



RAILWAY PROJECTS IN TURKEY

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Abstract: *The history of railways goes back to the Ottoman Empire. The development of railways in Turkey continued by 1950's when the government decided to develop road networks and railway lines were neglected. The aim of the railway authorities after 1950 is to ensure wheels turning. Therefore modal shift from railway to road transport has been in the favor of road transport for both passenger and freight traffic. This has resulted in higher transportation cost, environmental problems and traffic accidents problems. The government has realized the problem in 1990's and some projects have been developed to increase the share of railway in transportation. Unfortunately there has not been any project in action by 2002. After the general election in 2002, new government that is still on power has decided to invest on railway projects such high speed lines and Marmaray project. In the paper, Marmaray project, high speed lines which are still being constructed and at project level will be discussed.*

Key words: *railways, high speed lines, projects.*

HISTORY OF TURKISH RAILWAYS

First railway line of 130 km was started constructing in 1856 by a British company between Izmir and Aydın and took 10 years to complete. The reason of selection of this line was that the region was more populated and had a higher commercial potential [1]. British, French and German had separate influence zones in the territory of Ottoman Empire. The western capital holders constructed the railways to connect seaports in order to transport raw agricultural and textile products from the Ottoman Empire land to their region. Companies have privileges such as profit guarantee per km. Lines were constructed according to political and economical aims of the western countries.

Sultan Abdulhamit the 2nd who ruled the Ottoman Empire for 33 years between 1876 and 1909 mentioned in his memories that the purpose of railroad connection was to connect Mesopotamia and Baghdad to Anatolia and to

reach the Persian Gulf in order to find new markets for grain and mines [1]. Total 8 619 km length of railroad were constructed between 1856 and 1922 in the territory of the Ottoman Empire. The lines were in Table 1.

Turkish Republic which was founded in 1923 took over standard gauge line of 3 660 km and narrow gauge line of 70 km from the Ottoman Empire.

Turkish Railways saw golden years between 1923 and 1940 when Atatürk who is the founder of Turkish Republic was on power. The length of railroad network reached to 8 637 km. Time between 1940 and 1950 was "recessional term" for the railway. Starting from 1950 till now only 1871 km og length of railroad was opened to service. Length of the railway network is currently 10 984 km and 98.2% of the network is single line [2]. Main line length is 8 697 km and 440 km of the network is double line. Length of electrified line is 2 305 km and signaled line is 2 505 km. Currently 33 718 people are employed.

Table 1. Railroad lines constructed between 1876 and 1922 [1]

Railroad name	Length (km)	Gauge type
Rumelia Railways	2 283	standard
Anatolia- Baghdad Railways	2 424	standard
Izmir- Kasaba and extension	695	standard
Izmir- Aydın and branches	610	standard
Damascus- Hama and extensions	498	standard and narrow
Jaffa- Jerusalem	86	standard
Bursa- Mudanya	42	narrow
Ankara- Yahsihan	80	narrow

RECENT RAILWAY PROJECTS

Turkish government has decided to improve railway quality in Turkey after 2002 election. Six billion \$ has been invested to railway sector in four years time starting from 2002 which has had the largest railway investment in Turkey. The aim of the investments is to improve quality of rail service for both freight and passenger traffic so that modal shift can be achieved from road transport to rail transport. Some of the main projects are Ankara-Eskişehir-Istanbul, Ankara-Konya, Ankara-Sivas, Ankara-Izmir high speed lines, Marmaray which connects Asia and European continents with railway so that a train could travel from Europe to Asian countries without any interruption, Turkey- Georgia (Kars-Tiflis) railway line, Halkalı (Istanbul) – Bulgaria border railway line. Marmaray project are being built and hopefully completed in 2012. Ankara-Eskişehir high speed line have been almost completed and test drives on the line are still being continued. Tender of Eskişehir-Istanbul line has been completed two years ago, however some contractors went to Public Tender Board (KIK) after tender and it took a year to complete the process. The tender was gained by a consortium China and Turkey firms. First time in history China Government gives a credit to Turkey, therefore many paperwork has been carried out between Turkey and China government officers and in a short time the process will be completed. Projects of both Ankara-Izmir and Ankara-Sivas high speed lines were completed and the ministry of transport is on decision process about which one will be the first project to start.

Marmaray Project

Istanbul is the most populated city of Turkey. It is the center of industry, commerce, culture and education. One-fifth of economic production, one-fourth of motor vehicles in Turkey is within the border of Istanbul. Twelve million people travel daily. Apart from this Istanbul is a history treasure and many tourists come to see. Marmaray project is one of the biggest project of Transport Ministry of Turkey and it is not only important for people of Istanbul bit also important for other citizens in Turkey and European and Asian countries. During the construction special care is taken to save the history, environment and cultural heritage of Istanbul. The aim of the project is to develop uninterrupted metro line of 76.3 km from Halkalı in European side to Gebze in Anatolia side with high capacity, fast and environment friendly. It will also help transit rail freight traffic and passenger traffic from European continent to Asia continent and vice versa. Plan of the Marmaray project is shown in Figure 1.

The idea crossing Bosphorus with railway was first initiated in 1860. The technology at the time would not allow constructing tunnel under seabed and the design was changed to floating type of tunnel placed on pillars [3]. In 1902 the design was changed to a tunnel placed on the seabed [3].

Some challenges of Marmaray Projects are [3]:

- The deepest immersed tunnel have been built so far which is 58 m under the water surface.
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Figure 1. Plan of Marmaray project [3]

- The expectation is that the area will have an earthquake at the magnitude of 7.5 during the lifetime of Marmaray Project.
- Deep stations and tunnels will be constructed in the areas where civilizations have been existing for 7000 years. Therefore, saving the history is one of the main goals in the Project.

The construction process has to be carried out under sea water traffic where annual traffic of Bosphorus is approximately 50000 ferries and passenger boats. Therefore some

delays in water transport and bottlenecks in the traffic are expected.:

Marmaray Project consists of four different contracts. Engineering and Consultancy Services, Railways Underwater Tunnel Construction, Improvement of Gebze-Haydarpaşa and Sirkeci-Halkalı suburban lines-Civil Works, Electrical and Mechanical Systems, and Procurement of Suburban Lines Rolling Stock. General information about Marmaray Project is given in Table 2.

Table 2. Marmaray Project properties

Total length of line	76.3 km
Surface metro length	63 km
Number of surface stations	37
Total length of railroad Bosphorus Tube	13.6 km
Length of tunnel cut	9.8 km
Length of immersed tube tunnel	1.4 km
Length of open-close tunnel	2.4 km
Number of underground station	3
Length of stations	225 mt (minimum)
Number of passengers in a direction	75 000 passenger/h/one direction
Maksimum gradient	1.8 %
Maksimum speed	100 km/h
Commercial speed	45 km/h
Train frequency	2-10 minutes
Number of rail vehicles	440

Ankara-Eskişehir- Istanbul High Speed Line

The Project has started in 1994 as a rehabilitation of current Ankara-Eskişehir-Istanbul railway line

[4]. The aim of the rehabilitation was that widening horizontal curve radius so that speeds between 90 and 120 km/h would be possible and some sections of the line would be doubled. The

project was taken in investment program of the government, however, it was stated that the project would not meet future needs and after some time project completion, modifications would be necessary to increase the standards. Therefore any work was not carried out between 1994-1999. In 1999 Turkish State Railways found a credit to carry out rehabilitation project between Esenkent (Ankara)- Eskişehir to increase the speed 200 km/h on the line. In the project the line would be doubled and would be as close as possible to current line. However, the speed of high speed lines increased by the time on the world and it was decided to increase from 200

km/h to 250 km/h. Whereas the project has become “high speed train” rather than rehabilitation project in 2005. The contract was signed in 2000 and the construction started in 2004 [4].

The aim of the project is to shorten the travel time between Ankara-Eskişehir-Istanbul and to increase the comfort and safety. Current distance from Ankara to İstanbul 576 km, after finishing the high speed line construction the distance will become 533 km. Project characteristics are shown in Table 3. Distance between Esenkent (Ankara) and Eskişehir is 206 km.

Table 3. Ankara-Eskişehir high speed line characteristics [4]

Design speed	250 km/h
Minimum horizontal curves radius	3.500 m
Maksimum gradient	1.6 %
Ballast thickness	Minimum 0.3 m
Subballast thickness	0.20-0.30 m
Levelling layer thickness	0.35 m
Slope of ballast layer	1.5 horizontal/ 1 vertical
Width of ballast blanket	0.50 m
Distance between axes of lines	4.50 m
Rail type	UIC-60
Prestressed sleeper type	B70
Distance between sleepers	0.60 m

Since the current line between Ankara-Eskişehir-Istanbul will be in operation for freight trains and the high speed line is close to the current line, hence some points on both line coincide and the intersections are inevitable. The high speed line also pass through agricultural areas and residential areas, therefore, underground and overpass bridges for people, animals, and vehicles are important element of the project. Amount of cut and fill, number culverts and bridges constructed on the line are shown in Table 4.

Test drives between Esenkent (Ankara)-Eskişehir has still been being continued and it is hoped that the line will be in service for passenger transport at the end of the 2008.

Ankara- Konya High Speed Line

Konya is one of higher populated areas of Turkey. It has the largest area in Turkey and is also center of production of grain and industry. The current railway line via Ankara-Eskişehir-Afyon-Konya is 987 km and is currently 10 hours and 30 minutes and the high speed line is 320 km and will take 1 hour and 15 minutes. Therefore, it will shorten the travel time between Ankara and Konya. Distance between Ankara and Konya is 258 km by road transport. Therefore, both passengers and freight traffic use highway rather than railways. The line later will be integrated İstanbul-Ankara high speed line via Polath station and İstanbul- Konya will take 3 hours 30 minutes which is currently 12 hours and 30 minutes. Technical properties of the line is shown in Table 5.

Table 4. Construction works on Ankara-Eskişehir high speed line

Amount of cut	14.070.987 m ³
Amount of fill	9.805.704 m ³
Number of culverts	225
Number of channel culverts	18
Number of service culverts	10
Number of channel passages	4
Number of natural gas passages	7
Number of 800 mm radiu irrigation pipes	119
Number of underpasses	31
Number of overpasses	30
Number of river bridges	13
Number of railway bridges	4
Number of railway underpasses	2
Number of highway bridges	2
Number of viaducts	4
Tunnel	471 m length

Table 5. Technical properties of Ankara- Konya high speed line

Length of the line	306 km
Length of the line to be constructed	212 km
Number of line	2
Design speed	250 km/h
Axle load	22.5 tons
Minimum horizontal curve radius	6.500m
Maximum gradient	1.6 %
Maximum superelevation	130 mm
Vertical clearance	6.72 m
Rail type	UIC-60
Rail length	36 m
Prestressed monoblock concrete sleepers	B70

Table 6. Technical properties of Ankara-Sivas high speed line

Length of the line	466 km
Number of line	Double
Maximum gradient	% 1.6
Minimum horizontal curve radius	3.500 m
Design speed	250 km/h
Total tunnel length	9.722 m
Number of tunnels	8
The longest tunnel length	2.958 m
Number of viaducts	6
Total viaduct length	3.513 m
Number of bridges	88
Number of stations	14

Ankara- Sivas High Speed Line

Current distance between Ankara and Sivas is 602 km and travel time is 12 hours. It is one of important chain of east- west corridor and the distance will be 466 km. and the travel time will

be three hours. As the standart of the line which double line is higher than previous one which is single line the capacity of railway between two cities will be increased from both passenger and freight traffic. Technical properties of the line is shown in Table 6.

Ankara- İzmir High Speed Line

Current distance between is 824 km and travel time is 14 hours. New high speed line will be 658 km via Manisa and 621 km via Mustafa Kemal Paşa. Travel time via Manisa will be 3 hours 50 minutes and via Mustafa Kemal Paşa 3 hours 20 minutes. The project has completed and now it is at right of way stage.

Halkalı (Istanbul)- Bulgaria Line

Turkey is a bridge from transportation view point between Asia and European continents. The line will be double and be in European standards. With the completion of the project, the line is started from Kapıkule ,which is border of Turkey with Bulgaria, to Tiflis (Georgia) and Azerbaijan via Istanbul-Ankara- Sivas- Erzincan- Erzurum-Kars. The line is at project level and it is hoped that the project will be finished at the end of 2007.

Kars- Tiflis- Bakü Railway Line

Railway link between Turkey and Middle Asia was broken in 1993 because of the war between Azerbaijan and Armenia. In order to establish the link again Kars- Tiflis- Baku corridor was chosen. The length of line is 105 km . 76 km of the line which is between Kars and Georgia border will constructed by Turkish Government. The infrastructure is suitable for double line, but for the time being the line will be constructed as single line. Georgia will construct 20 km line with Azerbaijan credit and rehabilitate 160 km

length of railway network. The project is expected to finish in 2010 and the target is to carry 500.000 passengers annually and 3 million ton freight annually.

CONCLUSIONS

Railway projects were neglected in Turkey since 1950. However, after 2002 the government has decided to invest to the railway projects to balance modal shift for passengers. High speed lines are being built in Turkey mainly connecting high populated cities such as Ankara-Eskişehir-Istanbul, Ankara-Konya, Ankara-İzmir, Ankara-Sivas. There is also Marmaray project that interests both Asian and European countries as well as Istanbul for urban transport. There also projects connecting neighbor countries such as Georgia and Bulgaria. In the near future both countries will be very close to Turkey.

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ЖЕЛЕЗОПЪТНИ ПРОЕКТИ В ТУРЦИЯ

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***Резюме:** Историята на железниците в Турция датира от периода на Отоманската империя. Развитието им продължава до 50-те години на миналия век, когато правителството решава да развива автомобилния транспорт, а железопътните линии са пренебрегнати. Целта на железопътните администрации е да осигурят движението. Следователно прехвърлянето на превозите от железниците към автомобилният транспорт е в полза на последния, както за пътническия, така и за товарния трафик. Това доведе до високи транспортни разходи, проблеми с околната среда и катастрофи. Правителството осъзна проблемът през 90-те години на миналия век и разработи няколко проекта, за да увеличи дела на железниците в транспорта. За съжаление няма нито един проект в процес на реализация до 2002 г. След изборите през 2002 г. новото правителство реши да инвестира в железопътните проекти като тези за високоскоростни линии и проекта „Marmaray”. Докладът разглежда проектите, които все още са в процес на осъществяване.*

***Ключови думи:** железници, високоскоростни линии, проекти.*