

Marmaray - Connecting Istanbul's Asian and European side by railway

Istanbul, Turkey 

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The Marmaray railway public transportation system was opened in 2013 in Istanbul [1]. Transportation has been a major problem for Istanbul for many years, especially transportation between the two sides of the city - Asia and Europe - has been a real challenge. Before Marmaray has been implemented the two sides have been connected only by highways (2 Bosphorus bridges) and sea transit ferries. The high-tech construction methods used for the Marmaray project helped creating smart solutions for specific challenges in cities. The project was planned already back in 1860, however only today's technology made it possible to construct and operate it. In the further steps of the project, Marmaray will be connected to the existing railway system of the city [2]. It enables to pass the Bosphorus in 4 minutes and to transport 75,000 passengers per hour (Yenikapi station) [3].

Country/ City Profile

	Country		City	
	Population (2014)	78 million [4]	Population (2014)	14 million (metropolitan) [4]
	Land area (km ²)	783,562	Land area (km ²)	5,461 [6]
	GDP per capita (2014, US\$, at purchasing power parity)	10,830 [5]	GDP per capita (2008, US\$, at purchasing power parity)	14,591(metropolitan) [7]
	Region	Europe, Asia	Region	Coastal
City's physical geography	Location	<ul style="list-style-type: none"> ✓ Located in the north west of Turkey, Marmara Region ✓ The city extends over two continents; Europe and Asia, divided by the Bosphorus 		
	Climate	<ul style="list-style-type: none"> ✓ Mild wet winters, dry hot summers; average temperature : 13.5°C 		

Initiating context

Istanbul is the mega city of Turkey with a population of 14 million people. Increasing population has led to an increase in transportation demand. Transportation needs have led to more than 1.6 million cars [8]. The travel time and traffic congestion has been a major problem for daily life in Istanbul. Although investments in public transportation have increased in the city, the number of cars in the traffic makes congestion a significant problem. The Marmaray project was developed to overcome the traffic problem on the Bosphorus bridges. It aims to connect the European and Asian sides with a railway tube tunnel under the Bosphorus Strait. The construction of a tube tunnel and stations of the highway costed over USD 3 billion. The project is perceived as the backbone of the future city transportation system [8].

Project description

The project has three parts. The first part starts on the European side with a 19.6 km railway system. This part of the project consists of upgrading the existing system, including its modernisation and connecting it to the tunnel. The second part is the tunnel of a length of 1.4 km under the Bosphorus Strait. The last part is on the Asian side with a 43.3 km railway system, which is also upgrading the existing system and connecting it to the tunnel. The construction of the tube tunnel started in 2004 [8] and has been completed in 2013 starting to operate in the same year. The next steps will be connecting the tunnel to the European and Asian side's existing railway systems including their modernisation. The whole project - upgrading existing railway systems and connection - is expected to be completed in 2018. The Marmaray project is an example for other cities that reveals how high-tech construction methods can be used for specific challenges of cities. During the construction of Marmaray, ancient

layers were discovered. Those important findings enlightened the city history 8,500 years back from so far known history [9].

Implementation process

Projects implementation details

Process	The construction of the tube tunnel under the Bosphorus Strait started in 2004. It was completed and started to operate in 2013. The upgrading of the railway connection of the Asian and European sides of Istanbul is planned to be completed in 2018.
Leadership	The project is managed by the Ministry of Transport and the General Directorate of Railways, Harbours and Airports Construction [9].
Financing	1,25 billion € loan by the European Investment Bank [10], Japan Bank for International Cooperation (JBIC) with a 950 billion USD lump-sum credit, and the Council of European Development Bank (CEB) [9].
Involved stakeholders	Many experts and engineers from various countries are involved in this intercontinental project. All the staff from various different racial, cultural and religious backgrounds have devoted themselves to the project and work together towards a successful completion [9]. Contractors include the Taisei-Gama Nurol Joint Venture which consists of Taisei from Japan and the companies Gama and Nurol from Turkey as well as the Alstom-Marubeni Dogus Consortium, consisting of Alstom from France, Marubeni from Japan and Dogus from Turkey [9].

Results

The Marmaray project has the capacity to carry 75,000 passengers per hour in one direction and 1,200,000 passengers in a day. After Marmaray started to operate GHG emissions decreased by 425,000 tonnes. According to projections, CO₂ emissions are expected to decrease by 933,106 tonnes/year when the whole project operates. [11]. By reducing air pollutants it also contributes to the city's inhabitants health. Marmaray decreases the travel time of the two side connection which is now just 4 minutes from the station on the European side to the station on the Asian side. When the whole project is completed, the travel time from Halkali to Gebze (between first and last stations) will be 105 minutes, currently it is 180 minutes. [2]. The project also protects landscape and minimises the use of land and resources [8].

Lessons learned

Increasing population brings many challenges for mega cities. Istanbul has been suffering from traffic congestion and pollution because of high car usage. Public transportation is in principle the main solution, however the geographical conditions of the city, being divided into two sides by the Bosphorus was an obstacle. Improving technology finally provided a solution for connecting the two sides. The project was a major infrastructure project of Turkey and with its engineering challenges it brings important solutions to environmental problems. The Marmaray project not only helps to decrease traffic and travel time, but also leads to environmental and social improvements of the city by reducing air pollutants and being accessible to all.

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