

## Turkey

### Golden Horn Bridge Repair and Widening Project

Report date: March 2001

Field survey: September 2000

#### 1. Project Profile and Japan's ODA Loan



Site map: Istanbul, the Republic of Turkey



A view of the Golden Horn Bridge from the Old City

#### 1.1. Background

The Golden Horn Bay divides the European side of Istanbul into two major areas: the Old City, the location of government offices and commercial districts, and the New City, which is mainly residential. There are only three bridges, including the Golden Horn Bridge, spanning Golden Horn Bay. A survey conducted in December 1989 indicated that the Golden Horn Bridge, which is located on European Highway No. 5 (E-5), one of the principal roads in Turkey, accounted for nearly half of the total traffic volume for the three bridges. In 1990, the traffic volume for the Golden Horn Bridge was over 1.5 times greater than predicted at the time of planning, and 2-way congestion persisted for around 10 hours a day. Since the traffic volume for the bridge was expected to continue growing, it was necessary to widen the bridge to reduce congestion.

Sixteen years had elapsed since the existing Golden Horn Bridge was constructed with Japan's technical and financial assistance in 1974. Due to the greater than anticipated increases in traffic volume and vehicle weight as well as other factors, however, the steel portion of the bridge had been heavily damaged, necessitating immediate repair.

#### 1.2. Objectives

One objective of the project was to repair the Golden Horn Bridge on the trunk road that runs through the city of Istanbul in order to maintain its functions. Another was to reduce congestion and ensure smooth road transport by widening the bridge and taking other measures, thus contributing to greater efficiency in economic activities in the region involved and its revitalization.

### 1.3. Project Scope

The project comprised (1) a detailed inspection of the existing bridge and repairs to the upper section, (2) constructing two new 955-meter-long, 12.1-meter-wide, two-lane bridges—one on each either of the existing structure—using steel-box and PC concrete girders, (3) improving the interchanges located at both ends of the bridge, and (4) widening the access roads and improving the intersections. ODA loan covered all project costs quoted in foreign currency and part of those quoted in local currency.

### 1.4. Borrower/Executing Agency

The Republic of Turkey/General Directorate of Highways (KGM), Ministry of Public Works

### 1.5. Outline of Loan Agreement

Loan amount/Loan disbursed amount	¥13,763 million/¥11,763 million
Exchange of notes/Loan agreement	April 1991/April 1991
Terms and conditions	Interest rate: 2.9%, Repayment period (grace period): 25 years (7 years), General untied
Final disbursement date	January 1999

## 2. Results and Evaluation

### 2.1. Relevance

The Golden Horn Bridge occupies a highly significant position in Istanbul in that it connects the Old and New Cities in Turkey's the center of industry and commerce and that it is situated on European Highway No. 5 (E-5), an important international road. KGM continues to position the maintenance and repair of the section of the E-5 that runs through the country<sup>\*1</sup> as one of its most important tasks and to promote repair and improvement of the highway utilizing overseas loans. Thus the project remains relevant.

### 2.2 Efficiency

#### (2.2.1.) Project Cost

The actual project cost was ¥13.756 billion, 27.6% lower than the ¥18.998 billion estimated at the time of appraisal. This was due to the increasing appreciation of the yen against the Turkish Lira. For this reason, the amount of loan disbursement was ¥11.763 billion, 14.5% lower than the approved loan amount ¥13.763 billion.

#### (2.2.2.) Implementation Schedule

The completion of the project was initially scheduled for February 1994, but actually

<sup>\*1</sup> The Turkish section of the E-5 is called the "Trans-Turkey Highway."

occurred in June 1998, four years and three months later than planned. This was due to delays in the evaluation of bids tendered and in contract negotiations, which held back the selection of contractors and consultants by 19 and 40 months, respectively. It was also caused by the entire construction period being extended by 19 months; the project actually took 50 months to complete as compared to the 31 months initially predicted.

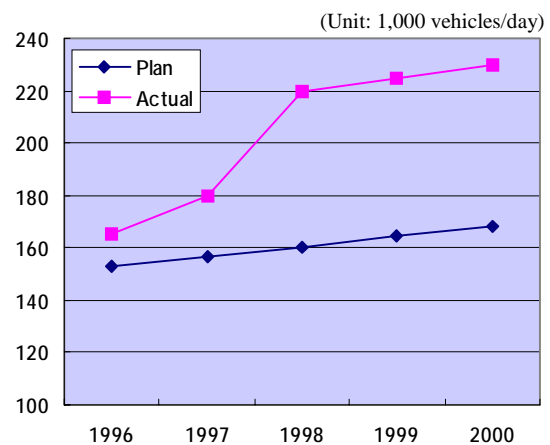
The reasons for the prolonged construction period included the following: (1) At inspection, the lower section was found to be more heavily damaged than expected and required longer to repair (48 months as compared to the predicted 19 months), (2) the construction section on the New City side was extended by 300 meters to improve road alignment and connect the road to the Okmeydani Interchange, and (3) conforming with the requirements of the Turkish law governing the conservation of historical structures was time-consuming and resulted in partial rerouting of the road.

### 2.3. Effectiveness

#### (2.3.1.) Meeting Traffic Demand and Reducing Congestion

On completion, in 1998, the traffic volume for the Golden Horn Bridge grew by 22.2% as compared to the previous year, a steady and significant increase exceeding the annual traffic growth rate of 2.4% initially predicted. This was because large goods vehicles (HGVs), which were formerly prohibited from using the Golden Horn Bridge, were now permitted to pass the bridge, although limited to the new structures, and because reduced congestion in the vicinity probably encouraged traffic on other routes to shift to the bridge route.

Despite the increased traffic volume, increases in the number of lanes both ways from six to ten, and widening of access roads reduced congestion during rush hours. The time required for traveling the approximately 3.5-km section from the Edirnekapi Interchange to the Okmeydani Interchange was reduced by approximately 15 minutes at peak times, and 10 minutes on average, as compared to the 12 minutes initially predicted (see Table 1).



**Figure 1 Changes in Annual Average Daily Traffic Volume**

**Table 1 Comparison of Forecasts & Actual Results**

Indicator		1996	1997	1998 (project completion year)	1999	2000
Annual average daily traffic volume (1,000 vehicles/day)	Actual results	165	180	220	225	230
	Forecasts	153	157	160	164	168
Time required for traveling the Edirnekapi-Okmeydani section* (minutes)	Normal time	15	15	5	5	5
	Peak time	25	25	12	10	10
Average driving speed for the Edirnekapi-Okmeydani section** (km/h)	Normal time	13.7	13.7	41.1	41.1	41.1
	Peak time	8.2	8.2	17.1	20.5	20.5

\* Estimates by the 17th branch office

\*\* The average driving speed is calculated based on the time required.

**(2.3.2.) Repair of the Existing Bridge**

The existing bridge was originally completed in July 1974 using a Japan ODA loan and was opened for traffic in September of the same year. When this project was started, some 20 years had elapsed since initial construction. Under this project, a detailed inspection of the existing bridge implemented prior to repair work revealed more serious damage than initially expected. Examples included the numerous cracks discovered in the supports and welded steel troughs, and heavy damage identified in some of the materials in the expansion and contraction systems. This damage was mainly the result of greater increases in traffic volume than initially predicted. Repair work was performed during the daytime with the bridge open to traffic, and in addition to the reinforcement and replacement of the components mentioned above, the lateral girders were fully reinforced and re-painted. Although the cost of repairing the existing bridge accounted for only about 10% of total costs, it is believed that the work involved was comparable to the construction of new bridges in terms of both difficulty and necessity<sup>\*2</sup>. It has been reported that the



**Figure 2 Position of Roads and Bridges in Istanbul**

<sup>\*2</sup> Matsuzawa, Kudo & Yanagihara, "Rehabilitation of Golden Horn Bridge," *Bridge and Foundation*, December 1999

great earthquake, which occurred in western Turkey in August 1999, caused no damage to the existing and new bridges.

### **(2.3.3.) Recalculation of the Economic Internal Rate of Return (EIRR)**

The results of recalculation indicated that the EIRR for the project was 21.67%, significantly higher than the 13.9% obtained at the time of appraisal. This was due to a shift in traffic volume from other routes to the bridge route, causing the actual traffic volume for the bridge to exceed that initially predicted and in addition, the total cost was reduced as compared to that quoted at the time of appraisal.

## **2.4. Impact**

### **(2.4.1.) Greater Efficiency in Economic Activities and Distribution in the City**

As a result of reductions in congestion produced by the project, smooth traffic flow was achieved between the residential areas on the Asian side and the government, commercial and industrial districts in the northern and southwestern areas on the European side, contributing to reductions in commuting time and greater efficiency in economic activities.

Although the Golden Horn Bridge is located on the E-5, an important international road, HGVs were prohibited from using the bridge because they might exceed the design active load for the existing bridge and cause congestion. With the completion of the project, however, permission was granted for HGV use, though limited to the new structures, enabling HGVs, which had theretofore been forced to detour around the bridge, to take the shortest route, facilitating international and intercity distribution.

### **(2.4.2.) Technology Transfer Effects**

Steel and other materials used for the upper structure of the new bridges were manufactured at a local plant under instruction from a Japanese contractor. New bridges were also constructed locally under the direction of the same Japanese contractor. In addition, technical transfer to local companies and the executing agency was achieved via the technologically difficult repairs to the existing bridge.

### **(2.4.3.) Environmental Impact**

Reduced congestion helped reduce atmospheric pollution caused by low-speed driving and idling. Grass and trees were planted on both sides of the bridge in consideration of the surrounding landscape.

### **(2.4.4.) Impact on Historical Structures**

Castle walls and a cemetery from the Constantinople period stand adjacent to part of the access road, Savaklar Street. When the detailed design was drawn up, necessary steps were taken in accordance with the Turkish law pertaining to the

conservation of relics to choose a route that would minimize the impact on the castle walls. Relocation of 580 headstones was unavoidable but they were carefully transferred with no damage incurred. In this way, the impact of the project on historical structures was minimized.

## **2.5. Sustainability**

### **(2.5.1.) Operation and Maintenance**

KGM, the agency executing the project, operates and maintains roads and bridges through its head office, 17 branch offices, 112 operation and maintenance offices and 365 local offices. The first to 16th branch offices are responsible for their 16 respective districts, with Istanbul falling under the jurisdiction of the first branch office. In addition, a 17th branch office, which operates and maintains the Golden Horn Bridge, was established in 1967 to design, construct, operate and maintain automotive roads and large bridges in and around Istanbul. The 17th branch office currently has 1,208 employees of which 503 are responsible for administration, 177 are skilled workers (including 51 engineers), 521 are workers and seven are responsible for other operations. The operation and maintenance of the Golden Horn Bridge is mainly undertaken by the Cavacik operation and maintenance office and the Golden Horn Bridge local office under the control of the 17th branch office. Personnel at the Cavacik office consist of 30 skilled workers, including three engineers, and 72 administrative officers, and maintenance equipment is stored in the office. Local offices are storehouses for construction materials, but one employee is stationed at the Golden Horn Bridge local office at all times.

### **(2.5.2.) Budgeting for Operation and Maintenance**

The 17th branch office requests budget allocation in accordance with its annual plans, and the KGM usually approves approximately 70% of the sum requested. There has been no particular problem with budgeting to date.

The restoration of roads and bridges damaged by the earthquake in August 1999 is being undertaken using financial assistance from overseas. Accordingly, these demands do not appear to have had a major effect on the operation and maintenance budget allocations to the 17th branch office.

### **(2.5.3.) Sustainability**

The 17th branch office executes the operation and maintenance of the First and Second Bosphorus Bridges and has abundant experience in this area, so no particular problems are anticipated in terms of sustainability.

## Comparison of Original and Actual Results

Item	Plan	Actual results
1. Project scope	<ul style="list-style-type: none"> <li>· Existing bridge               <ul style="list-style-type: none"> <li>· Detailed inspection</li> <li>· Repairs to upper section</li> </ul> </li> <li>· Construction of new bridges               <ul style="list-style-type: none"> <li>· New western bridge Total length: 995 m Width: 12.1 m Number of lanes: 2</li> <li>· New eastern bridge Total length: 995 m Width: 12.1 m Number of lanes: 2</li> </ul> </li> <li>· Widening of the access road               <ul style="list-style-type: none"> <li>· Widening of Halicioglu~ Okmeydani road East: 4 lanes → 5 lanes West: 3 lanes → 4 lanes</li> <li>· Widening of Savaklar Street</li> </ul> </li> <li>· Improvement of interchanges               <ul style="list-style-type: none"> <li>· Ayvansaray Interchange Construction of a new Savaklar Street~E-5 road</li> <li>· Halicioglu Interchange</li> </ul> </li> <li>· Consulting services (612 M/M)</li> </ul>	<ul style="list-style-type: none"> <li>· Existing bridge               <ul style="list-style-type: none"> <li>· Same as left</li> <li>· Repairs to upper section</li> <li>· Repairs to lower section</li> </ul> </li> <li>· Construction of new bridges               <ul style="list-style-type: none"> <li>· New western bridge Total length: Same as left Width: 11.0 m Number of lanes: Same as left</li> <li>· New eastern bridge Total length: Same as left Width: 11.0 m Number of lanes: Same as left</li> </ul> </li> <li>· Widening of the access road               <ul style="list-style-type: none"> <li>· Widening of Halicioglu~ Okmeydani road Same as left Same as left</li> <li>· Not implemented</li> </ul> </li> <li>· Improvement of interchanges               <ul style="list-style-type: none"> <li>· Same as left</li> <li>· Same as left</li> </ul> </li> <li>· Consulting services (706 M/M)</li> </ul>
2. Implementation schedule	May 1991 to February 1994 (31 months)	May 1994 to June 1998 (50 months)
3. Project cost		(Source: Data provided by KGM)
Foreign currency	¥10,220 million	¥11,751 million
Local currency	TL178,408 billion	TL1,030.57 billion
Total	¥18,998 million	¥13,756 million
ODA loan portion	¥13,763 million	¥11,763 million
Exchange rate	TL1.00 = ¥0.0492 (1990)	TL1.00 = ¥0.00195 (1995)