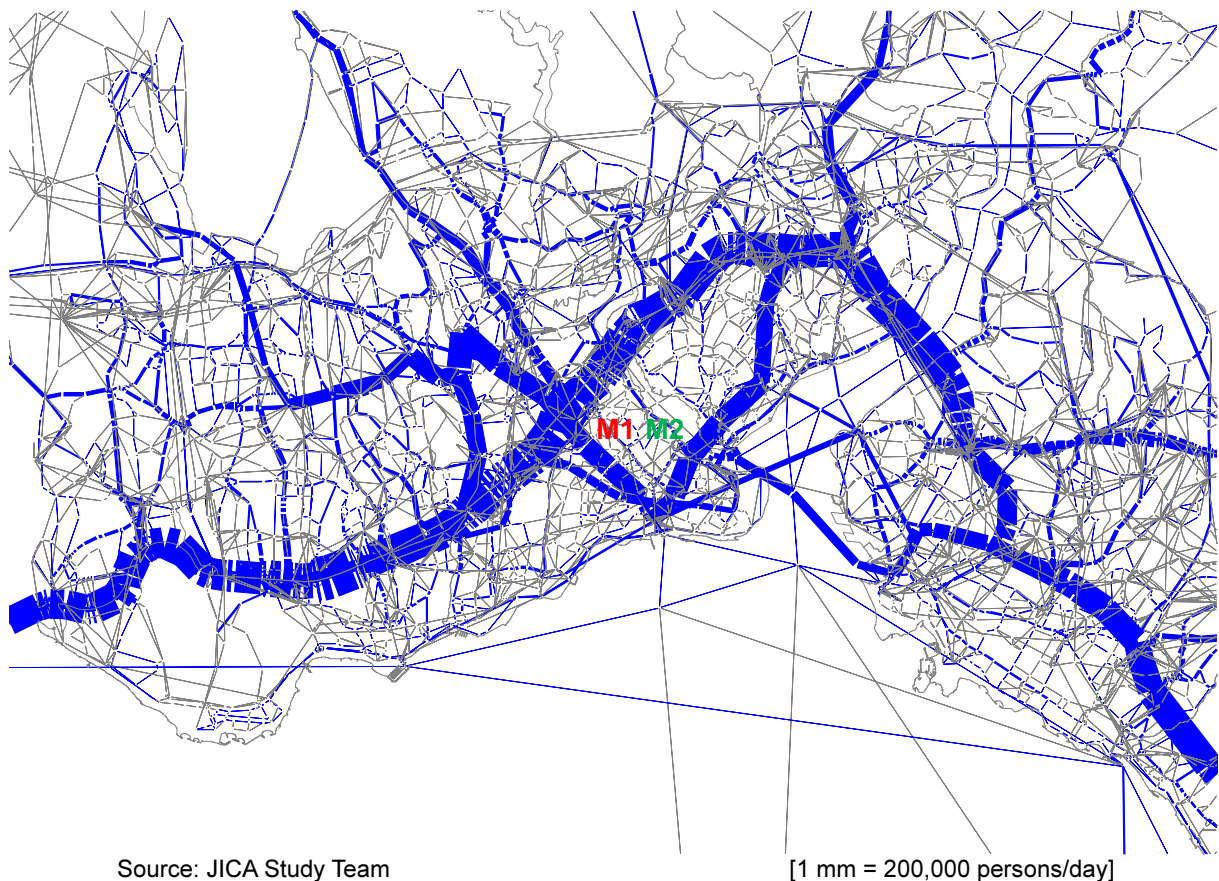


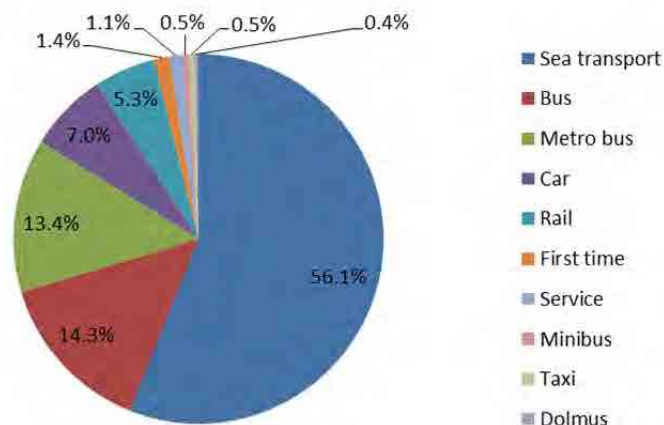
Figure 2.15 Changes by Rail Transit Development (by Transit Assignment) after Marmaray, Taksim Line (M2) Extension and Airport Line (M1) Extension

2.3 Modal conversion caused by the Marmaray and User Behaviors of Marmaray

The modal conversion, the origin and destination of users, frequency, reason of using, the cost saving and time saving by Marmaray, access and egress mode will be shown in this section based on results of the interview survey. The detail of survey results is shown in Appendix of this report.

(1) Modal Conversion by Marmaray

The more than half of Marmaray users were converted from a sea transport. The users converted from Metro Bus and Bus are 14% and 10%, respectively. The users converted from car is a few persons, it is 7% only. Also the conversion from minibus and Dolmuş is few because there are no routes crossing Bosphorus. The conversion from service which consists large share in Istanbul is also few. It is maybe that the route connecting Marmaray stations and working places is not developed.



Source: JICA Study Team

Figure 2.16 Mode Converted to Marmaray

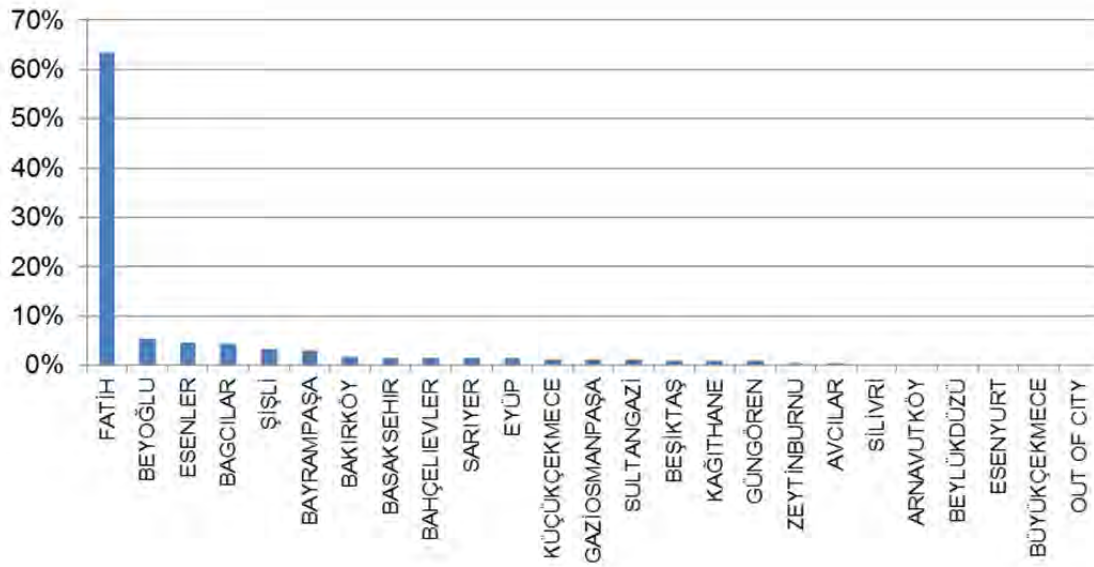
Table 2.4 Mode converted to Marmaray

Mode	No. of answers (Multiple)	%
Sea transport	734	56.1
Bus	187	14.3
Metro bus	176	13.4
Car	91	7.0
Rail	70	5.3
First time	18	1.4
Service	15	1.1
Minibus	7	0.5
Taxi	6	0.5
Dolmuş	5	0.4
Total	1309	100.0

Source: JICA Study Team

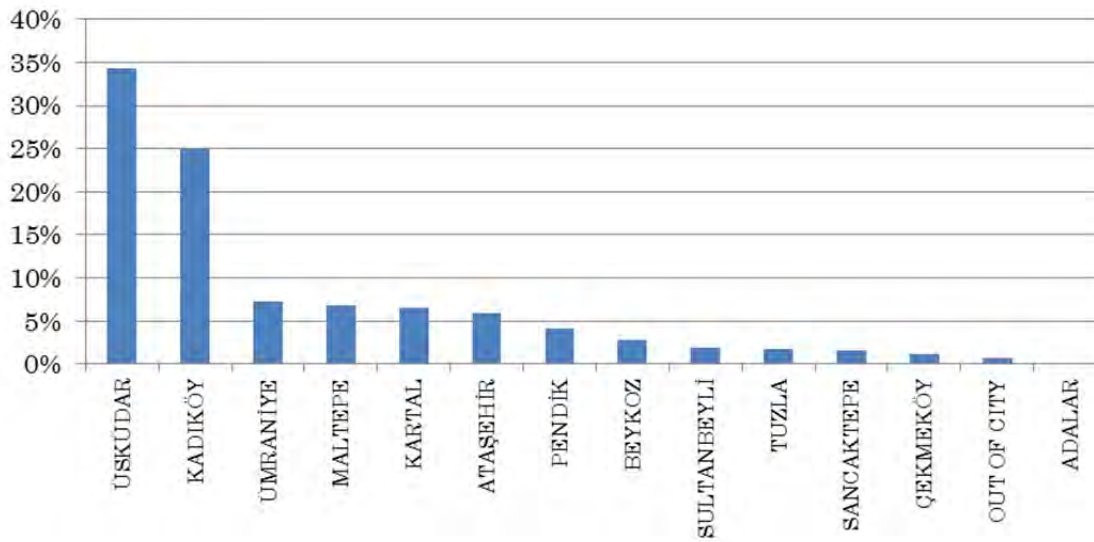
(2) Origin and Destination

Figure 2.17 and Figure 2.18 shows purpose and location of origin and destination. 65 % of boarding passenger of Sirkeci and Yenikapı station came from Fatih district. The reminders came from west side of Fatih or Taksim side. Üsküdar and Kadıköy consist 80% of destination place.



Source: JICA Study Team

Figure 2.17 Origin -District

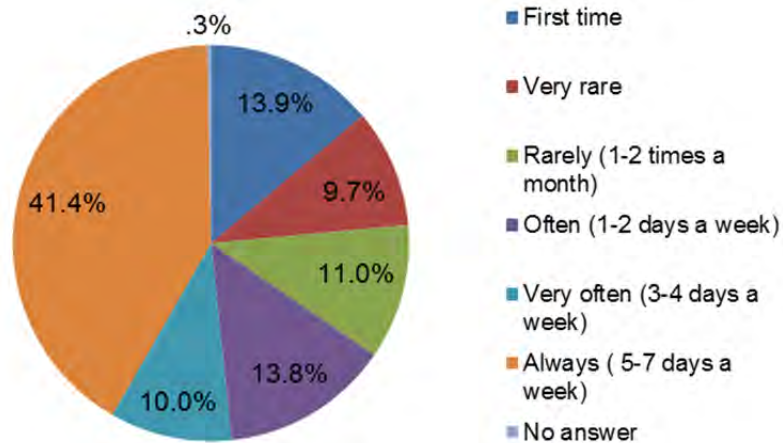


Source: JICA Study Team

Figure 2.18 Destination -District

(3) Frequency of Using Marmaray

More than 40% of users are using Marmaray line 5 to 7 days a week as shown below. However, 13.9% of answers are first time. This means that Marmaray line still has potential users.

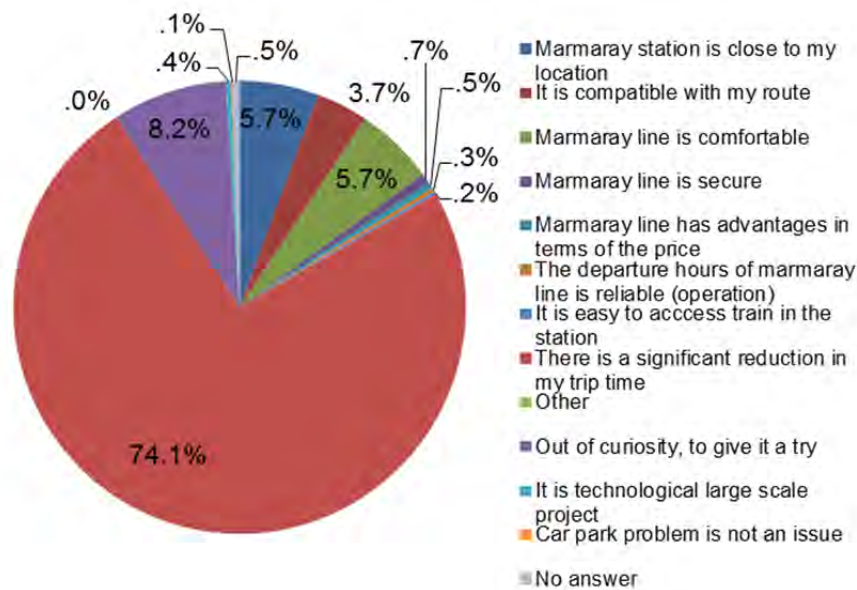


Source: JICA Study Team

Figure 2.19 Frequency of Using Marmaray

(4) Reason of Using Marmaray

Figure 2.20 shows reasons of using Marmaray line. Almost users answered “There is a significant reduction in my trip time”. Marmaray line contributes reducing trip time of citizens in Istanbul.



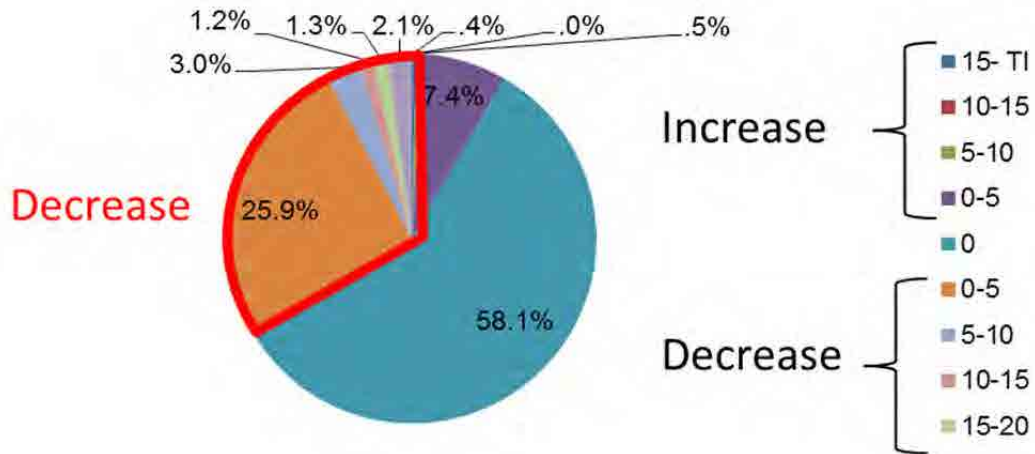
Source: JICA Study Team

Figure 2.20 Reason of Using Marmaray

(5) Travel Cost Saving by Marmaray

The average travel cost before using Marmaray is 5.2 TL. By using Marmaray it became 3.8 TL. Therefore the average travel cost saving is 1.4 TL. However, the persons whose

travel cost decreased is 34% only as shown in Figure 2.21. On the other hand, the person whose travel cost did not change is account for 60% of all. Increase is 7%.

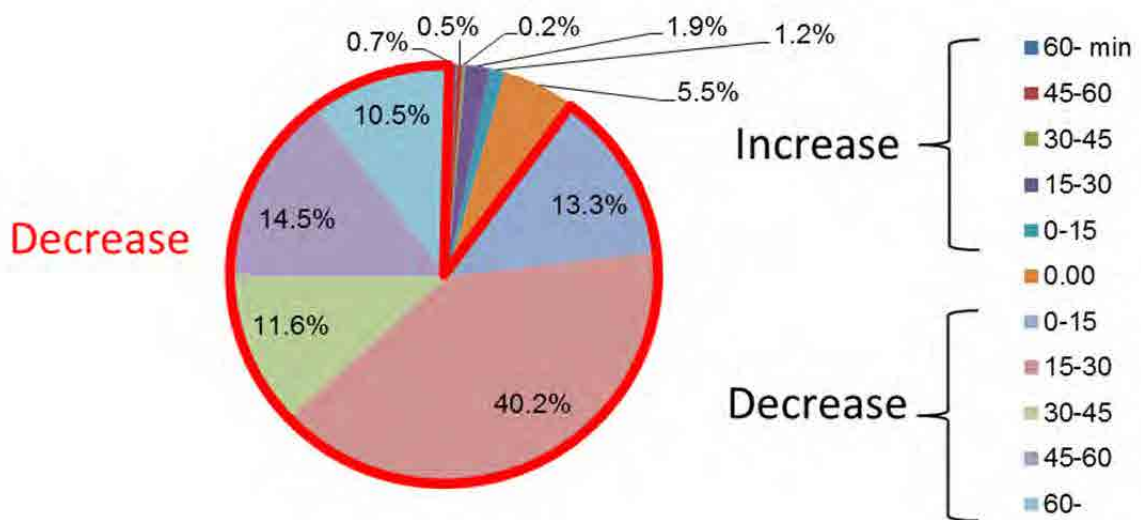


Source: JICA Study Team

Figure 2.21 Travel Cost Saving (Before-After Marmaray Usage)

(6) Travel Time Saving by Marmaray

The average travel time dramatically improved after the Marmaray usage from 85 min to 33 min. As shown in Figure 2.22, approximately 90% of all persons answered that their travel time decreased by using Marmaray.

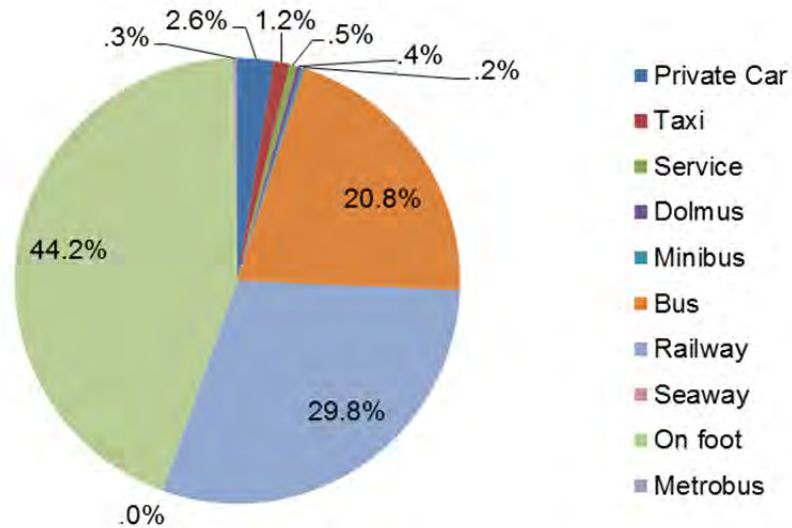


Source: JICA Study Team

Figure 2.22 Travel Time Saving (Before- After Marmaray Usage)

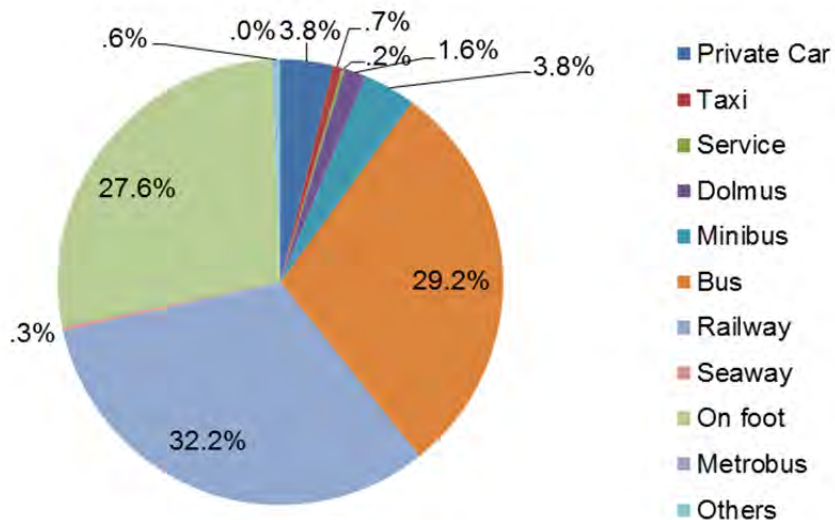
(7) Access/ Egress Mode

Figure 2.23 shows access mode to Yenikapı station or Sirkeci station. The largest access mode with 44.2% is on foot. Railway and Bus account for 29.8% and 20.8% of answers respectively. It means that improvement of transfer facilities of Yenikapı station and Sirkesi station is necessary to increase transfer passengers from other mode. On the other hand, the largest egress mode from Asian side stations is Railway as shown in Figure 2.24. It shows that many passengers transfer to Metro in Asian side at Ayrılıkçeşme station.



Source: JICA Study Team

Figure 2.23 Access Mode

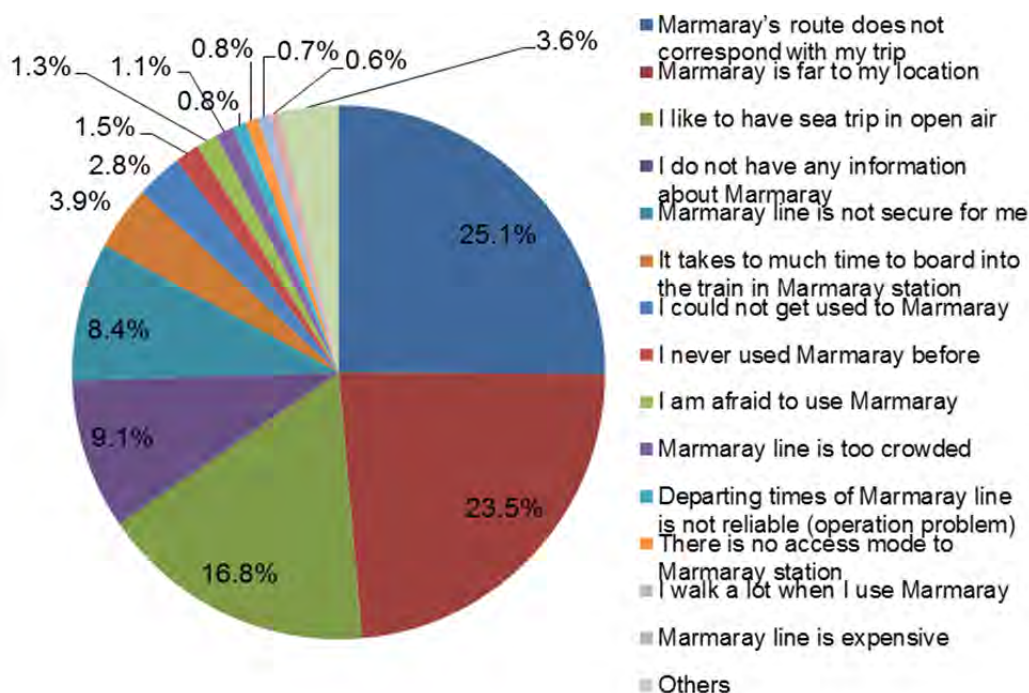


Source: JICA Study Team

Figure 2.24 Egress Mode

(8) Reason of not Using Mramray

Figure 2.25 shows the reasons of not using Marmara which is result of interview survey to sea transport users. “Marmaway’s route does not correspond with my trip” and “Marmaray is far to my location” are consisted 25.1% and 23.5% respectively. If accessibility to station will be improved, they may move to Marmaray line. “I do not have any information about Marmaray” is 9.1%. It means that promotion of Marmaray is important.



Source: JICA Study Team

Figure 2.25 Reasons not Using Marmaray

2.4 Potential Demand of Rail

The production trips by mode prepared by “The study on Integrated Urban Transportation Master Plan for Istanbul Metropolitan Area in the Republic of Turkey” were updated by using latest socio economics. The updated numbers are shown in Table 2.5. The public transportation demand will increase approximately by 30% from 9,677,000 trips in 2014 to 12,482,000 trips in 2023. The public transportation demand included railway. Therefore, the improvement of railway service will contribute to increase railway user.

Table 2.5 Current and Future Production trips by mode ('000 Trips/ day)

Mode	Year 2014	2018	2023
Car	6,254	8,914	11,056
Service	2,314	2,306	2,440
Public Transportation	9,677	10,133	12,482
Total	18,245	21,353	25,978

Source: JICA Study Team

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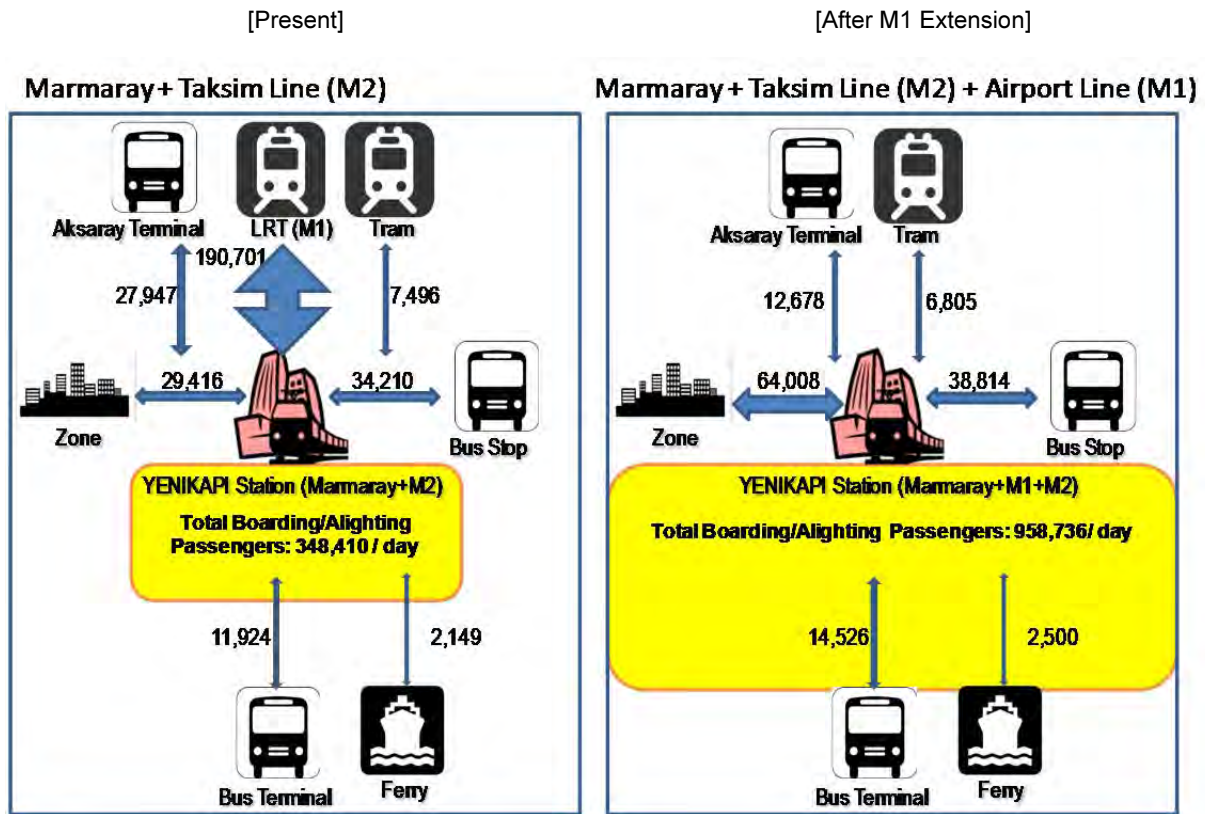
3. Urgent improvement plan of Yenikapi Station and Sirkeci Station and the walker facilities in the outskirts

3.1 Passenger Flows at Yenikapi and Sirkeci Station

Passenger flow in and around Yenikapi Station and Sirkeci Station in the present case (after the opening of Marmaray and extension of Taksim Line (M2)) and after Airport Line (M1) extension from Aksaray Station to Yenikapi Station that is scheduled in December 2014 is presented in Figure 3.1 and Figure 3.2.

Current Yenikapi Station is used by about 350,000 passengers every day, consisting of about 90,000 passengers at Marmaray Yenikapi Station and about 260,000 passengers at M2 Yenikapi Station. Since the transfer between these two modes will be made underground, it is not displayed in Figure 3.1, but the number of passengers transferring between Yenikapi Station, as a combination of Marmaray railway and M2, and the surrounding public transport modes is displayed. While it will take time until the actual situation becomes stable enough to reach the passenger flow depicted as "present" in the figure, the transit assignment result indicates that the largest number of transferring passengers to/from Yenikapi Station at present is daily about 190,000 passengers who transfer to/from M1 Aksaray Station on the ground by walk, spending over ten minutes. The second largest number of transferring passengers is those transferring to/from the bus stop beside the station and Aksaray bus terminal that account for daily about 30,000 passengers each, followed by about 10,000 passengers transferring to/from Yenikapi bus terminal. In addition, approximately another 30,000 passengers utilize Yenikapi Station for access to or egress from the nearby zones. Meanwhile, the numbers of passengers transferring to/from tramway (T1) Aksaray Station and Yenikapi ferry terminal are relatively small showing daily around 7,000 and 2,000 passengers, respectively.

Furthermore, after extension of airport Line (M1) from Aksaray station to Yenikapi Station, the total number of daily passengers at Yenikapi station, which now connects three lines, namely Marmaray railway, Taksim Line (M2), and M1, is forecast as about 960,000 passengers, consisting of approximately 120,000 at Marmaray, 450,000 at M2, and 390,000 at M1. However, it should be noted that, since the transfers to/from M1 will be made underground after the extension of M1, the number of transferring passengers to/from Aksaray is forecast to decrease drastically. In addition, the number of transfers between Yenikapi Station and Aksaray bus terminal is forecast to decrease as they will be shifted to transfers between M1 Aksaray Station and Aksaray bus terminal. It should also be noted that the number of transfers to/from the nearby transport modes around Yenikapi Station is forecast to generally increase. Among others, increase in the number of passengers who utilize Yenikapi Station for access to or egress from the nearby zones is remarkable.



Source: JICA Study Team

[unit: persons / day]

Figure 3.1 Passenger Flow in and around Yenikapi Station before and after Airport Line (M1) Extension

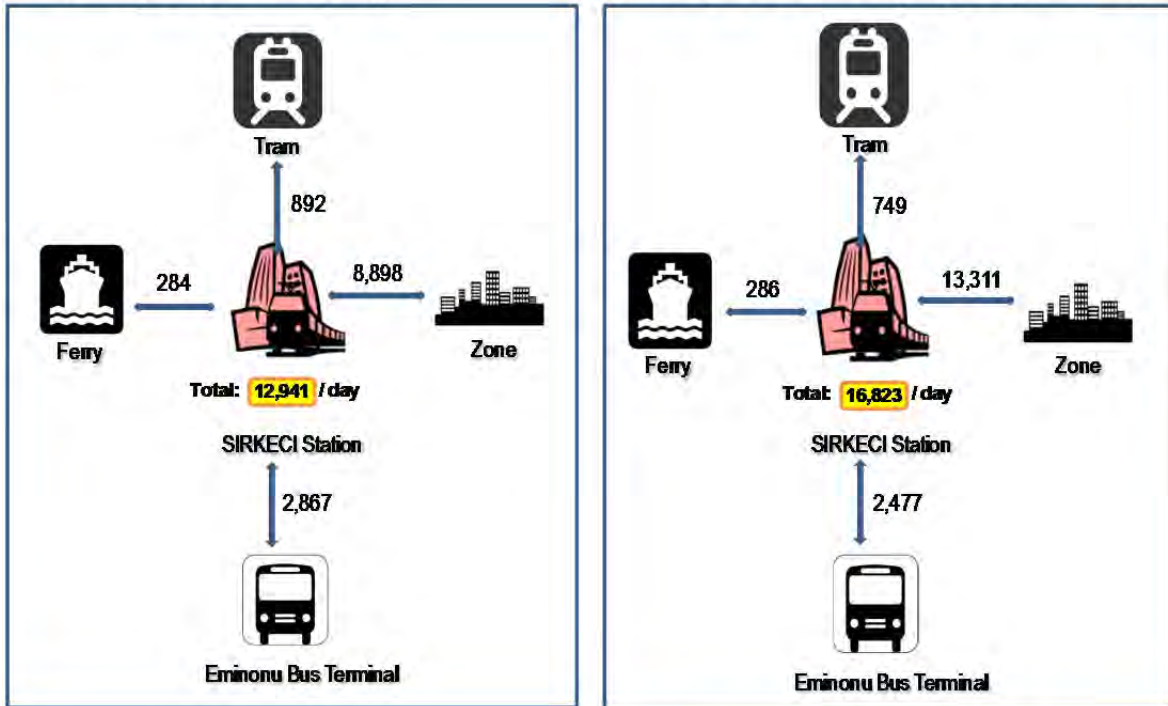
Meanwhile, as for Sirkeci Station, the number of passengers transferring to/from the public transport modes around the station is forecast as much smaller than that of around Yenikapi Station as shown in Figure 3.2, partly because Sirkeci Station consists of Marmaray railway only, or because the transit network assignment has been proved to underestimate the number of passengers at Sirkeci Station. While the direct impact of the extension of M1 on Sirkeci Station is considered to be minor, ripple effects are forecast such as an increase in the number of passengers at Sirkeci Station and the number of trips to/from the nearby zones. On the other hand, the number of transfers between Sirkeci Station and Eminonu bus terminal or Sirkeci Tramway (T1) station is forecast to decrease due to the shift to Yenikapi Station as a transfer point for more convenience. It should be noted that this figure shows flow of Marmaray passengers only; thus, there may be many more passengers transferring between Eminonu ferry and bus terminals as well as the tramway station and the area of Eminonu and Sirkeci is forecast to be crowded with those passengers.

[Present]

[After M1 Extension]

Marmaray+ Taksim Line (M2)

Marmaray+ Taksim Line (M2) + Airport Line (M1)



Source: JICA Study Team

[unit: persons / day]

Figure 3.2 Passenger Flow in and around Sirkeci Station before and after Airport Line (M1) Extension

3.2 Current Situation and Issues of Pedestrian Facilities

(1) Yenikapi Station Vicinities

There are four railway stations and one ferry terminal around Yenikapi station as follows.

- Yenikapi Station of Marmaray Railway
- Aksaray Station and Yenikapi Station (plan) of Hafif Metro (M1)
- Aksaray Station and Yusufpasa Station of Tranvay (T1)
- Yenikapi IDO Terminal



Yenikapi Station of Marmaray Railway



Aksaray Station of Hafif Metro (M1)



Aksaray Station of Tranvay



Yusufpasa Station of Tranvay (T1)

Figure 3.3 Situations around Yenikapi Station

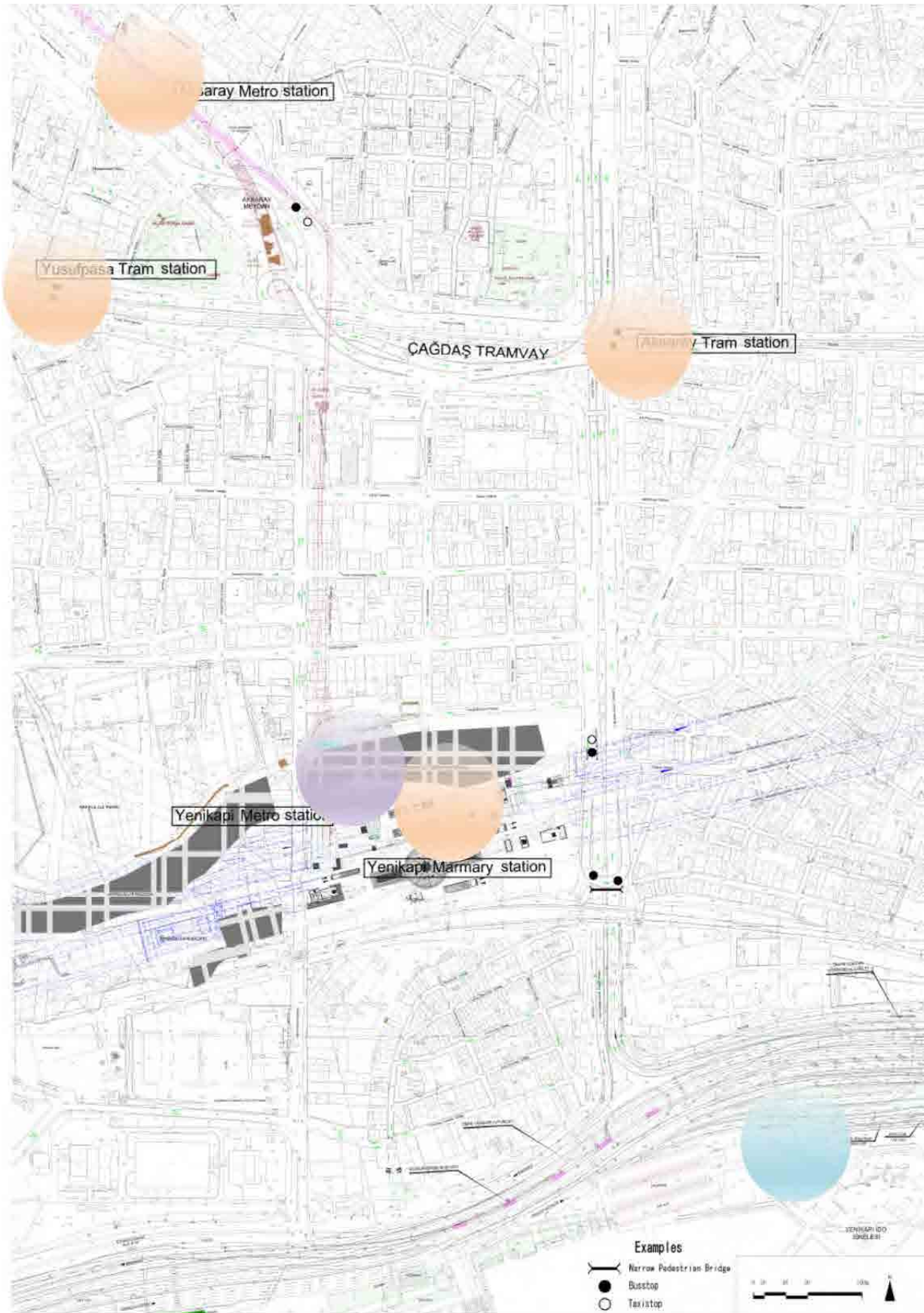


Figure 3.4 Railway Stations around Yenikapi Station

Now Yenikapi Station of Hafif Metro is being build.



Figure 3.5 Construction of LRT Yenikapi Station

There is a plan to construct the Istanbul an Archeological Museum next to a building Yenikapi Station of Hafif Metro in the Yenikapi Transfer Center area.

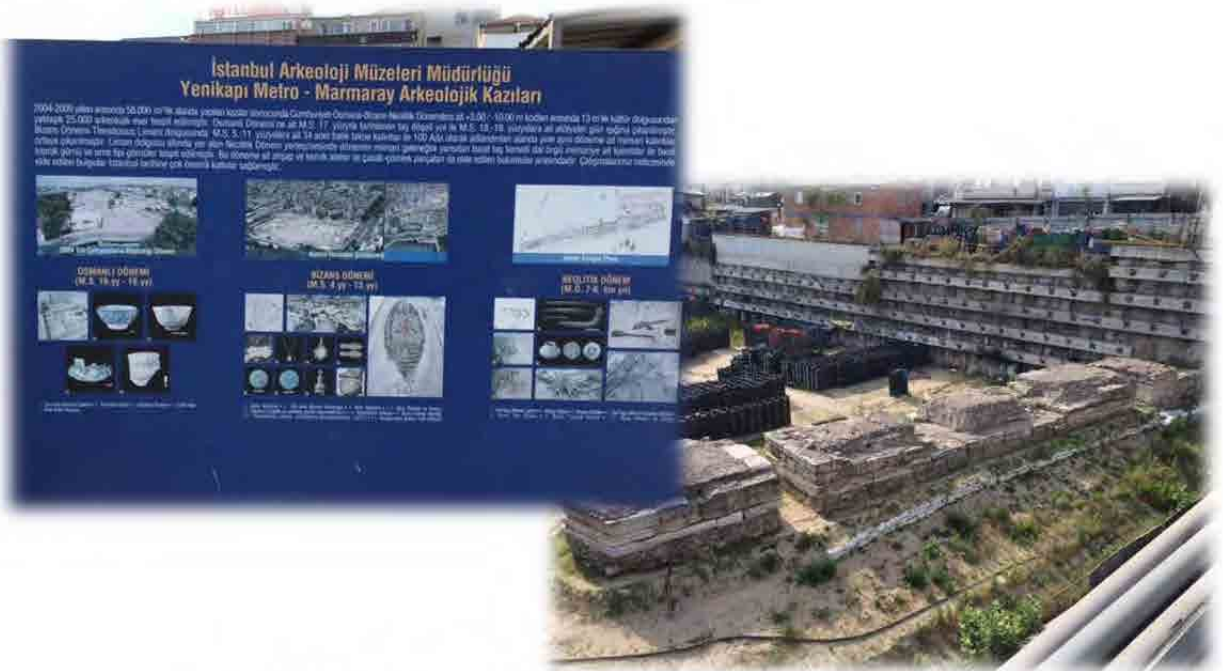


Figure 3.6 Information Board of Istanbul Archeological Museum

There is a ferry terminal of IDO about 1 kilometer from Yenikapi Station.

The relatively large bus terminal is located near this ferry terminal, and there are not so many passengers.

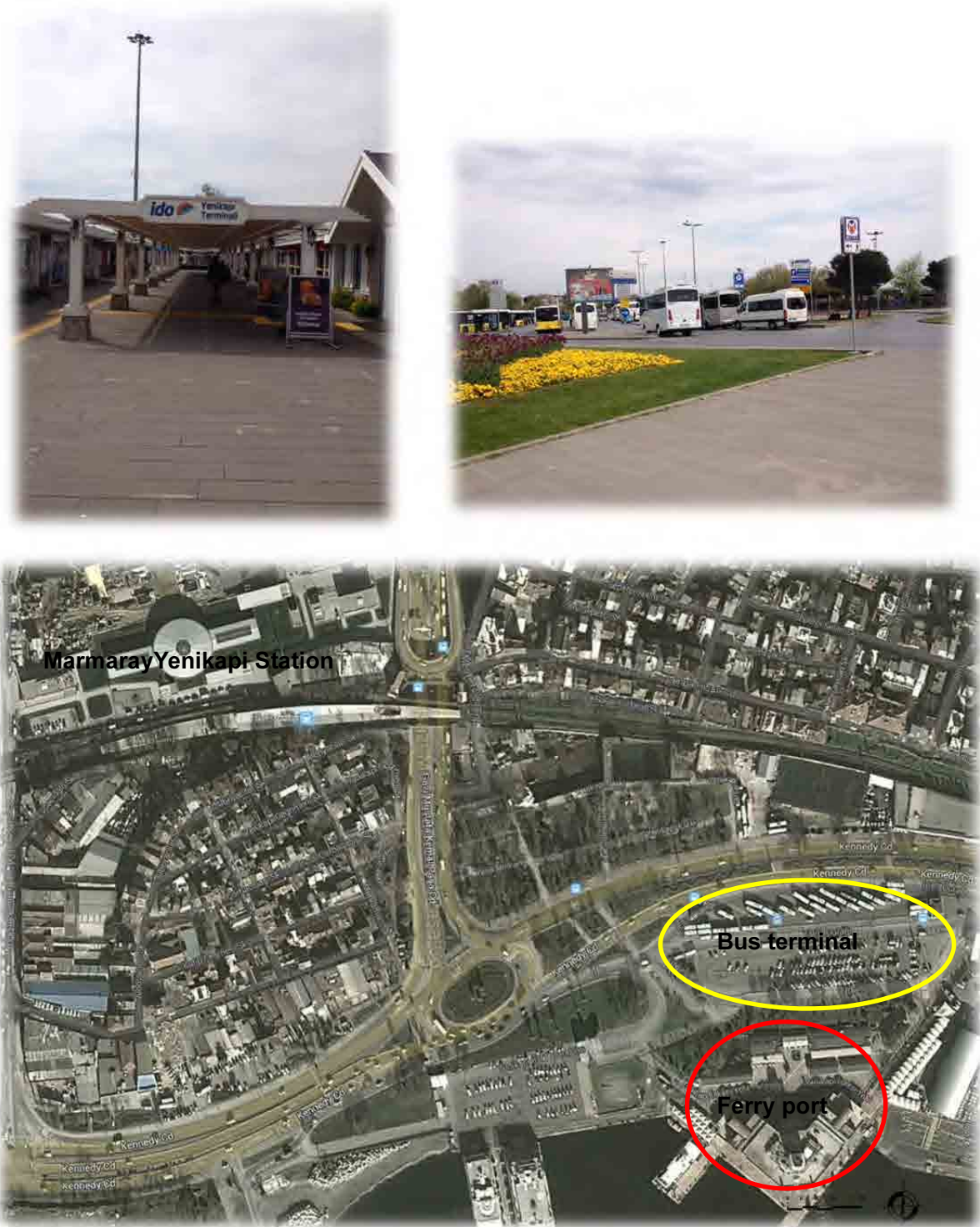


Figure 3.7 Bus Terminal near the IDO Ferry Terminal

There are many passengers and pedestrians at the Aksaray station, but pedestrian environment is not so good. Because crossing time for pedestrians is very short and there are many vehicles. So many pedestrians need to across the road in unsafety.



Figure 3.8 Road Crossing around Aksaray Station of Tramway

There is a narrow pedestrian bridge near the Aksaray station of tramway.



Figure 3.9 Under Pass and Pedestrian Bridge around the Aksaray Station of Tramway

Current situation of road spaces between Aksaray station and Yenikapi station

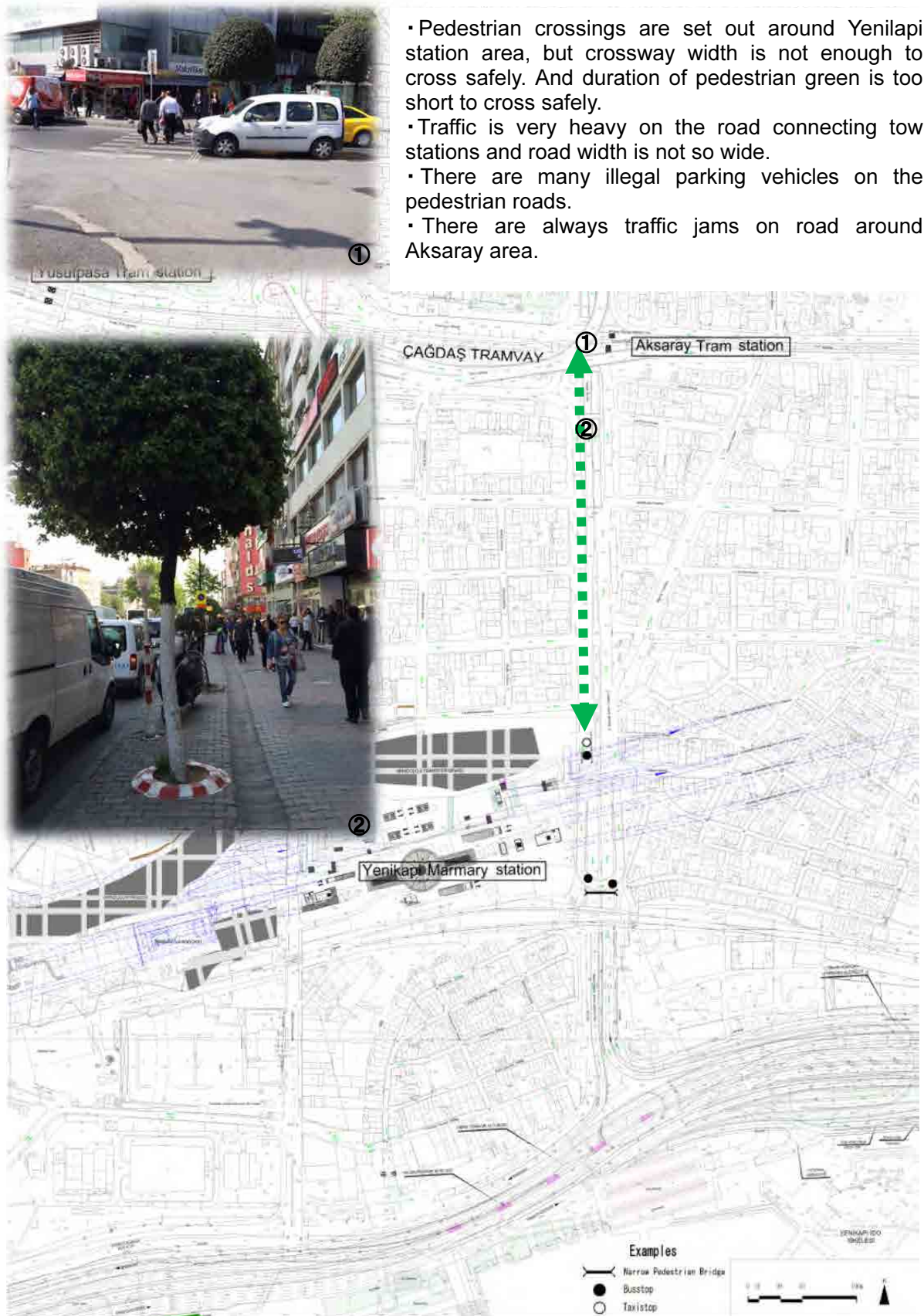


Figure 3.10 Pedestrian ways connecting Yenikapi Station and Aksaray Station



Figure 3.11 Two-dimensional Diagram of Yenikapi Station

There are three bus stops and one taxi stand on the east side road of Yenikapi stations as in Figure 3.11. And two busy bus route are located under the u-tern bridge and bus information boards are set up at those bus stop.



Figure 3.12 Bus Stop under the U-tern Bridge

Taxi stand is located at the side of the road and in parallel with the bus stop as in Figure 3.13. There are four - five waiting taxis at the taxi stand usually. This system there will be a huge traffic jam on the road due to this design.

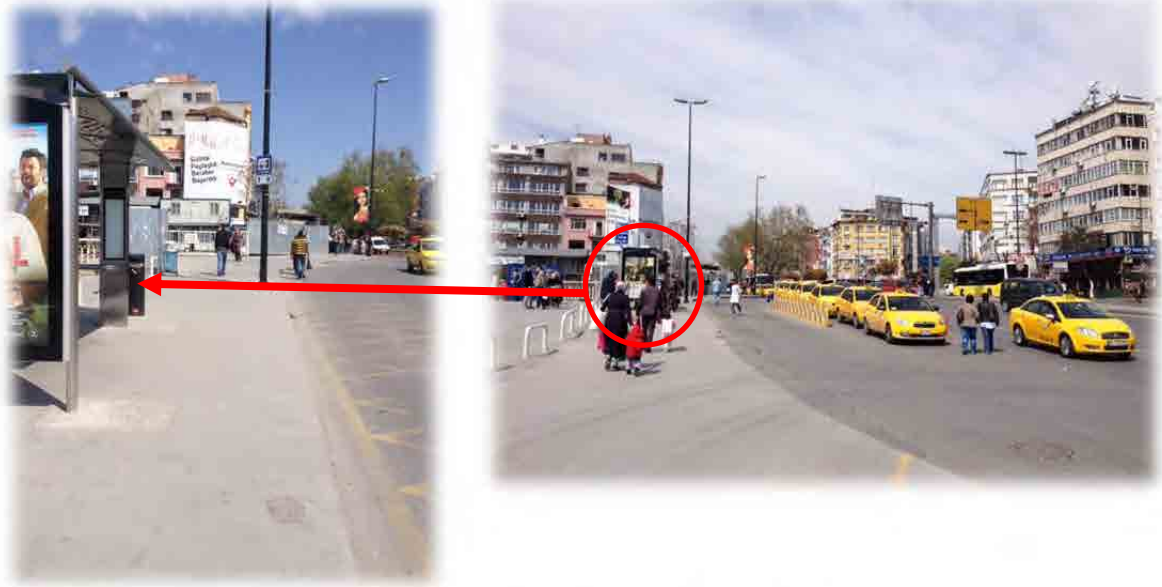


Figure 3.13 Bus Stop and Taxi Stand of Yenikapi Station

There are many transfer information board around Yenikapi station, but those information boards are not friendly for those unfamiliar with this area because those information boards mention only direction without area map.



Figure 3.14 Transfer Information Board

Transport problems around Yenikapi station are as follows;

- Pedestrian crossings are set out around Yenilapi station area and Aksaray station area, but crossway width is not enough to cross safely. And duration of pedestrian green is too short to cross safely.
- People cannot cross the road safely at the peak hour. And so many people crosses against light.
- Pedestrian crossing are set out at the limited places between two staions, Yenikapi Station and Aksaray Station. So people needs to go by a roundabout route and seems much longer sensuously.
- It's about 770 meters between Aksaray station of Hafif Metro and Yrnikapi station. 420 meters between Aksaray station of Tramvey and Yenikapi station, and about 670 meters between Yusufpasa station of Tramvey and Yenikapi station.
- Those distances are too far than average distance which people can accept to walk for transfer. And also width of those pedestrian ways are not enough to walk at the peak hours.
- There are many on-street café and they stand in the way of pedestrians.
- There are few passengers at the Yenikapi bus terminal near the IDO ferry terminal. And three bus stops around Yenikapi station are not suitable for passengers.
- Taxi stand near the Yenikapi station causes a traffic jam, and sometime taxi puts obstacles in the way of buses.
- It's around 500 meters between Yeniakpi station and Yenikapi IDO ferry terminal and people needs to cross the arterial road.



Figure 3.15 Taxis parked at bus stops illegally, and peoples waiting for a traffic light

(2) Sirkeci Area

There are two stations and one car ferry terminal at Sirkeci area, and Eminonu station is located at the not-too-distant area. And there are many transfer passengers between ferry terminal and those stations.

Marmaray : Sirkeci station
Tram: Sirkeci Tram station
Ferry-port : Harem Car Ferry Pire

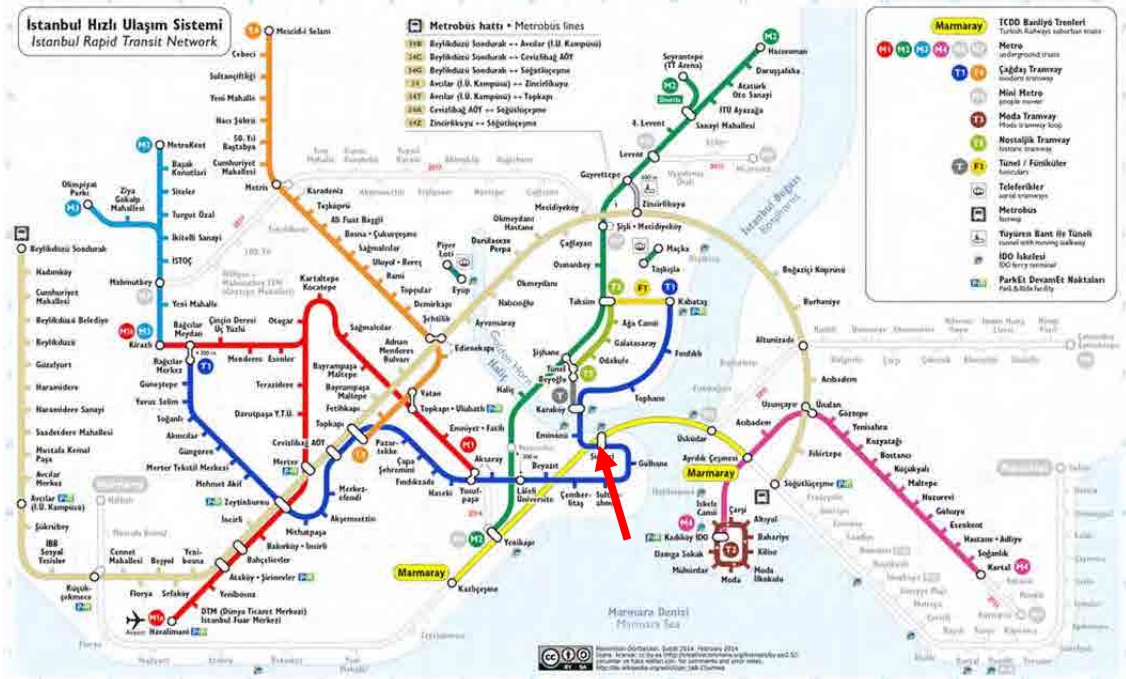


Figure 3.16 Sirkeci Station Area



Figure 3.17 Sirkeci Station



Figure 3.18 Harem Car Pire

Figure 3.19 Sirkeci station of Tramvey

Sirkeci area is surrounded by congested roads, and there are car parking, small garden, taxi stand and tram station in front of Sirkeci station. This area is located in the historical peninsular. So there are many narrow road inside this area. And this area bustles with many transfer passengers, tourists and others.



Figure 3.20 Re-constructed Building

There are two ways to access the ferry ports from Sirkeci station, one is a pedestrian crossing and another is a pedestrian bridge.



Figure 3.21 Pedestrian crossing near Sirkeci station

The height of the pedestrian bridge is about 6.5 meters and elevated electric cables are built under the pedestrian bridge.



Figure 3.22 Pedestrian Bridge and Tramway around Sirkeci Station Area

Transport problems around Sirkeci station are as follows;

- Pedestrian crossings are set out around Sirkeci station area. Crossway widths of those crossings are not enough to cross safely, and also duration of pedestrian green is too short to cross safely.
- People cannot cross the road safely at the peak hour. So many people cross the road against lights.
- There are many transfer information boards around Sirkeci station, but those information boards are not friendly for those who are unfamiliar with this area because those information boards mention only direction without area map.

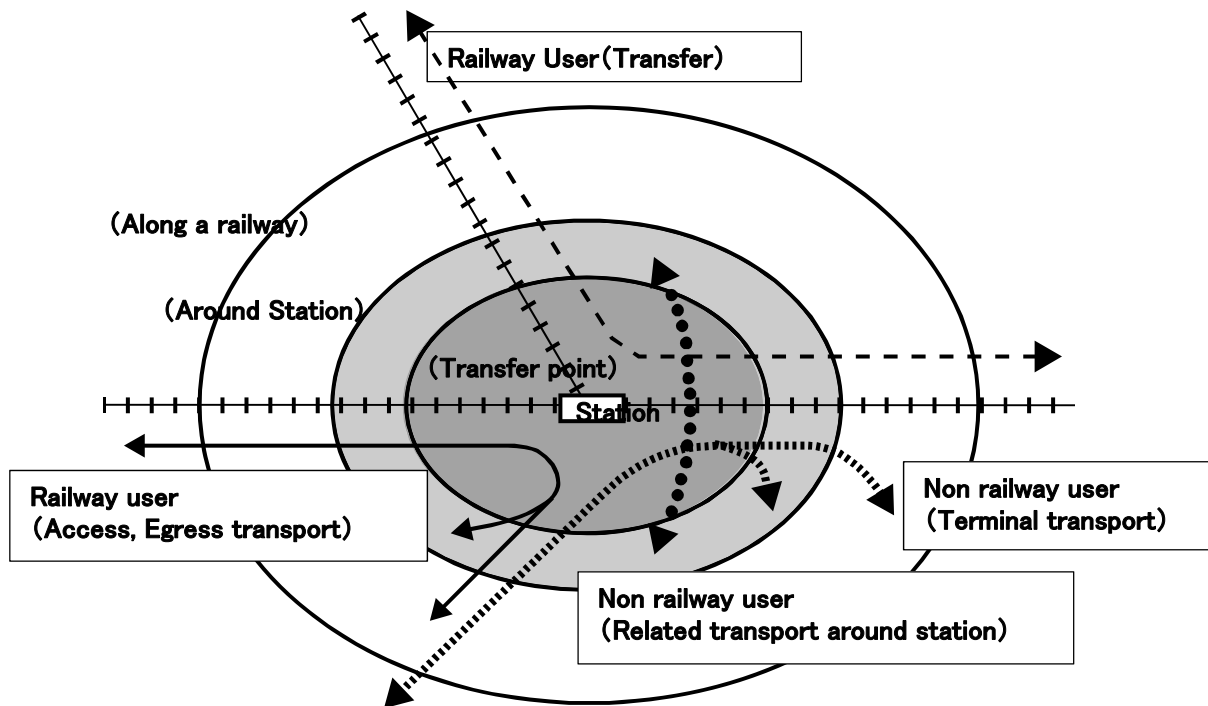
3.3 Improvement Plans for Around Yenikapi Station

The current situation and issues around Yenikapi station and Aksaray station were shown in previous section. The improvement plans will be proposed in this section in order to increase the railway users. The keywords for improvement are “Intersection”, “Side walk” and “Usage of station plaza”. First, a station plaza will be summarized based on a view of a transfer facility.

(1) Concept of a transfer facility planning

A view of transfer facility in planning of station plaza is important for improvement of urban transport. In addition, the development of transfer facility each station will contribute to develop the transit oriented city.

- Smoother transport related to transfer facility
 →Improvement of service level of public transportation
- Hub center
 →Rebuild of city structure



Here,

- * Railway user
 - Transfer between railways
 - Railway user whose destination is around station
- * Non railway user
 - Terminal transport such as transfer between buses
 - Walking trips etc.

Figure 3.23 Classification of Transport Related Transfer Facility

(2) Structure of transfer facility

A transfer facility will be developed as a part of redevelopment project around a station or a part of a new transportation plan. The number of users of Yenikapi station will increase after connection of Airport metro to Yenikapi station. In addition a historical museum will be constructed next to Yenikapi station. Therefore a station plaza should develop with these projects.

The outline of structure of transfer facility is shown the figure below.

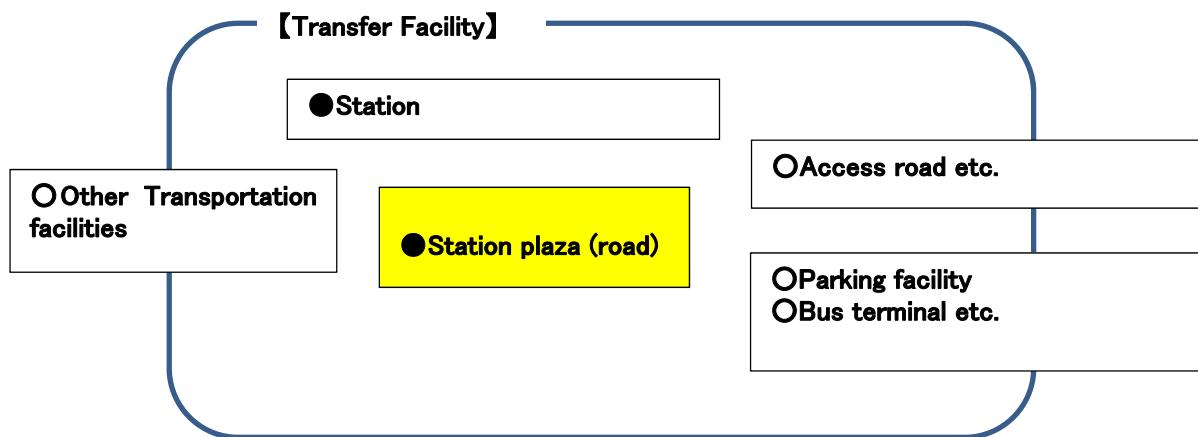


Figure 3.24 Structure of Transfer Facility

(3) Improvement of Intersection

Aksaray intersection should be had an open space and a pedestrian crossing. Particularly the area around Aksaray tram station is not comfortable situation for pedestrian due to an emission gas from vehicles. Therefore the open space with green area was proposed in order to improve the intersection.

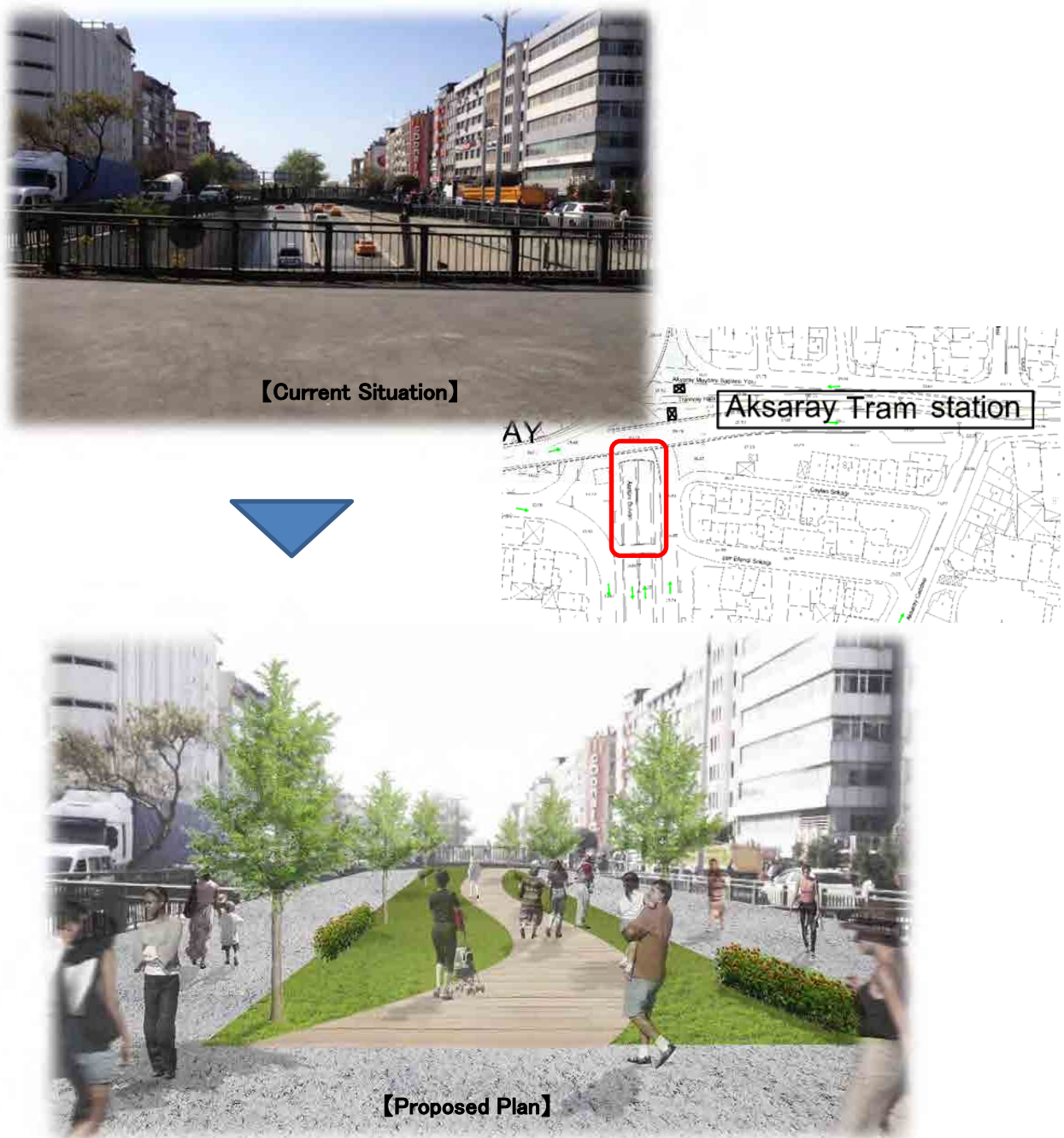


Figure 3.25 Image Figure near Aksaray Station

(4) Improvement of sidewalk

The sidewalk between Aksaray station and Yenikapı station is narrow. Therefore parking space should be space for pedestrian.



Figure 3.26 Improvement Plan of sidewalk between Aksaray station and Yenikapı Station

The underground mall has a role of connection with Aksaray Metro station and Yenikapı station.



Figure 3.27 Underground mall near Aksaray Station

The underground mall (AVM OUTLET) connects to pedestrianized streets. Therefore many persons are using this underground mall.

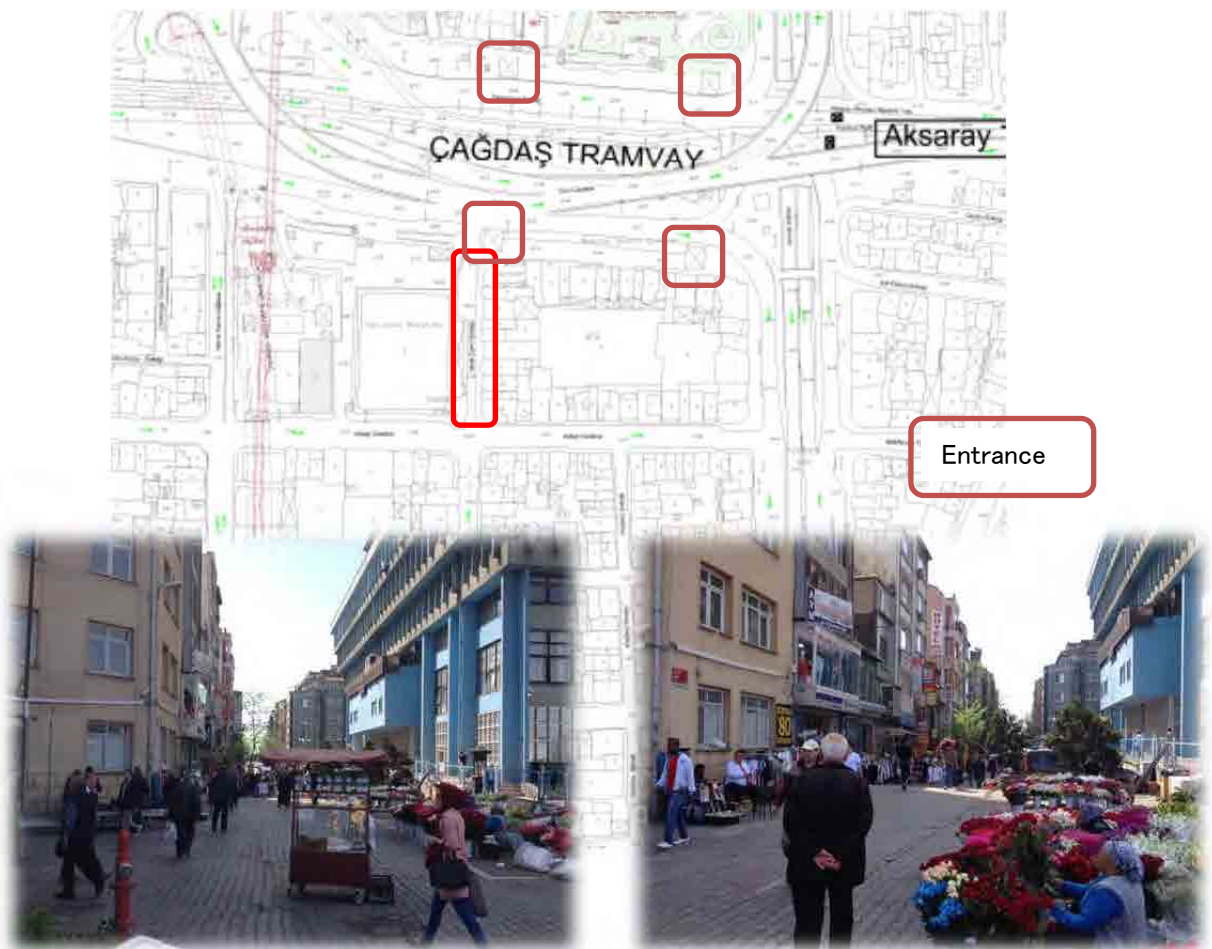


Figure 3.28 Pedestrianized Street connected to underground mall

The roads in south area of underground mall have congested by vehicles because of no signal control and road side parking.



Figure 3.29 Congested Road and Intersection

On May of 2014, the vehicle stopping barrier is installing in this area.

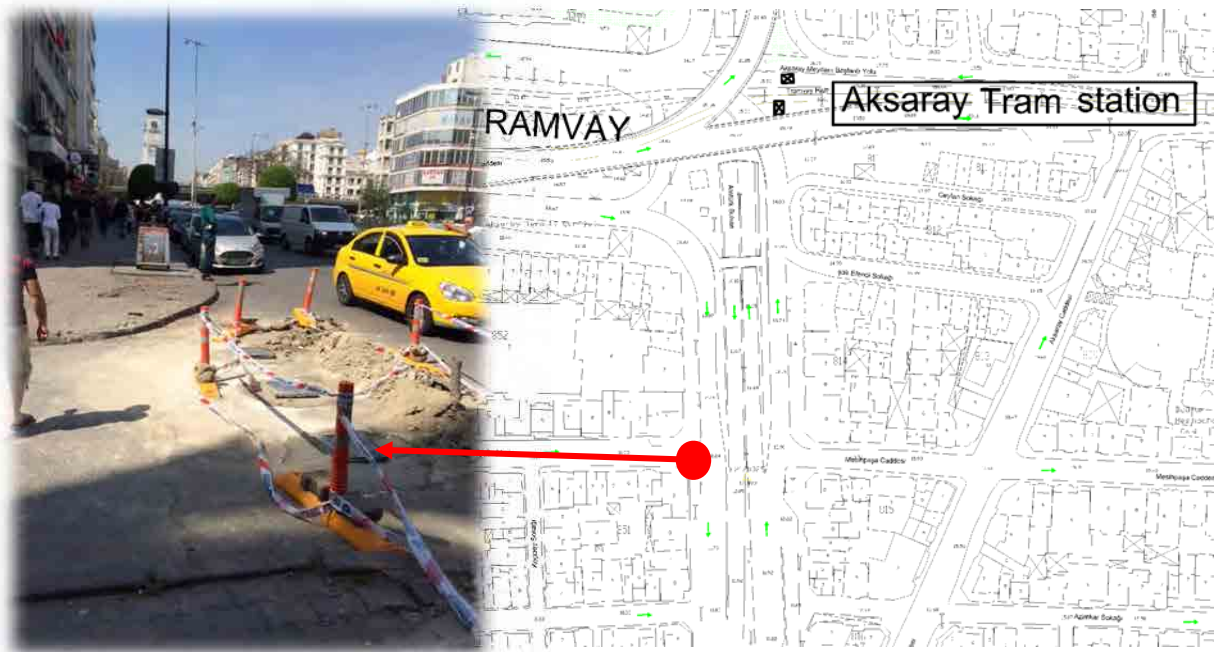


Figure 3.30 Vehicle Stopping Barrier

The vehicle regulation has been enforced in other areas in Istanbul. Therefore the vehicle regulation will be acceptable measure by a resident in this area.



Figure 3.31 Vehicle Stopping Barrier in other area

Thus, the time vehicle regulation will contribute to develop a comfortable pedestrian space. In addition it will also contribute to increase Marmaray users.



Figure 3.32 Concept of Road Space

The underground passageway connected with the underground mall and Yenikapi station was proposed as one of the countermeasure. However it was rejected because of some issues such as security and impact to historical heritage.

(5) Improvement of the transfer facility by using a station plaza

The railway users will increase after the Metro line, M1, will connect to Yenikapi station from Aksaray station. Therefore improvement plan by using a station plaza will be proposed in this section.



Figure 3.33 Metro Line connected with Aksaray Station and Yenikapi Station

A function of station plaza should be considered in order to improve the station plaza. "Guideline for Station Plaza Planning" was referred A space of a station plaza is able to separate to a traffic space and an environmental space. A function is able to separate to a transfer function and an open space function.

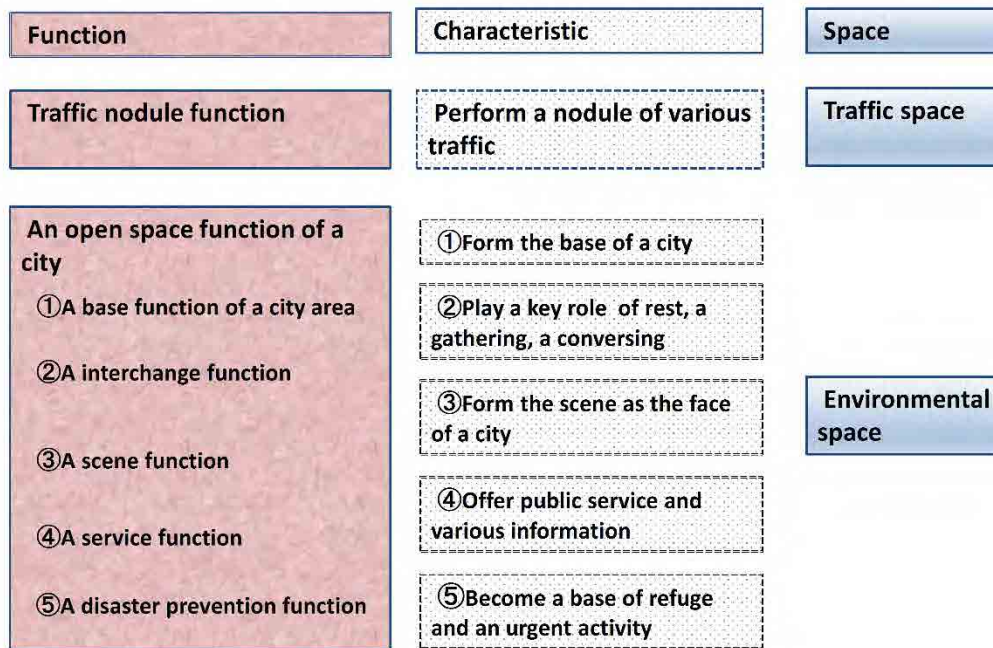


Figure 3.34 Function of Station Plaza

① Basic policy for construction of a traffic space

A station plaza should be considered following matters in order to increase in a level of convenience and coziness.

- Traffic line and walking line should be separated.
- Walking line should be continuance.
- Consider an elderly people and disability person.
- Easily-transferred guide facility and rest facility.
- Main traffic line should be simplification and shortening.

② Basic policy for construction of environmental space

It should be considered characteristics of a station and an area. In addition it should be consider following matters.

- Land scape facility such as a symbolic facility or planting
- Safety and accessibility
- Enjoying the historical heritage. Considering smell or music etc.
- A planting and lighting should be constructed with a rest facility as necessary
- Construction of an information spot
- Standardized guide facility

③ Concept for considering station plaza

The concepts of Yenikapi station are proposed below.

(Five concepts)

- Providing easily-transfer space, access-friendly space and easily-coming space
- Share of synchronized design space with surrounding area
- Considering nature environment
- Share of inheritance of historical heritage
- Using fashionable technology



Figure 3.35 Conceptual image

In current situation, Yenikapi station is covered by concrete because of under construction.



【Current situation】



In the future station plaza should be comfortable space for everyone by using historical materials.



【Improved】

Figure 3.36 Improvement of station plaza of Yenikapi station (Proposal)

④ Zoning Plans of Station Plaza

Two zoning plans are proposed at Yenikapi station plaza, serving for access transport means (bus, taxi and passenger car) and open space of pedestrian.

【Pattern 1】 The spaces for buses and taxis are allocated at both east and west sides of the station.

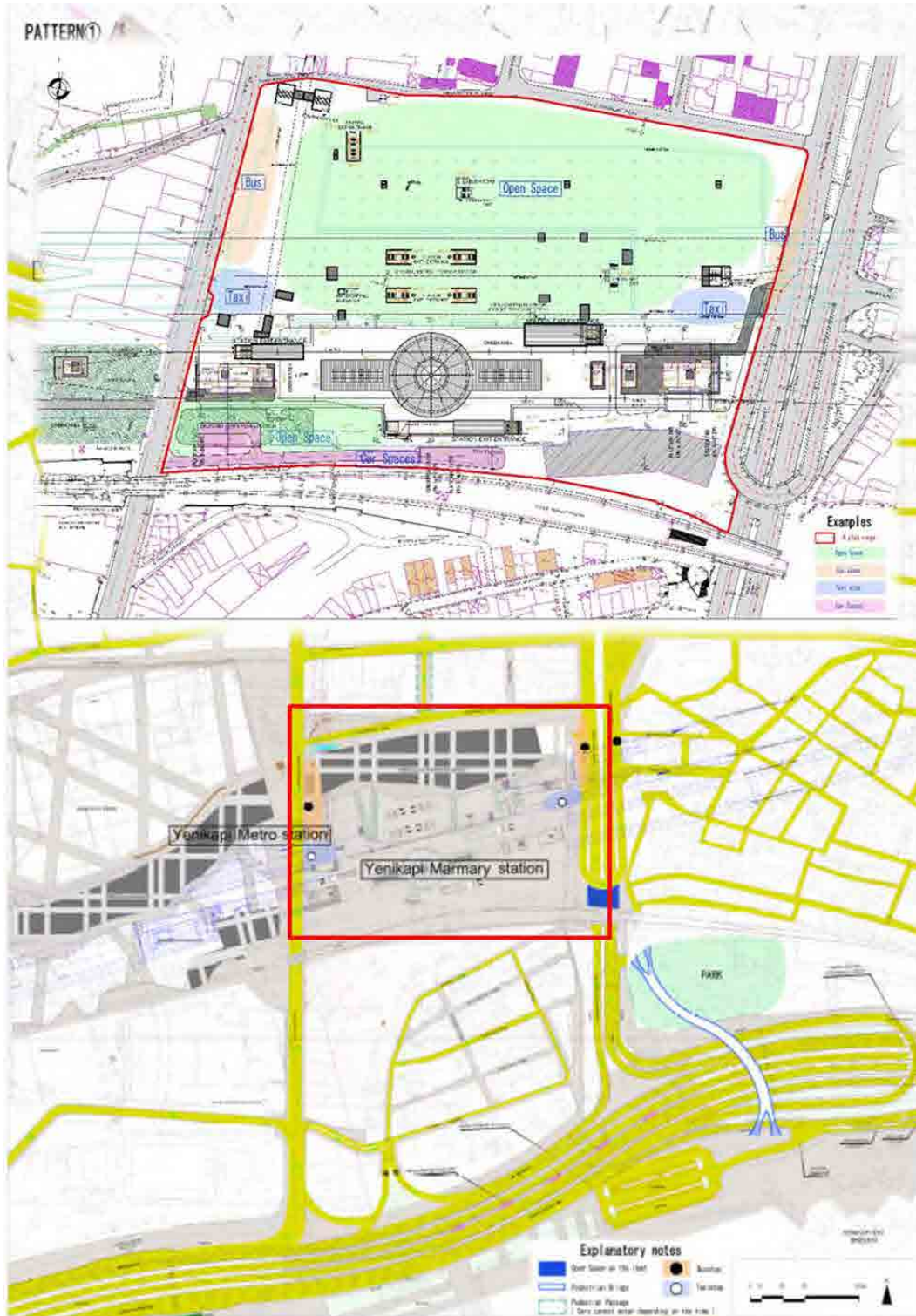


Figure 3.37 Zoning Pattern 1 of Station Plaza

If the restaurant building at the east-south edge, opening only for nighttime, would be removed in the future, a larger space for pedestrian could be allocated. Since the building is designated within a station plaza area, it is likely to happen after necessary discussion and coordination.

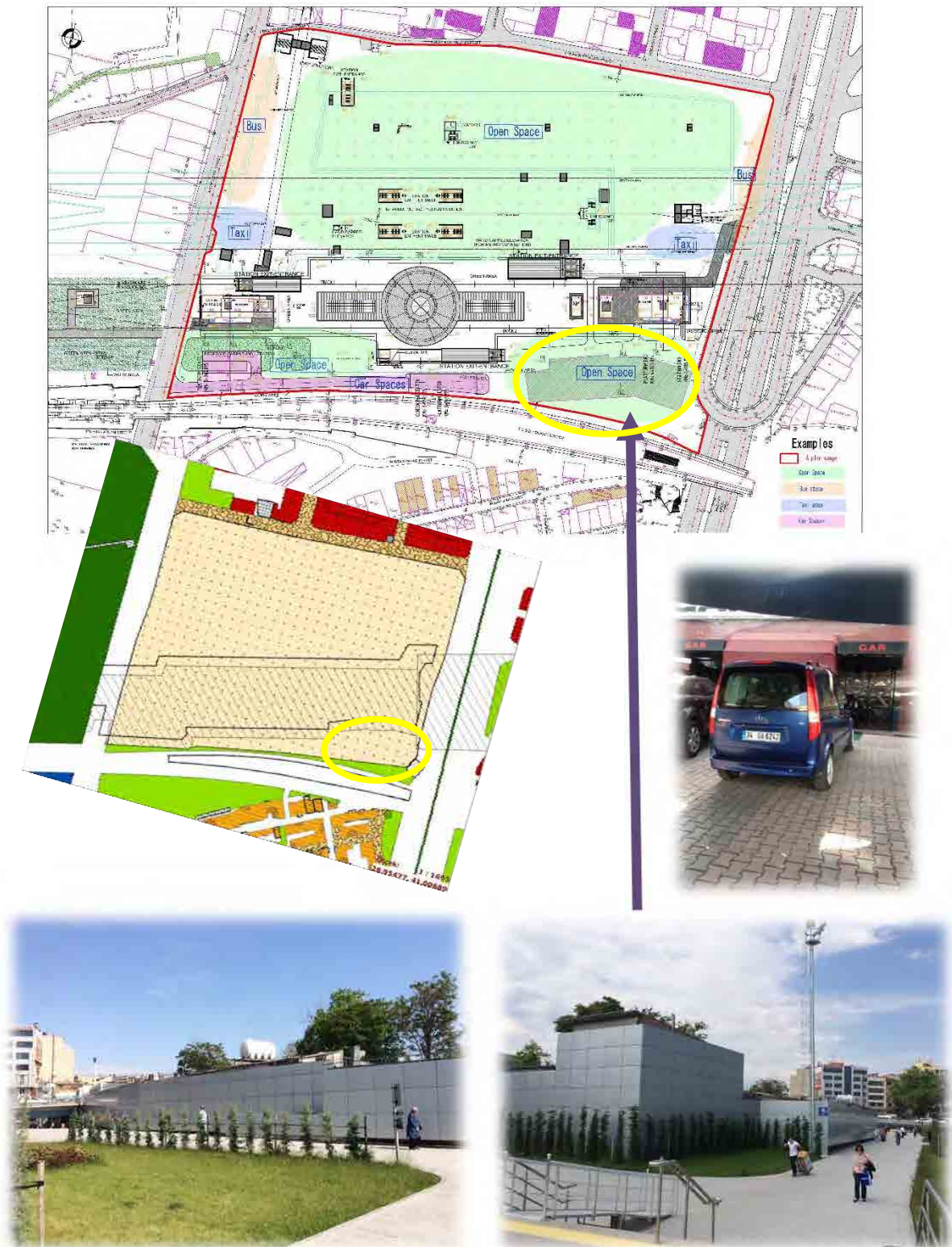


Figure 3.38 Location of the Building at the East-South Edge Surrounded by Fence

【Pattern 2】 Only buses will be allowed at both east and west sides of the station while taxis at the north-central area of the station site. Due to narrow carriageway and many roadside parking practices at the north side of the station, it is an issue how to use this road.

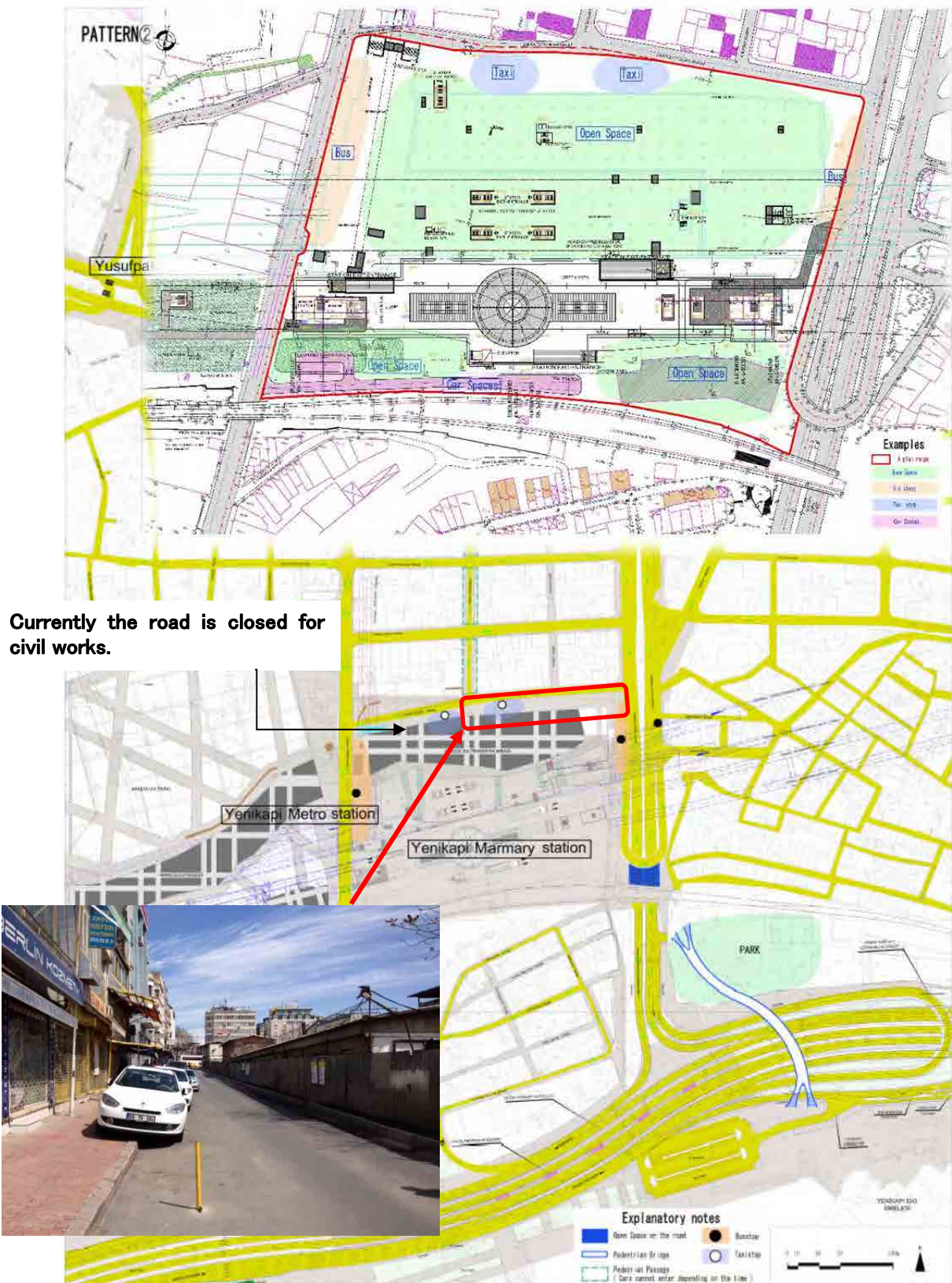


Figure 3.39 Zoning Pattern 2 of Station Plaza

It is noted that a necessary space for a taxi to boarding and alighting passengers has been examined in terms of taxi curving track at either Pattern 1 or Pattern 2. Relevant drawings are depicted below.

If roadside is lined with taxis, it may cause or worsen traffic congestion. It is suggested that a taxi bay for several taxis be allocated within the station site. However, there may be no planning dimension available to design such a taxi bay in Istanbul. When designing a taxi bay, minimum necessary space will be provided within the station site.

【Pattern 1】



【Pattern 2】

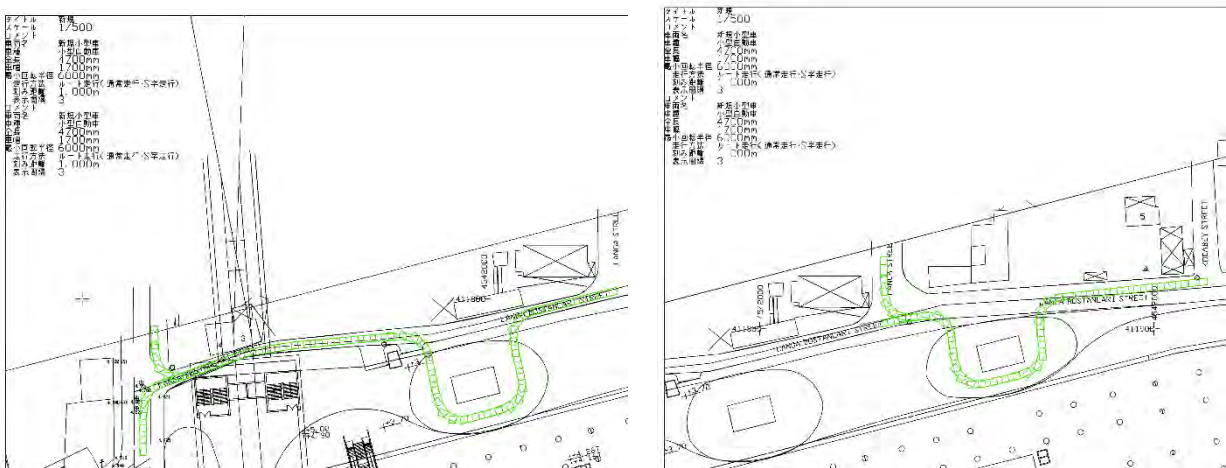


Figure 3.40 Vehicle Curving Track in the Case of Japanese Taxi

⑤ Promotion of Bus Usage

It is suggested to promote bus usage at both east and west sides of the station..



Figure 3.41 Suggestion of More Bus Usage (1)



【Present】



【Improvement】

Figure 3.42 Suggestion of More Bus Usage (2)

With the suggested bus usage, a berth capacity of 8-15 buses can be created at both east and west sides of the station.

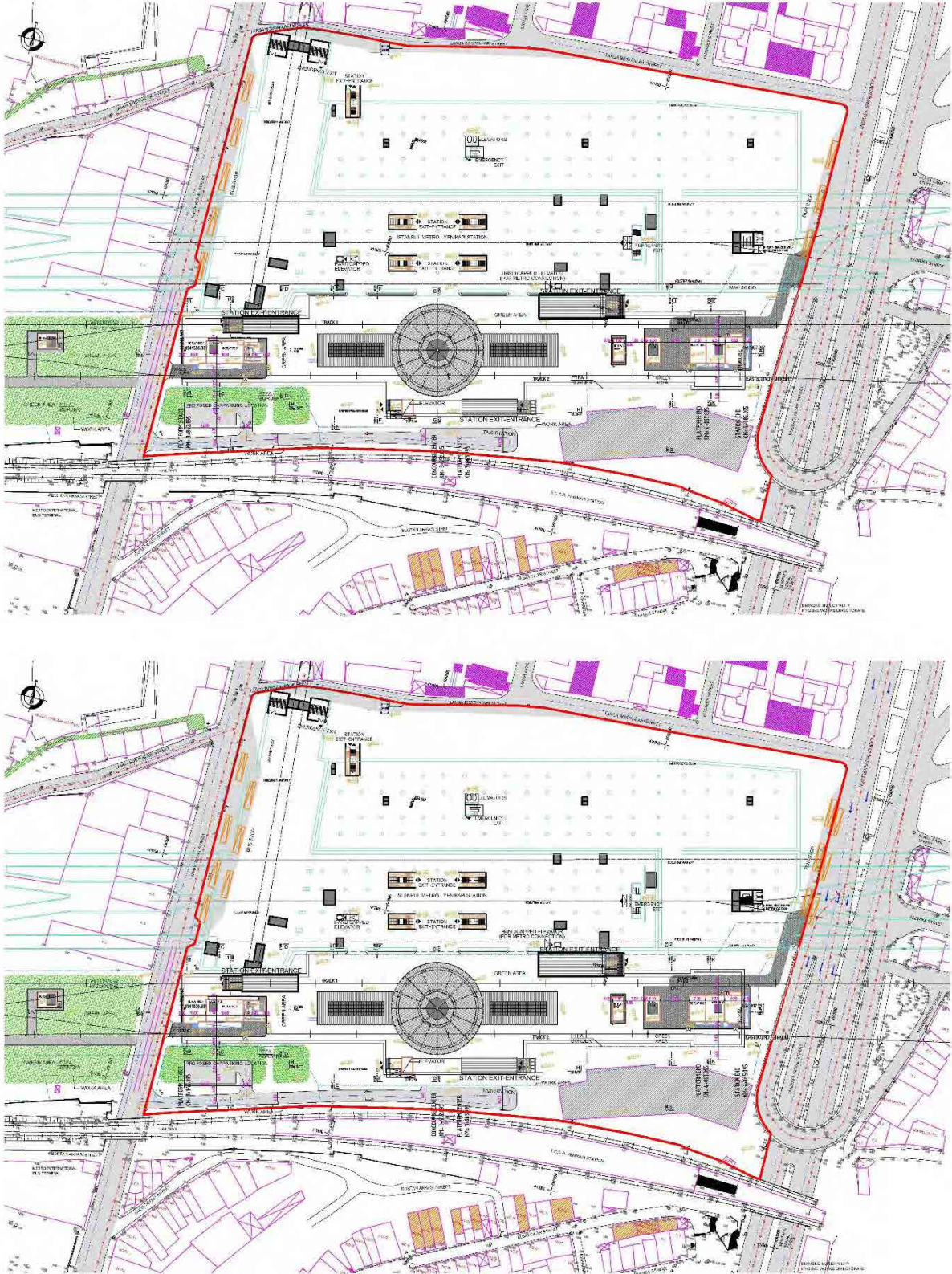


Figure 3.43 Bus Usage Plan (Upper: Single Queue, Lower: Double Queues)

It is necessary to coordinate with bus routes when assigning the road for a bus stop at the west side of the station. At present, the road is as wide as 12 meters with a few traffic such as vehicles for civil works. However, daily traffic congestion is observed at the intersection of the north-west edge of the station site.



Figure 3.44 Existing Conditions of the North Side Road

It is suggested that a convenient bus stop be developed where bus waiting time by route is indicated on board and high environmental amenity is secured.



Figure 3.45 Comparison of Existing Bus Stop with Bus Time Table in Istanbul with Greenery Bus Stop with Bus Waiting Time Board

There are various bus stop designs available. For instance, Curitiba in Brazil employs a cylindrical shape of bus stop for BRT. To gain passengers satisfaction, bus stop appearance is also crucial.



Figure 3.46 Unique Bus Stop Design at Curitiba, Brazil

(6) Phased Development for Station Plaza

With roadside geometric adjustment, the number of maximum bus berths is 15 as mentioned in the previous section. If more bus space would be necessary, more fundamental development plan must come in.

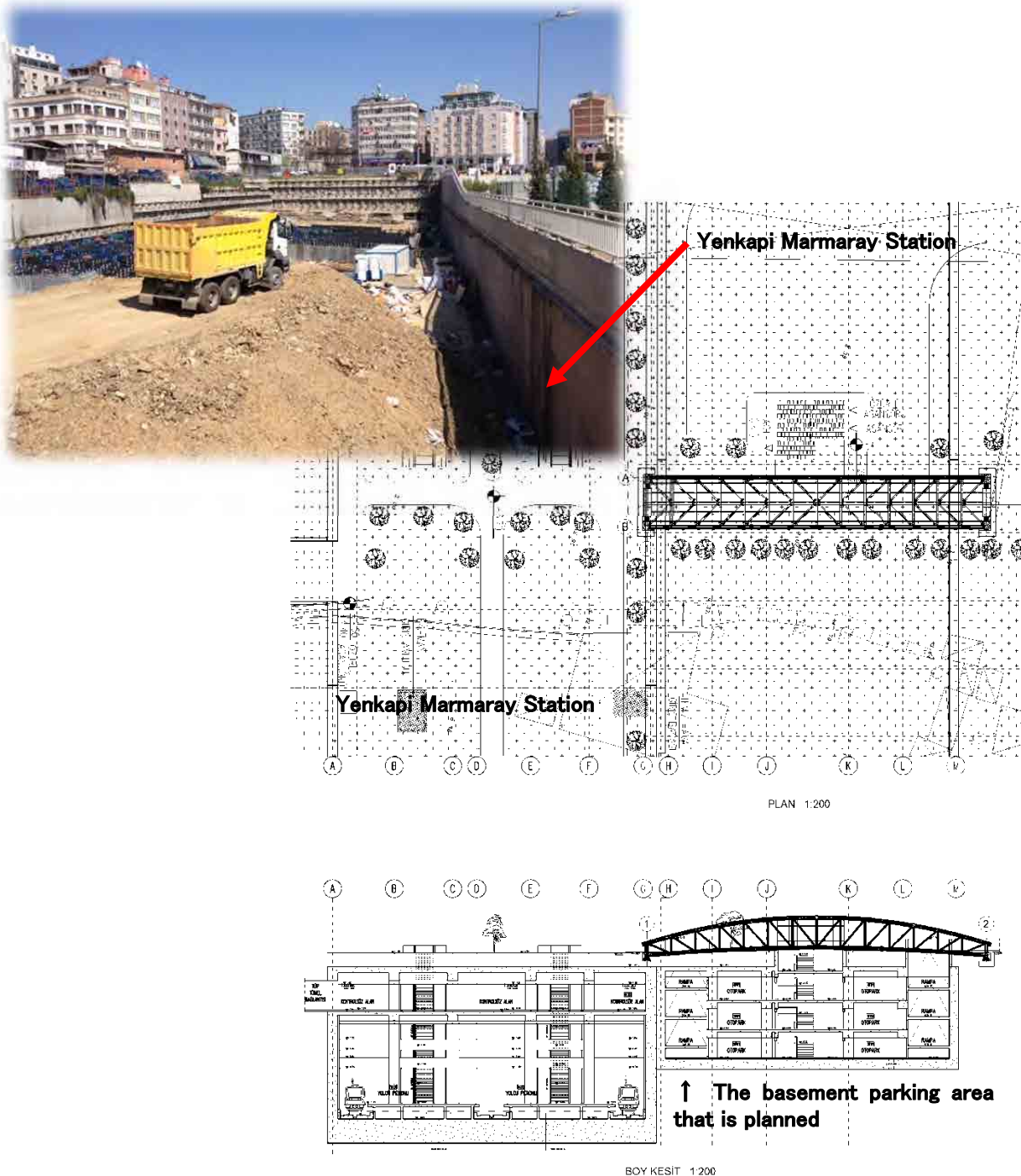


Figure 3.47 Plan of Archeological Museum and Underground Parking

There is still an archaeological excavation site beside Yenikapi Station. One plan shows that an archaeological museum will be built on the ground while underground car parking will be constructed.

As the plan comes into reality, when Yenikapi Station development is completed and a historical museum is ready for construction, the temporary pedestrian bridge to cross the excavation site will be removed.

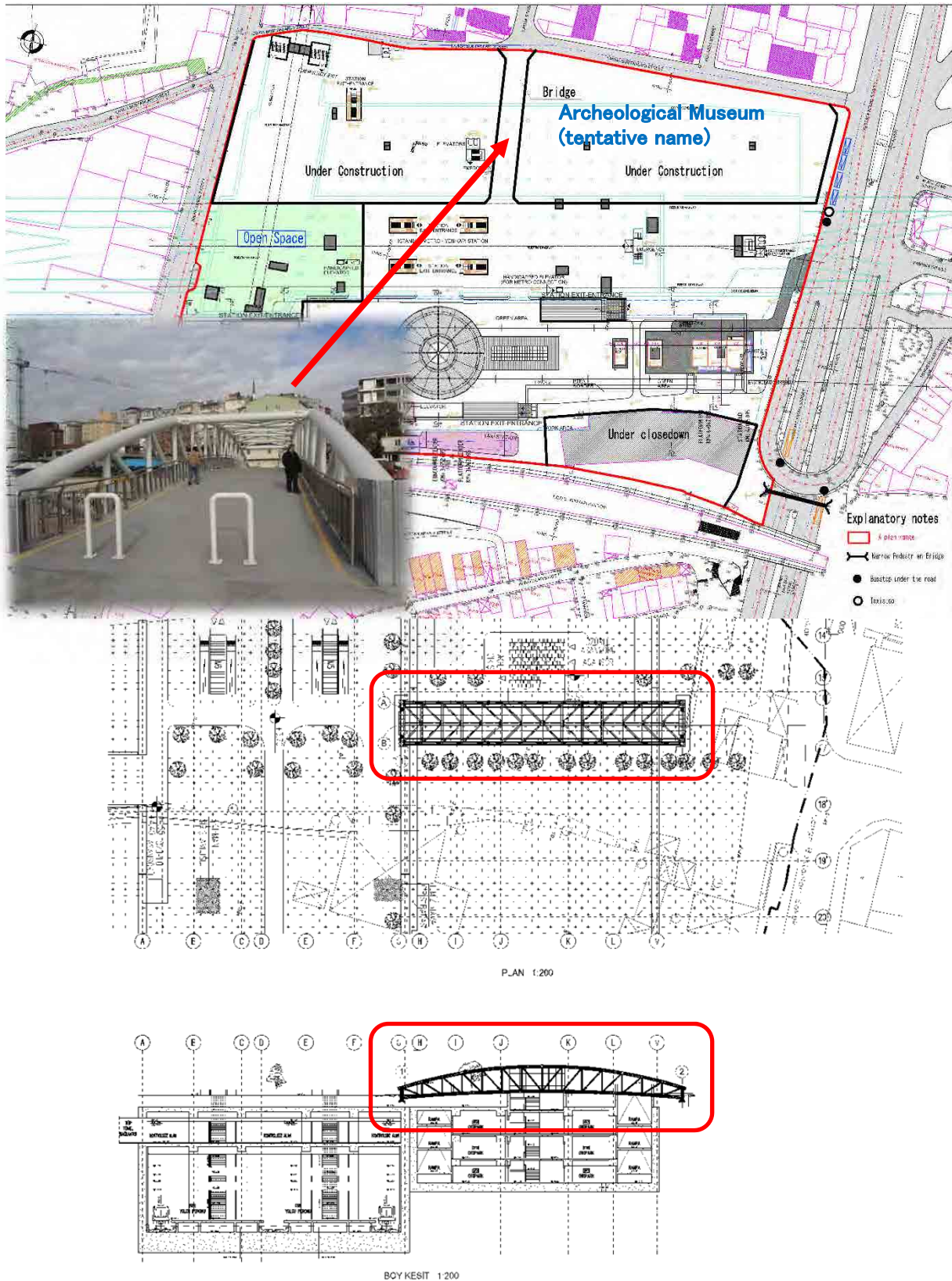


Figure 3.48 Archeological Museum Site (planned) and Pedestrian Bridge

Under such circumstances, there is a way to strengthen terminal function by an integrated building serving for railways, buses, taxis, cars and travelers. For example, bus and taxi terminals are allocated at the ground while pedestrian deck is provided above for safe and smooth people movement. An integrated rail station building accommodates rail station(s) inside and commercial and restaurant floors for travelers' convenience. Although there is no such railway station building in Istanbul, this concept can realize greater connectivity among rail service and its access transport services.



Figure 3.49 Integrated Railway Station Building and Bus Terminal (Sapporo City, Japan)



Figure 3.50 Integrated Subway Station and Bus Terminal (Nagoya City, Japan)

At the station plaza, bus stops and taxi stops are desirably located at different places separately for the convenience of passengers.



Figure 3.51 Separated Locations of Taxi and Bus Stops (Kawasaki City in Kanagawa Pref.)

At taxi stop, an advanced technology of roof glass with solar panels is installed, of which generated power is used for lighting.



Figure 3.52 Taxi Stops with Roofs Solar Panel

Recently, an experimental road pavement with hexagonal modules embedded with solar panels was reported in the Idaho State, USA. The project is called “Solar Roadway Project” aiming at self-supporting of energy. The hexagonal unit is embedded with solar panel, LED bulb and heater for melting snow. In the night time, road signs are lighted with electricity generated and stocked in the daytime. The experiment succeeded to make the road in service all the year round, in spite of the severe cold weather in Idaho. The modules generate energy enough for lighting and heating. The modules will last more than 20 years and a damaged module is easily replaced, which will expectedly result in low maintenance cost.

greenz.jp/2014/05/23/solar_led_roadway/



Figure 3.53 Road Pavement with Solar Panels

There is a large panel at the station plaza of Kawasaki City, explaining passengers how the plaza is designed environmentally friendly.

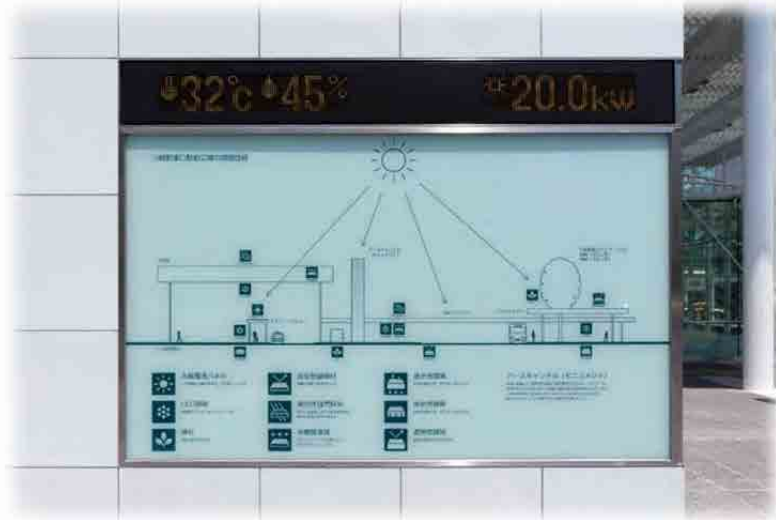


Figure 3.54 Explanation panel of Environmentally Friendly Design of Station Plaza (Kawasaki Station of Kawasaki City)

In addition, design of a station plaza will need to consider raising greenery at parking or retaining walls, which are already observed along highways in Istanbul.



Figure 3.55 Environment friendly devices with greenery

It is recommended to plant flowers of each season to put colors in a station plaza, as well as lawn and trees, in order to make a pleasant space to see.



To plant a variety of colorful flowers



Figure 3.56 Environment friendly spaces with Flower beds



People interacting with the space. Photography credit: Heike Kaiser



Tel Aviv's Habima Square, which connects Chen and Rothschild boulevards, hosts a number of cultural venues, including Habima Theatre, Mann Auditorium, and Helena Rubinstein Pavillion for Contemporary Art.

Also known as Orchestra Plaza, the square's importance to the city is undeniable. However, its design generated a few controversies when a sculptor, rather than a landscape architect, was put in charge of the project.

Sculptor Creates Major Public Square! - Landscape Architects Network

Figure 3.57 Habima Square, Tel Aviv, Israel

Two measures are recommendable to improve pedestrians' convenience between Yenikapı station and Yenikapı IDO's terminal: one is to improve crossing of the artery adjacent to the station and the other is to build a pedestrian bridge. Currently, pedestrians are forced to cross a narrow bridge if they want to take the shortest pass, as the photos below show.

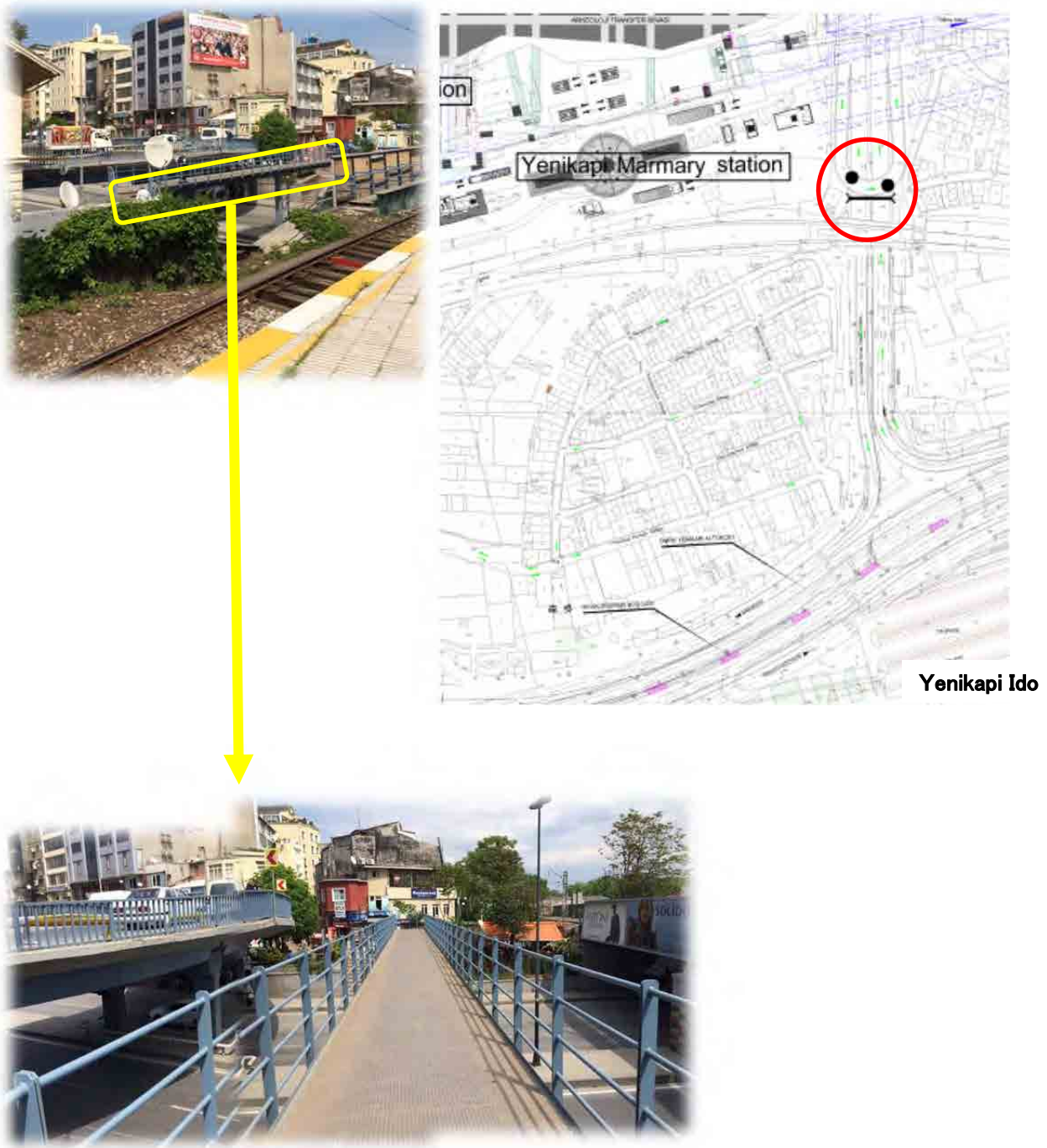


Figure 3.58 Narrow Pedestrian Bridge crossing over Ataturk Highway with heavy traffic.

Recommendations are to replace the narrow pedestrian bridge to a new wider one and the station entrance is to be built at the southeast corner of the block, which is presently surrounded with a fence and shops in which are open only in the night.

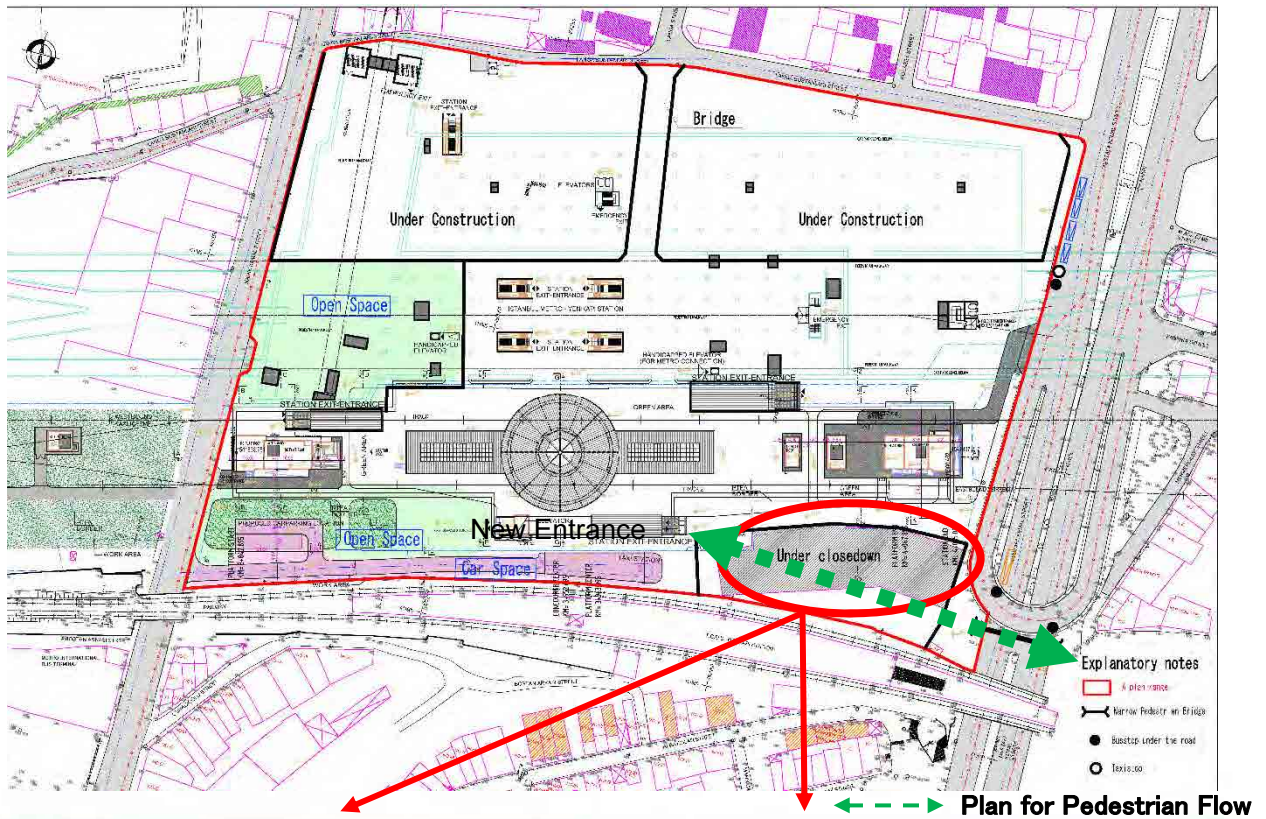


Figure 3.59 New Entrance of the Station at the Southeast Corner

The present narrow pedestrian bridge is planned to widen into a new bridge 12 m wide and a ramp way for pedestrian is to be built to fill the gap in height.



Figure 3.60 A Ramp Approach to the New Wider Bridge

The other recommendation is to build another pedestrian bridge over the Kennedy Road to guide pedestrians to Bus Terminal and IDO Terminal.

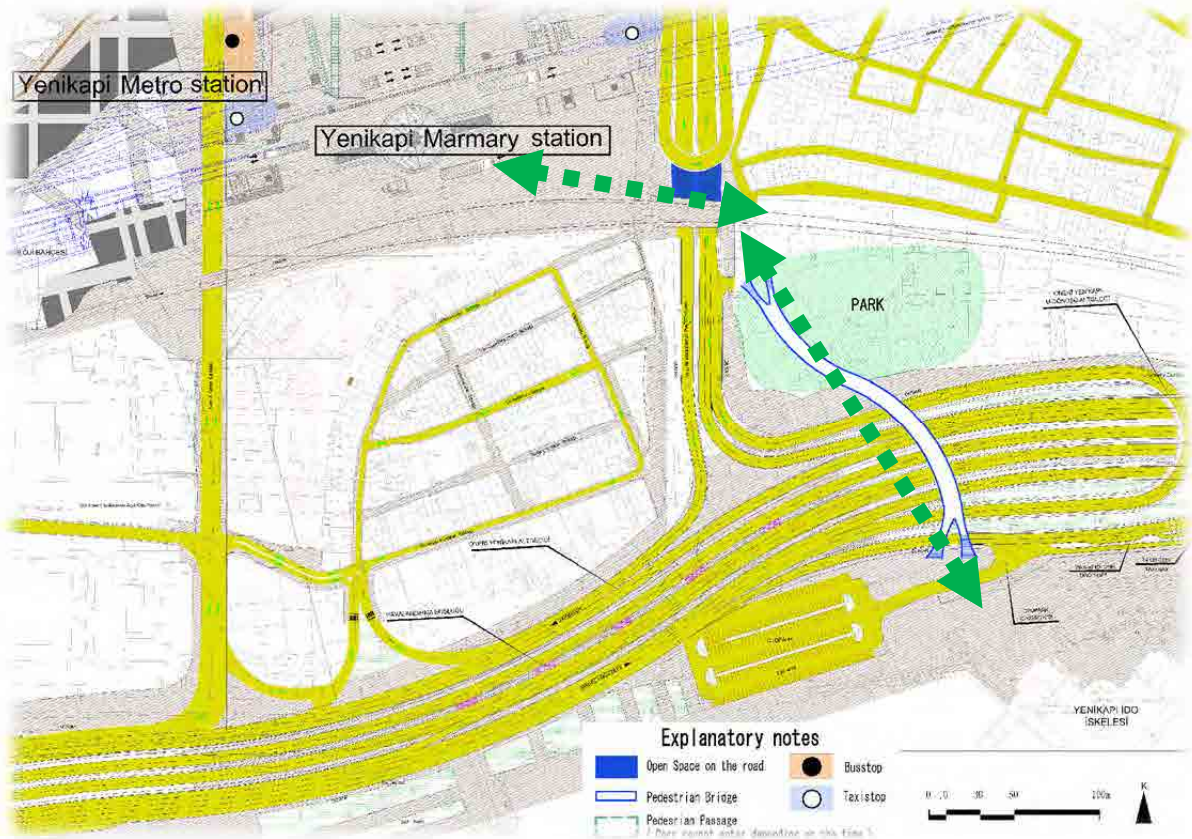


Figure 3.61 Pedestrian Bridge crossing Kennedy Road connecting with IDO Terminal

It shows Perth that watched the bird's-eye view of the foregoing paragraph from another angle.

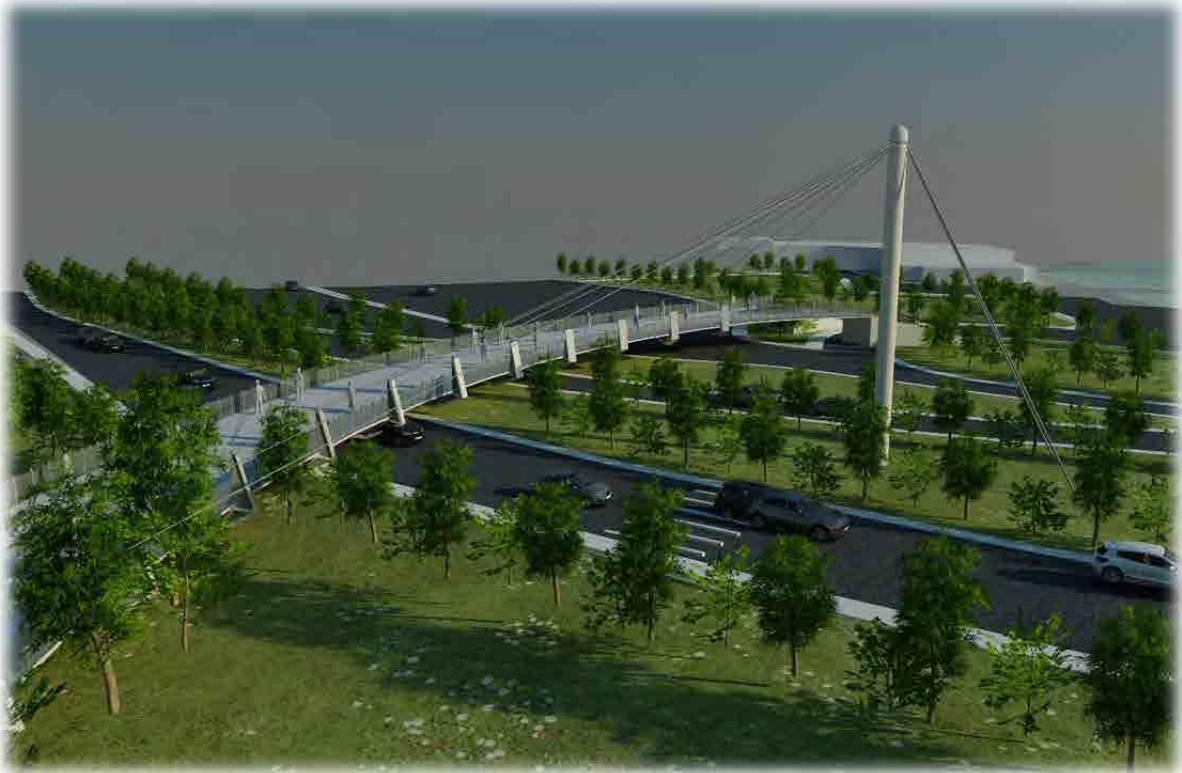


Figure 3.62 Planned Pedestrian Bridge over Kennedy Road

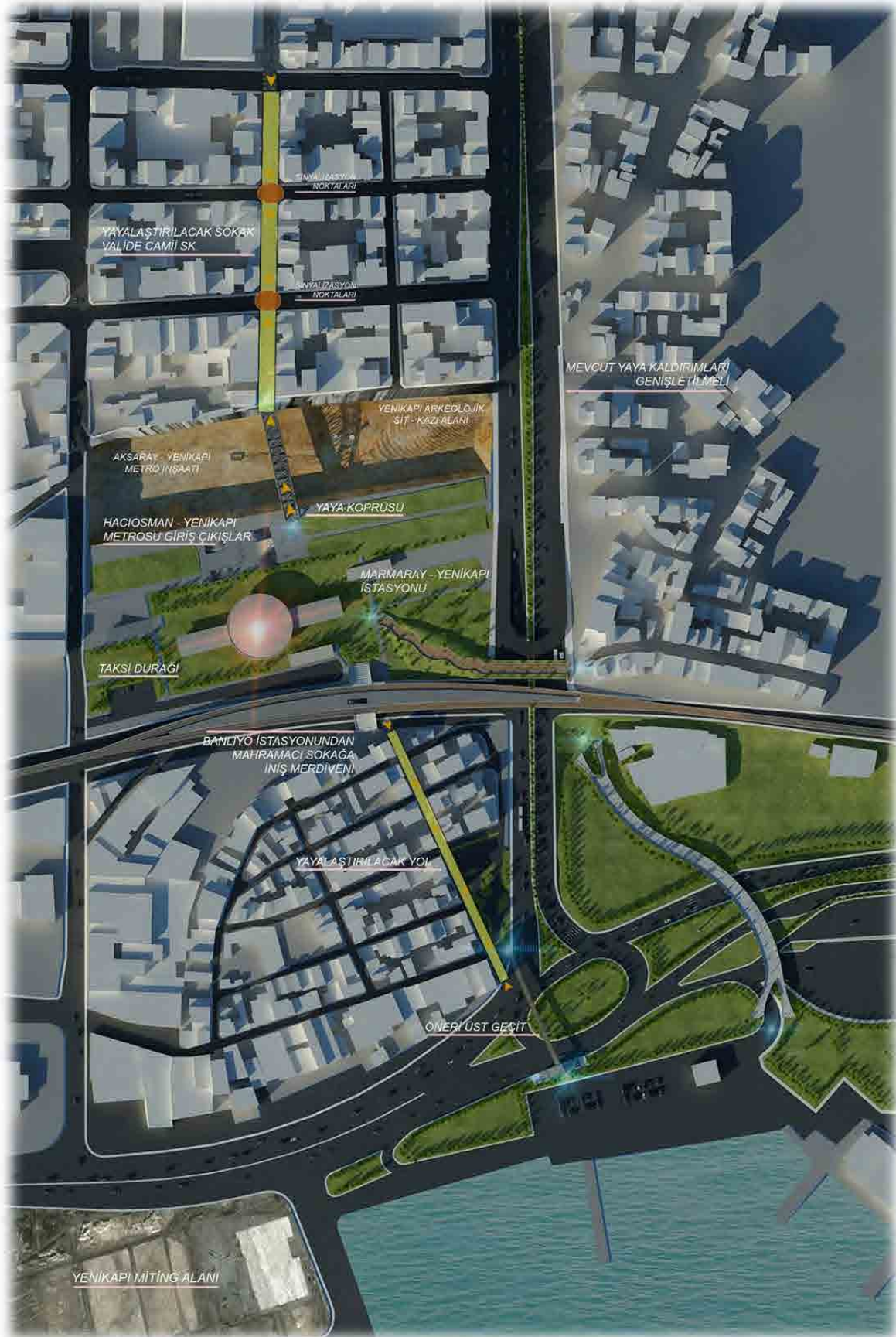


Figure 3.63 Connection of Pedestrian Road and Bridge between Yenikapi Station and IDO Terminal

There three points for planning of pedestrian bridge. Among them, material and structure have shown a variety of new possibilities by technological evolution, receiving greater attention through fusion with new design and ecological contribution.

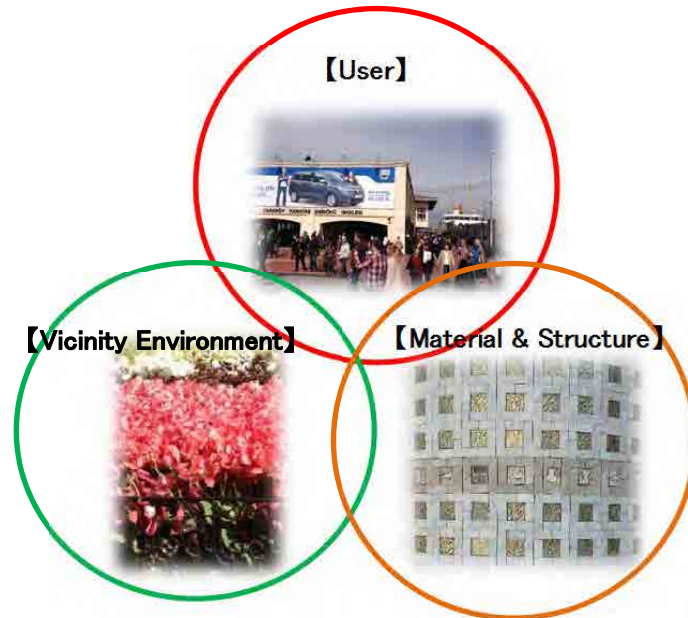


Figure 3.64 Three Points for planning of Pedestrian Bridge

Figure 3.64 presents three aspects important for pedestrian bridge design. Beside these, design should consider well-harmonization and consistency of the inner and outer spaces.

1) Outer Space

- Outer spaces are directly perceived by people being outside the bridge and will give a variety of impressions to them depending on the sight distance. From a distant place, shape as a whole, dominant color and massiveness are clearly perceived and detail design and texture of material will become important from nearby.

2) Inner Space

- Inner spaces are the pedestrian walk and on the bridge and approach, where comfortableness and ambience such as view and interior of the bridge are important rather than distance from the bridge. In case of lower floor bridges especially, design of a semi-closed space surrounded by suspensions and trusses are important.

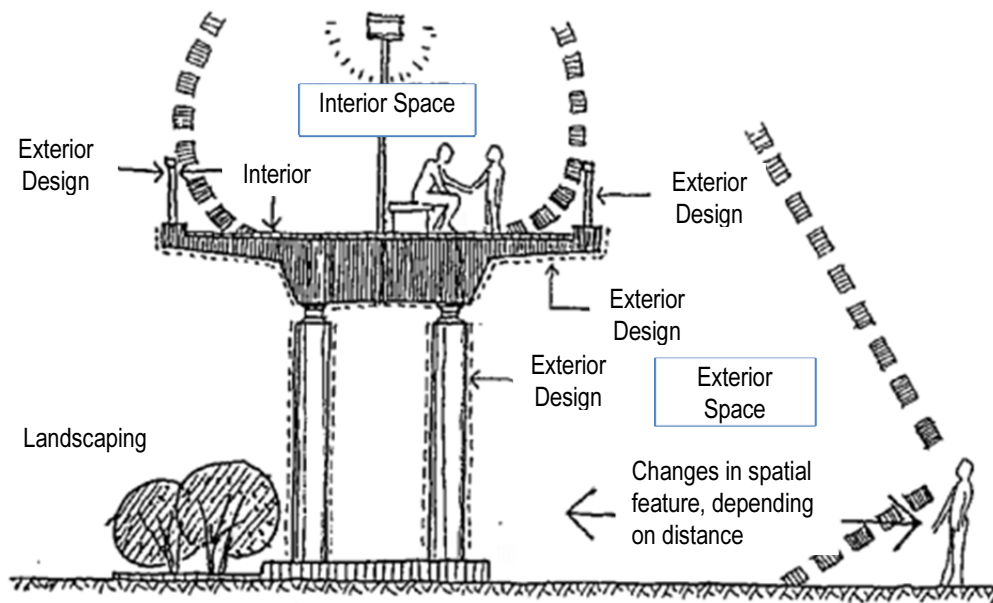


Figure 3.65 A Conceptual Design of Pedestrian Deck

Six (6) objectives are proposed as design criteria of the pedestrian decks/bridge as follows:

Objective 1: To assure fair, safe and flexible use by anyone

- offering the same means to any user to a possible extent;
- encouraging any user to use a lifting and lowering device; and
- assuring any user's safety and privacy equally.

Objective 2: to provide effective transmission of information and communication

- using a variety of communication methods by sight, hearing and/or sense of touch to assure accurate information;
- providing understandable key-information to users, making it distinct from other non-key information; and
- making information available for users to identify their surrounding situation, conditions and attributes.

Objective 3: to evade user's missteps and dangers

- providing an easily understandable and simple system so that any user, regardless of his/her experience and knowledge level, can intuitively identify the way to use it;
- lessening mixtures and/or congestions of users' traffic lines to assure their smooth movements with keeping their sense of orientation.
- making the easiest use of those which are often used by many users, thereby resulting in reduction of users' accidents and dangers effectively.

Objective 4: To reduce physical and psychological burdens

- proving safe and comfortable usage for any user regardless of day-and-night and weather;
- protecting any user from apprehension, discomfort and being involved in criminals;
- minimizing user's physical burden and fatigue; and
- provoking user's funs and pleasure to reduce his/her psychological and physical stress, constructing vista and resting places.

Objective 5: to offer necessary space and size

- providing space sufficient enough for users to assure their easy and smooth mobility;
- providing clear visibility for any user not to be disturbed from his/her necessary vista;
- assuring users' smooth flows at entrance/exit without accumulated fluids due to excessive concentration;
- securing sunshine in the neighboring; and
- offering adequate space necessary for public services for local people, if is required.

Objective 6: to utilize environment-friendly materials and structures

- using appropriate materials to minimize environmental loads, and remove adverse impacts on users' health;
- examining use of recyclable materials;
- using construction materials with lightweight, corrosion-resistant and environment-depurative nature;
- utilizing reused materials and designing a maintenance-free structure;
- inventing new and unique structure with appropriate techniques to make best use of materials in terms of coloring and texturing;
- considering a possibility of being a symbolic landmark to represent its historic and culture-oriented atmospheres in the locality.

There are a lot of the construction models of the pedestrian decks/bridges based on the objectives above over the world, out of which some example structures are as shown below (see Figures 3.67 through 3.72)



Figure 3.66 Example of Exclusive Pedestrian Bridge (German, Berlin City)



Figure 3.67 Example of Pedestrian Bridge (London)



Figure 3.68 Example of Pedestrian Bridge (PORTUGAL, Coimbra city)



Figure 3.69 Examples of Pedestrian Bridges attached to Stations (JAPAN)

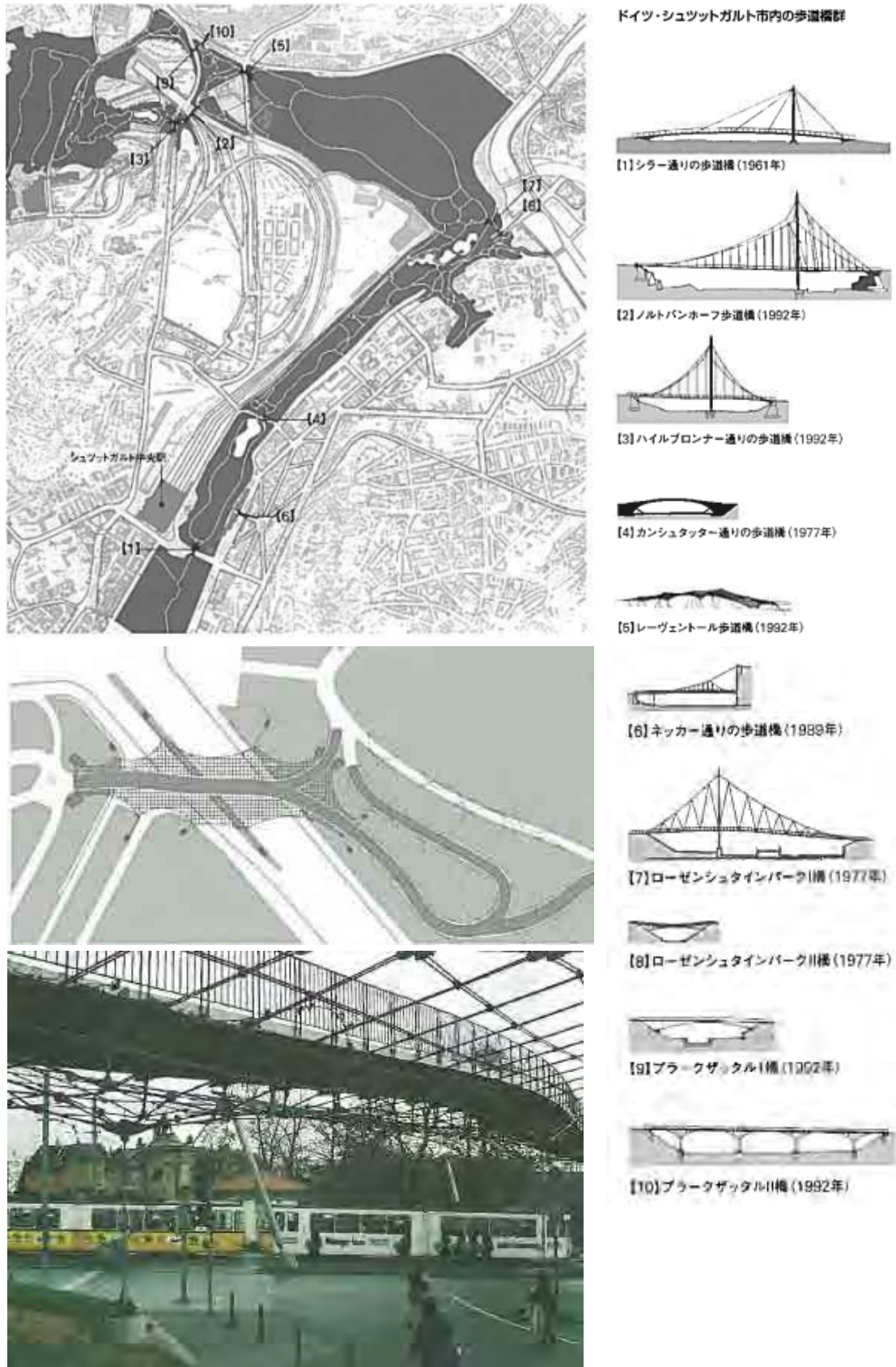


Figure 3.70 Example of Pedestrian Bridges (GERMAN, Stuttgart)

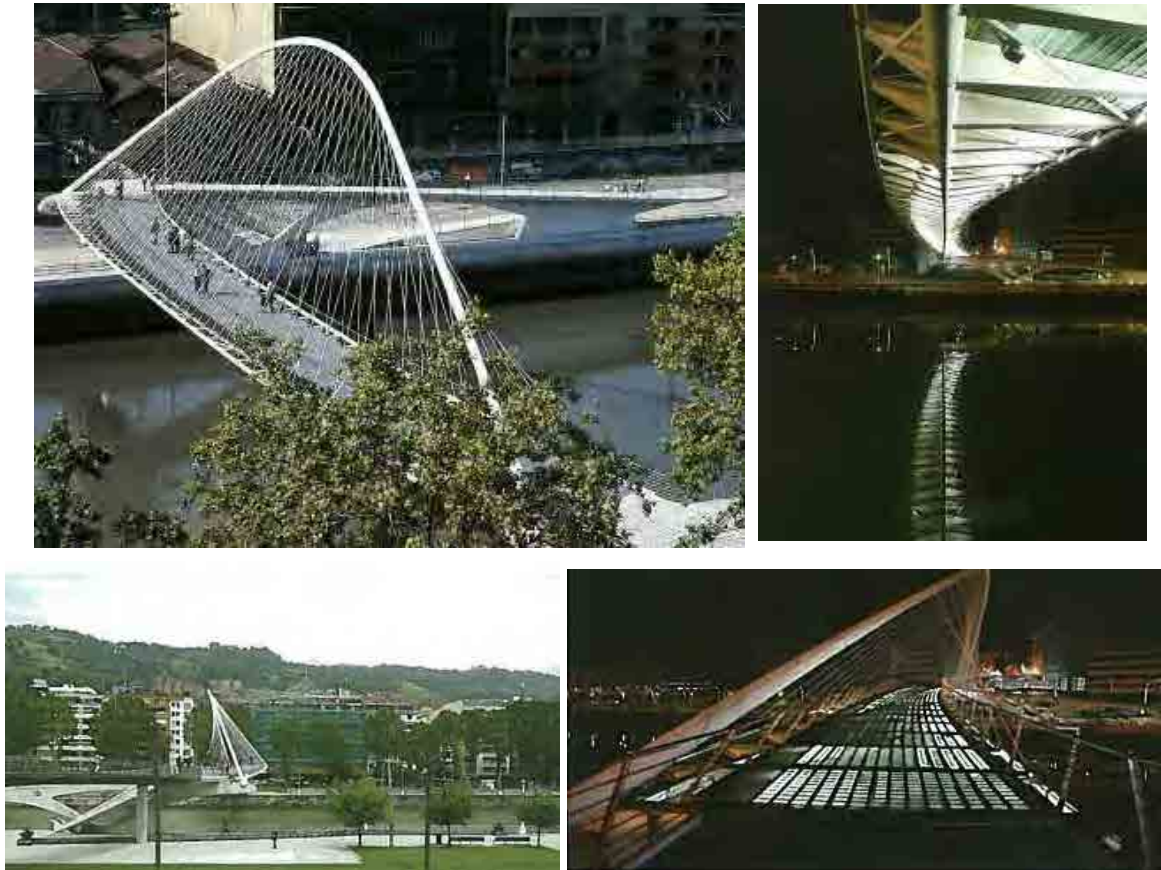


Figure 3.71 Example of Pedestrian Bridges (SPAIN, Campo Volantin)

Large Scale Bridge over Intersection

A special attention to landscape and urban design should be placed on the pedestrian bridge to be planned in a history district. A slender structure may be considered in this sense. A circle structure of large scale pedestrian bridge is a unique model to cross over the wide road and with several approaches (as seen in Fig. 3.73).

The design with roofing is optional. However, any closed space with roofs must not be created due to a security reason.



Figure 3.72 Example of Large Scale Pedestrian Bridge (JAPAN, Shin-Yokohama Station)

Lighting System:

In consideration of security and safety of passengers at the station, a lighting system needs to be carefully designed. The illumination intensity at night time should be sufficient enough to prevent crimes without dark spots. Nowadays, an LED lighting system is popular to be installed for saving of electricity consumption and environment (See Fig. 3.74)

There exists a unique and fascinating lighting system to lighten public open space in London where LED illuminations form grid lines on the pedestrian plaza (see Fig. 3.75).

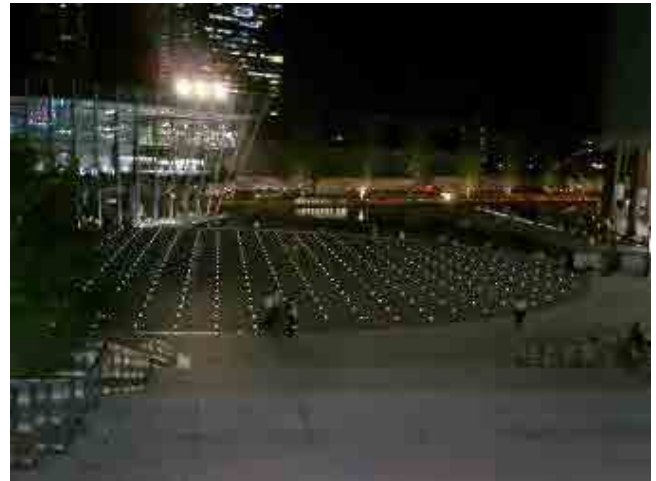
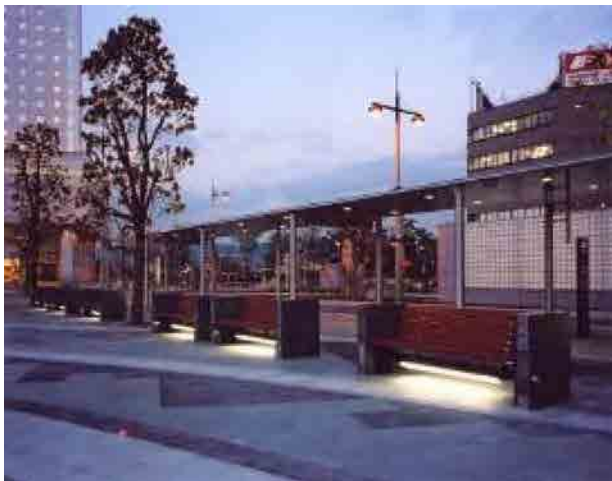


Figure 3.73 Example of Illumination Systems (some stations in JAPAN)



The Finsbury Avenue Square was seen as a dark and unwelcoming plaza that people avoided at all hours of the days. SOM's redesign is centered around an intricate lighting installation built into a matrix on the ground. Over 100,000 LED lights and 650 fixtures illuminate a variety of scenes during the day and night.

Figure 3.74 Example of Open Space with LED Lighting System (London)

Street Furniture:

Well-designed furniture such as bench and pedestrian paths is an essential element to create comfortable public space. At present, only temporary benches and fences for construction are placed in the station plaza with theater-type steps at the Yenikapi Station, and other urban furniture has not been designed for the public space (see Fig.3.76).



Theater Steps can be utilized for recreational activities.

Figure 3.75 Example of Setting of Urban Furniture



Figure 3.76 Examples of Creation of Urban Amenities at Railway Stations (JAPAN)

Billboards and Guiding Boards:

Well-designed billboards and visibly understandable guiding boards are indispensable equipment at station in particular. Those are important devices for tourists to get necessary mapping information on use of transportations and the surrounding areas.

A good example is observed in the city of London where billboards and map-boards were innovated at main streets under the campaign of "Legible London (<https://segd.org/legible-london>)". This movement was conducted before the Olympic Game was held in 2012 (see Fig. 3.77).

In the Istanbul City, a number of map-boards indicating their locations are installed at corners of streets, but there are few map-boards showing the locations in overlooking the whole town. The guiding boards should be designed to be visibly understandable as seen in the London example (Fig. 3.77), so that we can identify where we are now and how distant to our destinations.



Figure 3.77 Example of Visibly Understandable Map-Boards (London)

3.4 Suggestions on Improvement at/around the Sirkeci Station

After the Uskudar Station in the Asian side was connected with the Yenikapi Station in the European side by the Marmaray Line, a significant change in passengers' traffic movements took place. On the Marmaray Line, the Sirkeci Station must be another focal station for its inter-modality. The Sirkeci Station, the terminal of the Turkish National Railways in the European side, used to be famous with its function of the terminal of the Orient-Express. Thus, the station is a historical station with interconnections with transnational, domestic, and sub-urban trains. In addition, the station needs inter-modal facilities which assure passengers' safe and comfortable transfers to/from bus, taxi and ferry.

Needless to say, as this station is located at the corner of the historical district, scenic landscaping and spatial harmony with neighboring historical buildings must be taken into consideration for designing of new transportation facilities.

Because only narrow open space is available around/nearby the station, it is difficult to find a land area to develop new bus terminal(s), taxi-stands and pedestrian paths unlike the Yenikapi Station.

Under these circumstances, it is suggested that some urgent improvement works should be undertaken to assure safe and efficient passengers/pedestrians transfers to/from the other transportation modes, including the following works:

- Widening of sidewalks;
- Increasing of improved pedestrian crossings with signaling systems;
- Placement of well-designed guiding boards and/or map-boards.

The Eminonu area, being composed of the Sirkeci Station, the Eminonu Station, the ferry port and the bus terminal, is one of the busiest tourist destination. Therefore, this station area should be improved in such a way that pedestrians/tourists can benefit from safe and convenient usage of the multi-modal public transportations.

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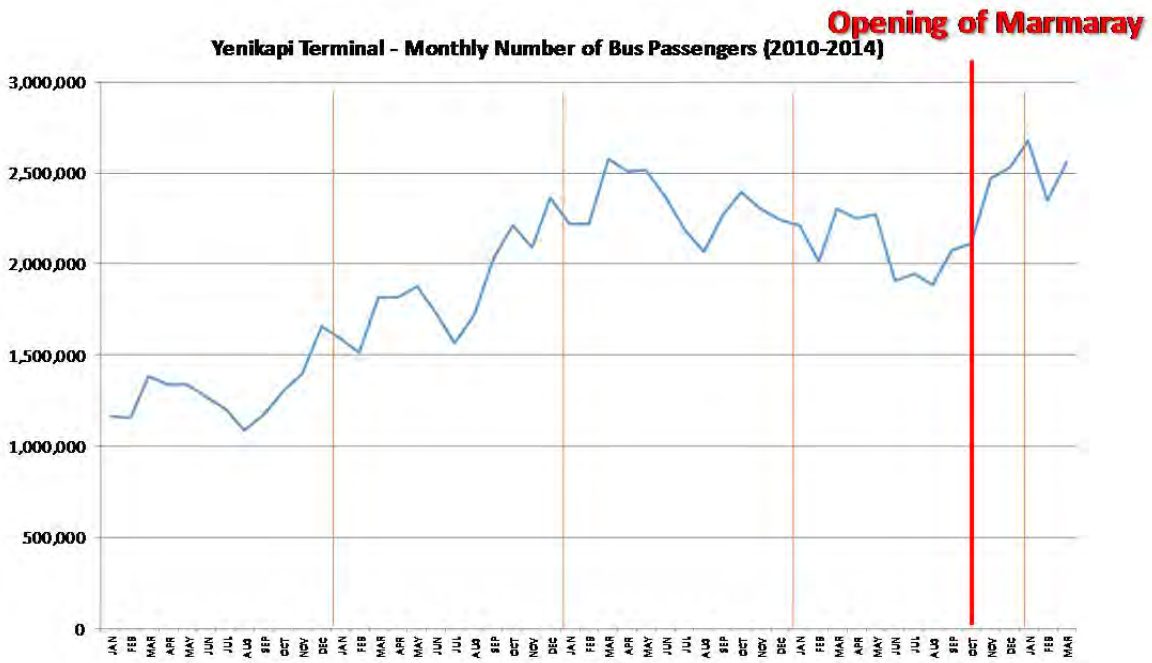
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4. Urgent Projects for Bus Rerouting in the Historical Area

4.1 Demand Changes of Bus Routes in the Historical Area

Regarding the number of passengers on the bus lines (except for Metro Bus) serving the historical area, no significant change is observed as shown in Chapter 2. Meanwhile, focusing on the number of passengers boarding at Yenikapı bus terminal, which is located close to Yenikapı Station and ferry terminal, a slight increase can be observed before and after the opening of Marmaray railway (and extension of Taksim Line (M2)), as shown in Figure 4.1. This tendency is considered to be due to the increase in the number of passengers at Yenikapı Station, where several public transport lines are interconnected. As stated earlier, in accordance with the extension of Airport Line (M1) from Aksaray Station to Yenikapı Station in the near future, the number of passengers at the bus terminal as well as on the bus lines connecting to Yenikapı Station is forecast to increase further. On the other hand, the number of passengers boarding at Eminönü bus terminal, which is located close to Sirkeci Station and Eminönü ferry terminal, no significant change is observed (Figure 4.2). Though the impact on the total passengers at Eminönü bus terminal may be minor, the number of transferring passengers between Marmaray Sirkeci Station and Eminönü bus terminal is forecast to decrease.



Source: BELBİM

Figure 4.1 Trend in the Number of Passengers at Yenikapı Bus Terminal

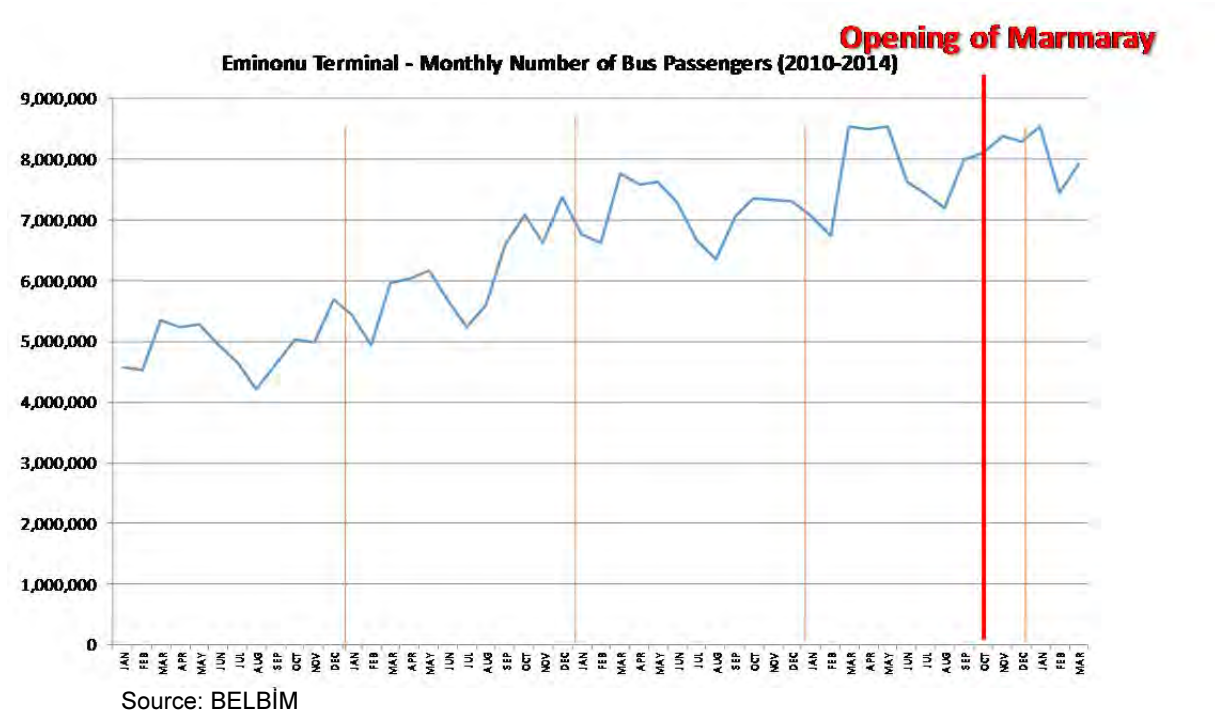
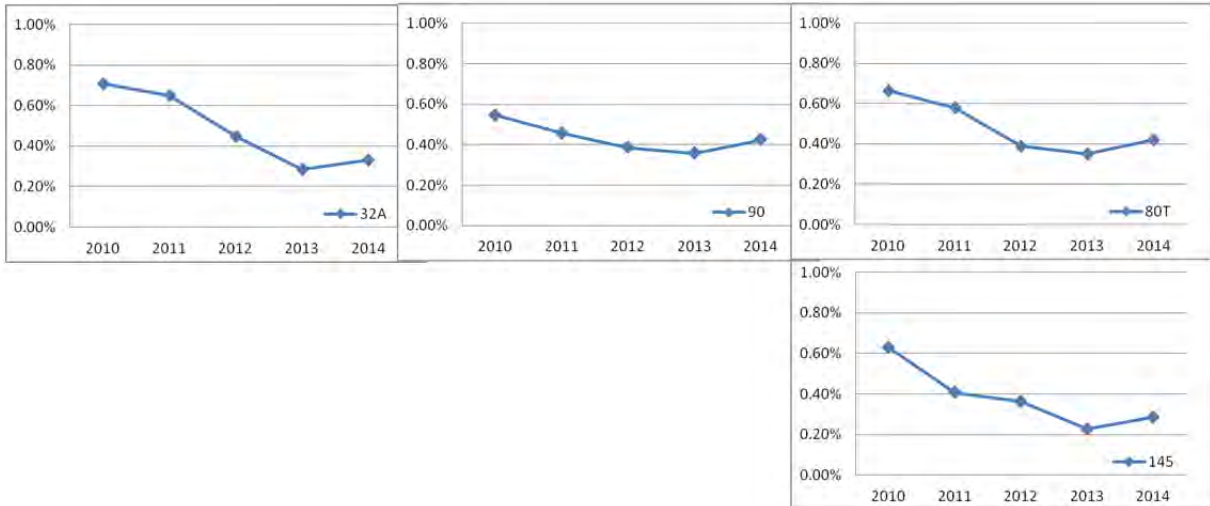


Figure 4.2 Trend in the Number of Passengers at Eminönü Bus Terminal

Furthermore, based on the statistical data of boarding passengers on buses, a ratio of the number of passengers on each bus line to the total passengers on all the bus lines serving the historical area was calculated and plotted in order to analyze the changes before and after the opening of Marmaray railway (and extension of Taksim Line (M2) in 2014). Based on the data of the monthly number of passengers of every March, bus lines where the above-mentioned ratios have increased or decreased are identified and presented in Figure 4.3 and Figure 4.4, respectively. As a result, four bus lines with the ratios increased after the opening of Marmaray and eight bus lines with the ratios decreased are displayed in these figures. The increasing or decreasing tendencies on these bus lines have also matched with the result of the transit network assignment that was simulated before and after the opening of Marmaray railway.

All the bus lines with the ratios increased after the opening of Marmaray have proved to pass by Yenikapı Station except for one bus line. It can be considered to be caused by the increase in the number of transferring passengers at Yenikapı Station. Meanwhile, most of the bus lines with the ratios decreased have proved to originate from Eminönü bus terminal and pass by Yenikapı Station. Among others, it can be inferred that the common section among those decreasing bus lines, that is, the section between Eminönü bus terminal and Yenikapı Station has lost passengers traveling from/to the west of the historical area, who have changed their transfer point from Eminönü bus terminal to Yenikapı Station since the opening of Marmaray railway (and extension of Taksim Line (M2)).



Note: Analysis based on the data of monthly number of passengers in March
Source: BELBiM

Figure 4.3 Bus Lines with Increasing Ratio of Passengers to All Bus Lines after Opening of Marmaray (and Extension of M2)



Note: Analysis based on the data of monthly number of passengers in March
Source: BELBİM

Figure 4.4 Bus Lines with Decreasing Ratio of Passengers to All Bus Lines after Opening of Marmaray (and Extension of M2)

4.2 Issues of Current Bus Lines and Bus Rerouting Proposal

Based on the analyses in terms of the increasing or decreasing tendencies of the number of passengers on individual bus lines, issues of the current bus lines can be summarized as follows:

- Around Yenikapı Station, where the demand for transfers has been increasing, it is

important to partly reroute the bus lines which particularly serve the west direction of the historical area and add a new bus stop beside Yenikapı Station, thereby increasing the bus lines via Yenikapı and enhancing the transfer connectivity between Yenikapı Station and the bus lines; and

- About the bus lines originating from Eminönü bus terminal and serving the west direction of the historical area, it is important to eventually modify and make these bus lines originate from Yenikapı Station (or bus terminal), focusing intensively on the transfers at Yenikapı Station.

While the above-mentioned issues have already been implemented in some of the bus lines, it is proposed to target not only Eminönü terminal-based bus lines but also nearby Aksaray or Beyazıt terminal-based bus lines which serve the west direction of the historical area and reroute most of those bus lines via Yenikapı Station, and eventually to modify and make them originate from Yenikapı Station. Those targeted Eminönü, Aksaray, and Beyazıt terminal-based bus lines are listed in Table 4.1 and proposed rerouting plans are presented in Figure 4.5, Figure 4.6, and Figure 4.7.

Table 4.1 Proposed List of Bus Lines for Rerouting

Eminönü Terminal-Based		Aksaray Terminal-Based	
35	Make these lines originate from Yenikapı Station instead of Eminönü terminal (Disconnect the service between Eminönü – Yenikapı)	89	Make these lines originate from Yenikapı Station instead of Aksaray terminal
33B		89B	
82		89i	
92		145	Rerouting via Yenikapı is completed
92C		Beyazıt Terminal-Based	
(92G)	Cancelled	82B	Make these lines originate from Yenikapı Station instead of Beyazıt terminal
93	Make these lines originate from Yenikapı Station instead of Eminönü terminal (Disconnect the service between Eminönü – Yenikapı)	92B	
94		94A	
97A		97	
		97B	
		(397B)	Cancelled

Source: JICA Study Team



Source: JICA Study Team

Figure 4.5 Proposed Bus Lines for Rerouting (Eminönü Terminal-Based Lines)



Source: JICA Study Team

Figure 4.6 Proposed Bus Lines for Rerouting (Aksaray Terminal-Based Lines)



Source: JICA Study Team

Figure 4.7 Proposed Bus Lines for Rerouting (Beyazıt Terminal-Based Lines)

4.3 Effect of Bus Rerouting

In the transit network assignment, changes in the number of passengers on the major modes after implementing the above-mentioned bus rerouting are shown in Table 4.2, and the overall flow of public transport passengers is presented in Figure 4.8. Implementation of the proposed bus rerouting is expected to further add nearly 15,000 passengers per day to Marmaray railway compared to the forecast in the case of after the extension of Airport Line (M1) that is scheduled in December 2014. Focusing on the number of passengers crossing the Bosphorus, most of the increase in the number of passengers on Marmaray railway is expected to come from ferry.

Table 4.2 Changes in the Number of Passengers on Major Modes before and after Rerouting of Bus Lines

Case	No. of Boarding Passengers on Marmaray(/day)	No. of Passengers Crossing the Bosphorus (/day)		
		Marmaray	MetroBus	Ferry*
After Extension of Airport Line (M1)	169,900	142,900	928,200	212,900
After Rerouting of Bus Lines	184,500	157,300	930,900	195,800

Note: *Ferry lines to/from Kadıköy only

Source: JICA Study Team

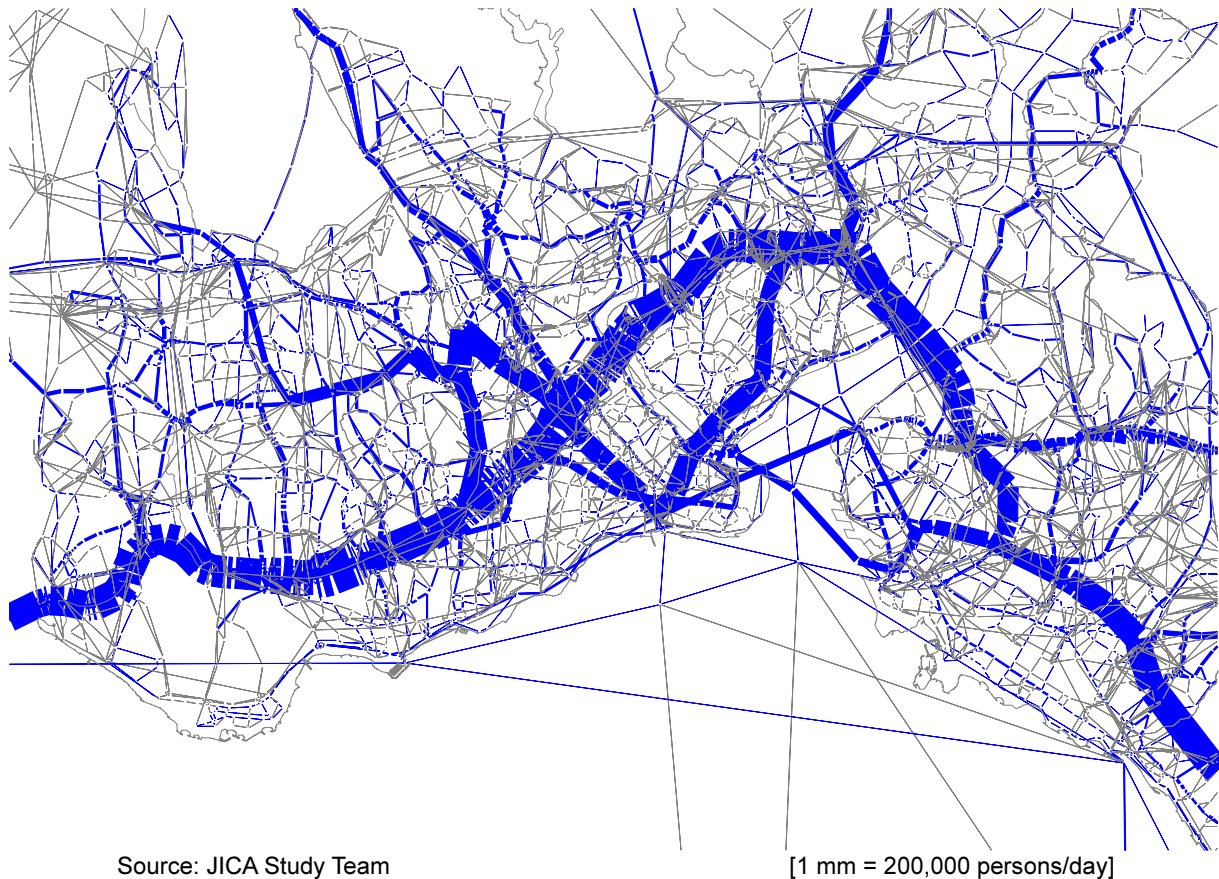


Figure 4.8 Changes by Rail Transit Development (by Transit Assignment) after Bus Rerouting (and Airport Line (M1) Extension)

Passenger flow in and around Yenikapı Station and Sirkeci Station after implementation of the proposed bus rerouting is presented in Figure 4.9.

The total number of daily passengers at Yenikapı station is forecast to increase to about 983,000 passengers, consisting of approximately 130,000 at Marmaray, 460,000 at M2, and 393,000 at M1. While there is an increase of about 10,000 passengers on both Marmaray and M2, in terms of the growth ratios, the one on Marmaray railway is the highest, implying that it will bring a great benefit especially to the passengers on Marmaray railway. Focusing on the changes in the number of transfers to/from the nearby transport modes around Yenikapı Station, increase in the number of passengers who transfer to/from the bus stop beside Yenikapı Station is remarkable, exceeding 50,000 passengers per day.

Meanwhile, as for the number of passengers transferring to/from the public transport modes around Sirkeci Station, no significant change from the case after the extension of Airport Line (M1) can be observed. Though many of the existing Eminönü-based bus lines are modified into Yenikapı-based bus lines, no significant change is observed in terms of the number of transferring passengers to/from Marmaray Sirkeci Station, which implies little negative impact on the transfers at Sirkeci Station.

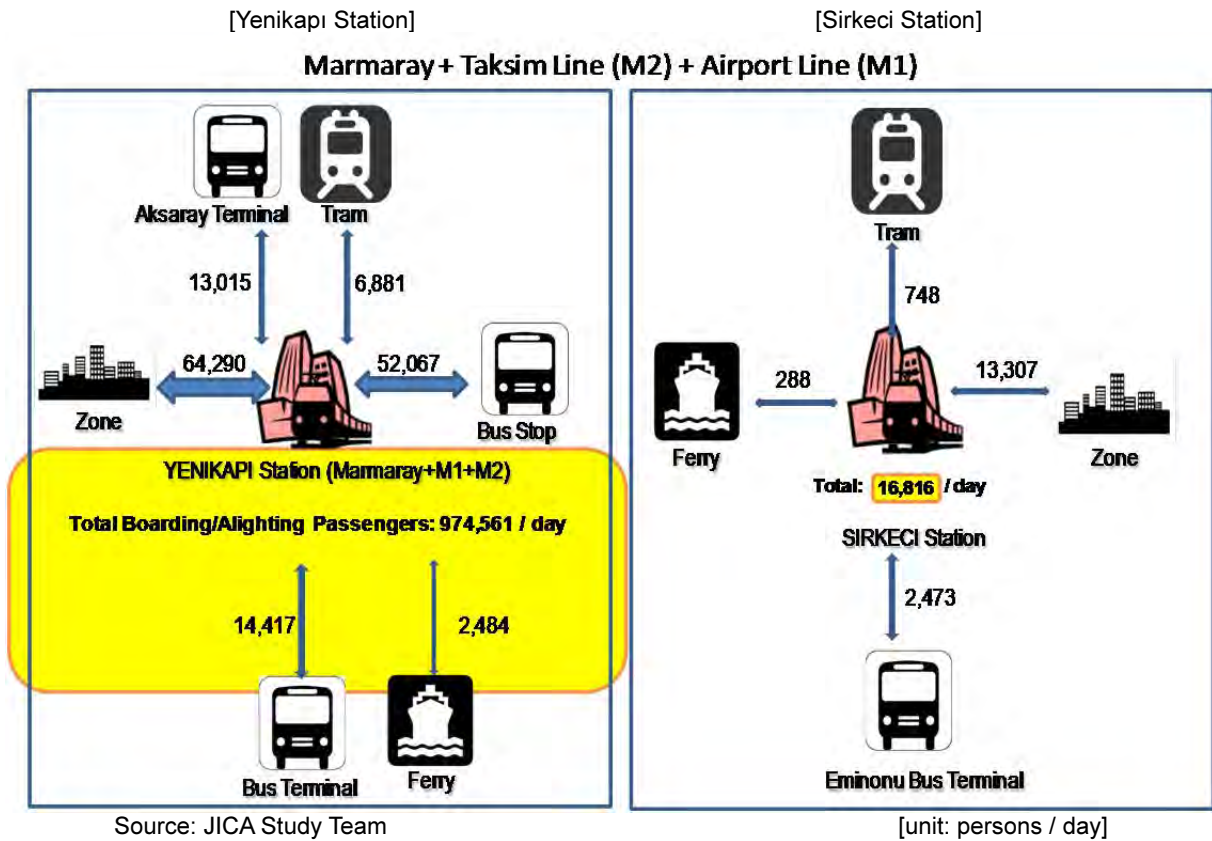


Figure 4.9 Passenger Flow in and around Yenikapı and Sirkeci Stations after Bus Line Rerouting (and Airport Line (M1) Extension)

Finally, in terms of the effect of the proposed bus rerouting, indicators of the expected benefit brought to the entire transit network (namely, entire Istanbul) are presented in Table 4.3. Focusing on the case after rerouting of the bus lines, while there is no remarkable change in the number of transfers, the total passenger-hours have certainly decreased. As a result, the travel time reduction per trip all over Istanbul can also be expected though the range is one minute or so. If the reduction of travel time or total passenger-hours shown in the table is to be enjoyed by additional transferring passengers at Yenikapı bus stop (approximately 21,000 person-trips), average travel time reduction per person-trip is estimated to be around 10 minutes per trip. Though it should be noted that this benefit will be brought to not only Marmaray passengers but also M1 and M2 passengers, about 15,000 passengers are transfer passengers between Marmaray Rail and Yenikapı bus stop. Thus, estimation of the above-mentioned travel time reduction may be reasonable.

Table 4.3 Expected Benefit Brought by Bus Line Rerouting

Case	Whole Area of Istanbul			Daily Number of Passengers on Marmaray	Daily Number of Transfer Passengers at Yenikapı Bus Stop
	Average No. of Transfers	Total Passenger-Hours	Average Travel Time (minutes)		
Present Case*	2.65	11,001,094	71.43	140,900	34,210
After Extension of Airport Line (M1)	2.69	10,933,182	70.99	169,900	38,810
After Rerouting of Bus Lines	2.69	10,929,615	69.87	184,500	59,900

Note: *After opening of Marmaray and extension of Taksim Line (M2)

Source: JICA Study Team

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5. Next Step

5.1 General

The Project started with a clear objective to improve the traffic conditions in the Historical Peninsula through introduction of effective traffic demand management measures. For this purpose, a number of measures and/or systems were explored, examined and discussed. Out of them, the “Smart Parking System (SPS)” was selected to be undertaken as the first social experiment which is a new trial to the government of Istanbul Metropolitan Municipality (IMM). The social experiment was successfully conducted by the counterpart team, and obtained appreciable results as expected, and it was identified that the SPS is a feasible measure and deserves to be continuously executed.

After then, the second social experiment was considered and a “Traffic Cell System (TCS)” was selected to be carried out. The counterpart team made intensive efforts to implement the TCS in the practical ground. However, it was finally decided by the government of IMM that its implementation was postponed in order to avoid some contingent social problems, considering the sensitivity in the election campaign season.

In October 2013, an epoch-making event took place in the Historical Peninsula, that is, the Marmaray Line with five (5) stations was opened in service for the public use, and in January 2015, the Taksim Line (M2) was extended and connected with the Yenikapı Station. This event greatly influenced to change people’s traffic flows and their patterns. However, essential measures and facilities to enhance the transport management were not placed in practice at and around the Yenikapı Station where a great number of passengers are transferring from/to the other transportation modes such as buses, tram and ferries.

The IMM government, recognizing the importance of formulating urgent countermeasures against traffic disruptions at the Yenikapı Station, asked JICA Project Team to study an effective intermodal system development plan and a bus-service rerouting plan as urgent tasks. JICA decided to extend the Project to respond to the official request, and outcomes of the study have been compiled in Volume 2 of this report.

It is noted that in this study, urgent and/or short-term measures to assure safe and convenient inter-modal transfer systems and bus-service rerouting are examined, focusing on the Yenikapı Station which is endowed with Marmaray Line and the Taksim Line (M2). In near future, another great change in passenger traffic flows will take place once further extension of the Marmaray Line and the direct connection of Aksaray Line (M1) at the Yenikapı Station are realized. Effective measures and action plans to respond to such a forthcoming condition, however, has not been delineated yet, and those remain as vivid planning issues to be tackled in the next step.

5.2 Planning Issues for Next Step

Overviewing the medium- and long-term planning issues, comprehensive transport development plans at/around major stations on Marmaray Line such as the Yenikapı Station and the Sirkeci Station. The following are the main themes for this purpose:

(1) Strengthening of Hub Functions of Yenikapı Station

The Yenikapı Station will surely become a hub of the public transport network in Istanbul as a whole as well as in the Historical Peninsula. The hub’s functions, based on traffic engineering knowledge, need to be enhanced with the following action plans:

- Action plan to assure safe and rational inter-modal transfer systems with three (3)

urban rail services and bus-services;

- Action plan to develop parking lots necessary to be attached to the Yenikapı Station
- Action plan to develop a symbolic station plaza at the Yenikapı Station in consideration of a pedestrians' priority concept;
- Action plan to develop and/or improve bus-stops/terminals to be functionally linked with the Station.

It should be noted that spatial coordination with the Archeological Museum project, which is under planning and design, is indispensable to formulate the action plans above.

(2) Bus Service Rerouting

It is a must to further pursue a rational bus-service network in the Historical Peninsula as a whole so that buses are complementary, not competing, with urban rail services. To this end, a hierarchical public transportation structure is formed with trunk modes and feeder modes.

- Re-integration or rerouting of bus services which shall be competing with extended Marmaray Line;
- Development or enhancement of feeder bus services to/from main stations; and
- Examination of rational tariff system for feeder bus services.

(3) Exploration of Traffic Demand Management (TDM) Measures for the Historical Peninsula

Pursuance of more effective measures and/or systems for traffic demand management (TDM) shall be indispensable along with changes in patterns of traffic flows and transport characteristics in the Historical Peninsula in the future. The TDM measures in the world were evaluated in this study. In the results, a tourist bus ban was recommended in order to keep the environment. However "Electric Mini-bu System" should be introduced as an alternative mode. Also Area Licensing/ Road pricing was recommended for the medium and long-term project.

In this context, introduction of a few possible measures should be examined in terms of their technical adaptabilities and economical feasibilities on the medium- and long-term perspectives.

- Introduction of "Area Licensing System" in the "**Low Emission Zone (LEZ)**" which will be designated to the area encompassed with the Kennedy Avenue and Atatürk Boulevard;
- Introduction of an "Electric Mini-bus System" in association with a policy of tourist bus ban in the LEZ; and
- Introduction of a "Pedestrianized Zone".

In the medium- and long-term visions, dynamic spatial impacts should be considered for improvement of the total transport system in this area, such as: 1) opening of the Euro-tunnel; 2) underground passage of the Kennedy Avenue to be connected with the Euro-tunnel; 3) Innovation of the Yenikapı bus-terminal and ferry-terminal; 4) large-scale urban redevelopment in the southern Yenikapı Area; so on.

(4) Formulation of Action Plan to Facilitate TOD in Yenikapı Area

TOD is a popular movement in world cities, but only few cases are observed in Istanbul so far. A model of TOD is represented by construction of a high-rise complex building

with rail-station, bus terminal, commercial/business facilities and residential functions. Assessing the highly strengthened intermodal and terminal functions of the Yenikapı Station, a great commercial potential will be born in and around the Station. Based on it, a new model of TOD will be possible to be materialized for maximizing passengers' convenience in association with:

- Urban Redevelopment in and around the Stations;
- Complex terminals of rails, buses, taxis and others and
- Shopping, business and tourist centers.

5.3 Expected Continuous Project for Next Step

IMM and the national government have ceaselessly been investing a tremendous amount of public funds in order to move chronic traffic congestions in the Istanbul Metropolitan. The Historical Peninsula, where more than 10 million tourists annually visit, is especially one of the most important destinations for such public investments. Therefore, a more intensive network of the metro system will be structured in the area. Along with the improvement of the public transport system, the area could enjoy sustainable economic development, if an appropriate transport policy is built and its actions are undertaken to maximize use of such vested infrastructures. Otherwise, the area would continuously shoulder environmental burden to be generated from unnecessarily increasing vehicle traffics.

The Project aimed to depict a sustainable scenario to reach the long-term goal, but its outcomes are not sufficient unfortunately. A number of planning issues, as discussed in the preceding section, still remain unsolved, and it is expected to tackle with those planning issues and formulate concrete action plans to realize the long-term vision, with JICA's successive technical supports.

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