

# Golden Horn Bridge

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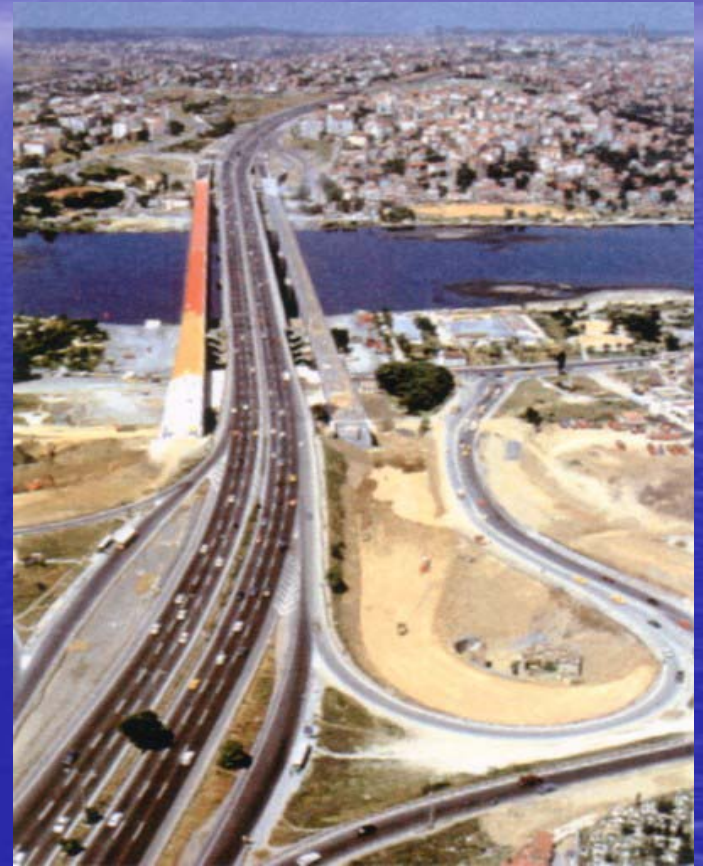
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# Introduction

- Our project is to research the repair of the Golden Horn Bridge, which located in Turkey. And our presentation is divided into 7 parts.
- Part 1 and 2 are introducing some basic information about the Golden Horn Bridge. Part 3, 4 and 5 are mainly talking about the bridge's problems and some of the alternatives that are out there to fix the bridge. To help decide on the best alternative static and economic analysis was applied and the results are shown in part 6. Finally, we will give the conclusion and evaluate the whole project in part 7.

# Background of the Bridge

- The Golden Horn Bridge is one of only three bridges in Turkey. In 1974, with the technical and financial assistance of Japan, the bridge was built on Golden Horn Bay and also on the European Highway No.5, which is the most important Highway in Turkey. The Golden Horn Bridge divides Istanbul, the Metropolitan Municipality in Turkey, into two parts. One side is government offices and the commercial districts, and the other side is mainly residential.



# Problem Statement of the Bridge

- **Traffic volume**
- The Golden Horn Bridge is the most important bridge in Turkey, but it has taken over 1.5 times the traffic volume it was constructed to hold. Because of this, the bridge is often congested over 10 hours in one day. For this reason, the bridge should be widened with the hope of reducing the congestion on the bridge and ensuring a smooth transport, which will make the bridge more useful and efficient in all economic activities.



[http://www.tanngethong.com/Istanbul/istanbul\\_and\\_the\\_seven\\_churches\\_.htm](http://www.tanngethong.com/Istanbul/istanbul_and_the_seven_churches_.htm)



<http://www.enka.com/motorway.asp>

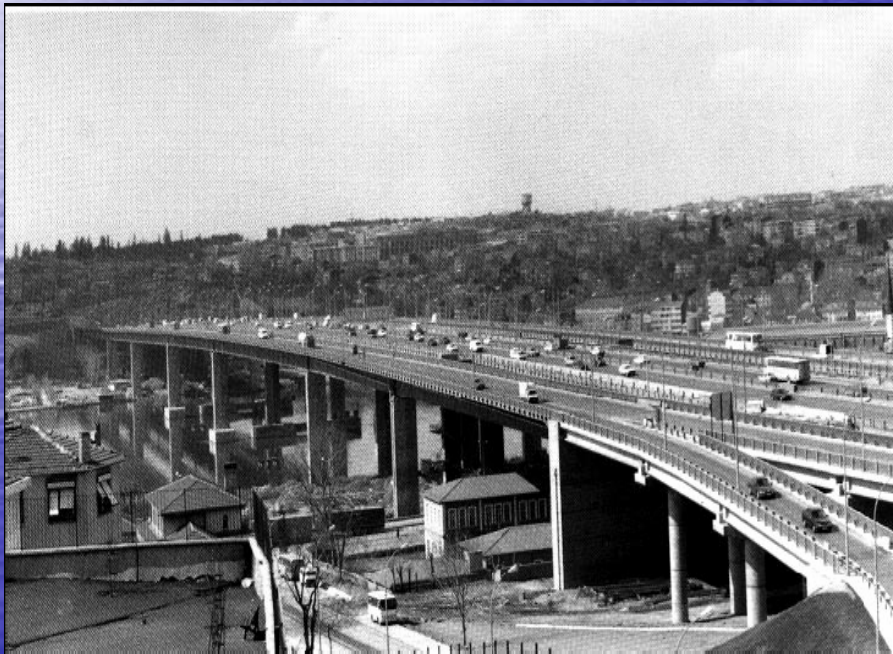
Indicator		1996	1997	1998 (project completion year)	1999	2000
Annual average daily traffic volume	Actual results	165	180	220	225	230
	Forecasts	153	157	160	164	168
Time required for traveling the Edirnekapi-Okmeydani section* (minutes)	Normal time	15	15	5	5	5
	Peak time	25	25	12	10	10
Average driving 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

# Corrosion

- Additionally, with the development of Turkey, the increase of the dumping liquid and solid waste from the residential buildings and industry into the shore of the Golden Horn has increased. This is bad because phosphorus, nitrogen and chlorine such as the  $\text{NH}_3\text{-N}$ ,  $\text{NO}_3\text{-N}$ , TP and dissolved things such as  $\text{PO}_4\text{-P}$  amounts have increased in the water. These substances are damaging a bridge that is already corrupt.

# Alternatives of Repairing the Bridges

- A. widen the bridge to reduce the congestion



- Everyone knows that every bridge has their own useful life, so it's not common for the bridge to be widened. Sometimes the methods of widening the bridge are to add lanes or add the decks. Either of these methods will increase the capacity of the Golden Horn Bridge.

For the Golden Horn Bridge, it has been suggested that two 995-meter-long, 12.1-meter-wide side bridges be built. One of them is on the existing bridge, and the other will be constructed using steel-box and PC concrete girders. When the widening is completed, the traffic volume will have grown 22.2%, the total traffic will grow 2.4% as before.

## B. Repaint to prevent corrosion



- The Golden Horn Bridge is built on the Golden Horn Bay where there are superfluous chloride ions in the water. These ions cause the onset of the corrosion in the concrete structure. To avoid corrosion, galvanized coatings should be used to protect the steel. Another method to protect the bridge from corroding is to stop the chloride ions from ever contacting the bridge. In order to do this, the Golden Horn Bridge should be constructed with noncorroding materials, and the anchorage areas should be protected by using some impermeable materials. These methods should protect the concrete in the water, and all these methods can reduce the rate of the corrosion.

Fig. painting



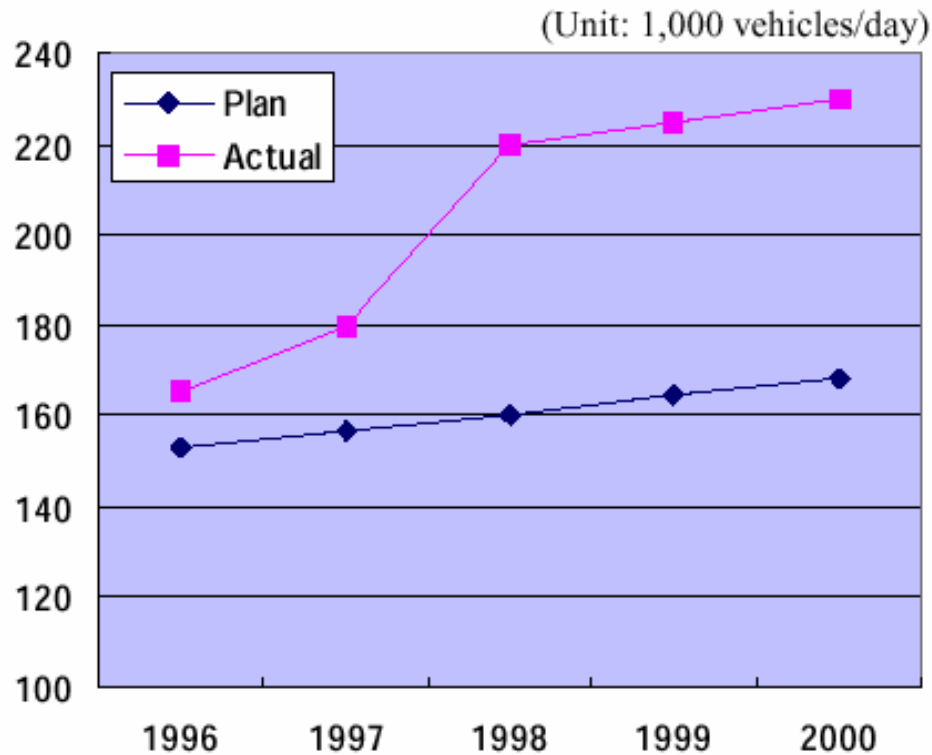
# Cost

- **Calculate EUAC for each alternatives**
- **Alternatives**
  - **Simply repair the bridge and make no further improvements.**
  - **Build a completely new, but larger bridge.**
  - **Repair the current bridge and build an addition on the side.**

# Rebuild

- Will Cost 10% of current project equaling  
13.756 billion(yen)\*(.1)= 1.3756  
billion(yen)/ 117.68(*conversion rate*) = \$11,689,326.00
- The repaired bridge will not last as long as what was presently there.
- Only fixes one of the two problems and just is not a suitable plan.

# Traffic Statistics



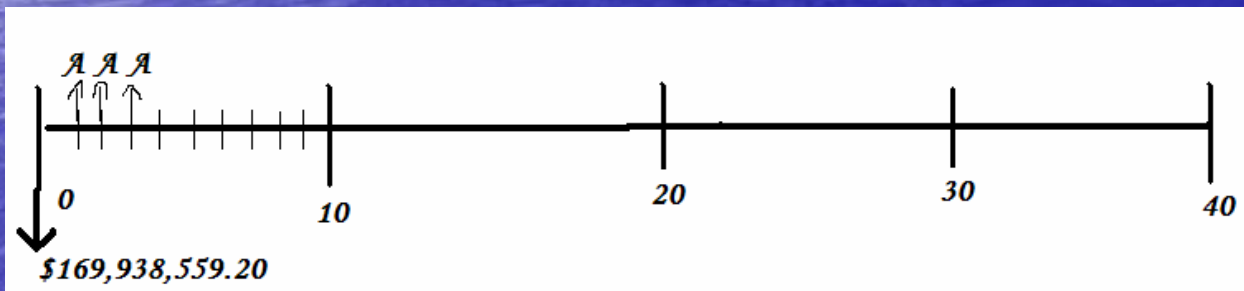
**Figure 1 Changes in Annual  
Average Daily Traffic Volume••**

# New Bridge *(twice as big)*

13.756 billion\*(.9)= 12.238 billion(yen)(90% of the current project) / (117.68)(conversion rate)=  
\$103,993,881.70

- The cost of two new two lane bridge would be
- Power sizing exponent 0.70 (estimated)  
=\$168,938,559.20

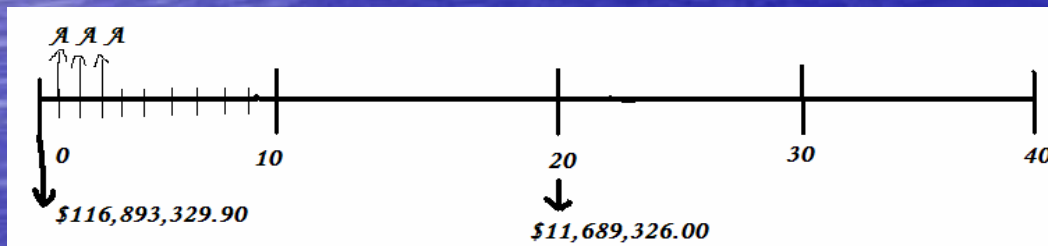
$$\frac{X}{104\text{mill}} = \left(\frac{2}{1}\right)^{.7}$$



- **EUAC=\$168,938,559.20(A/P,3,40)=  
\$7,315,039.61**

# Repair and Build an Addition

- The old bridge just had some joint, steel and concrete problems that were caused by excessive loads. Repairing these problems is nothing new and should not be too difficult.
- Repairs are \$11,689,326.00 and will be needed again in 20 years. (estimated)
- New bridge and repairs = \$116,893,329.90 with an extra \$11,689,326.00 added 20 years later.



- **EUAC=**  
 **$(\$116,893,329.90 + \$11,689,326.00(P/F, 3, 20))^*$**   
 **$(A/P, 3, 40) = \underline{\underline{\$5,341,735.23}}$**

# Impact

- Environment Impact
  - Repairing the bridge
    - No need to clear other areas of land for new bridges.
    - Will not reduce traffic so it will not reduce pollution

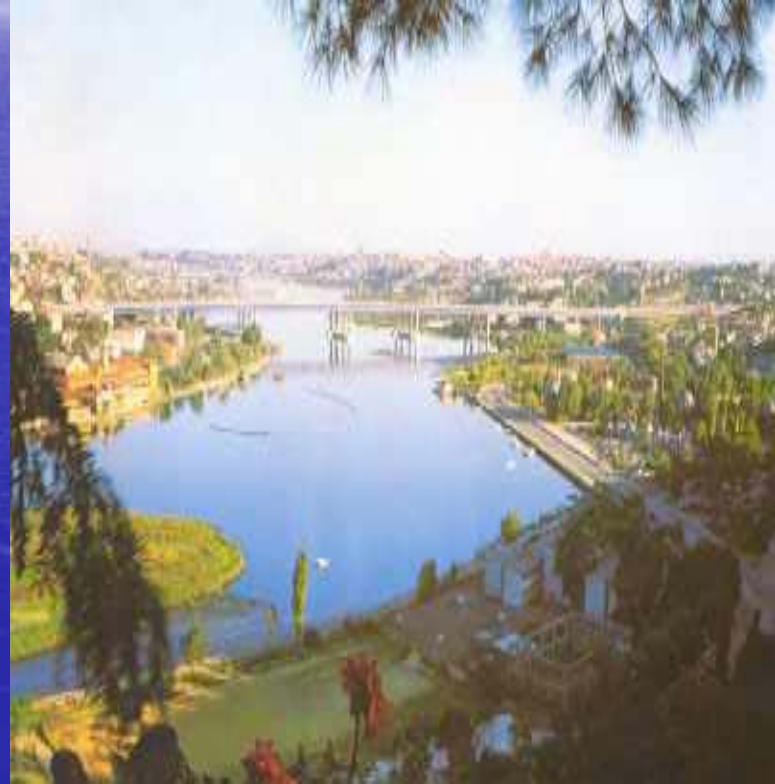
# Environmental Impact



- Widening the bridge
  - Reduce air pollution
  - Grass and trees planted on sides of bridge improve landscape

# Environmental Impact

- New bridges
  - Reduce air pollution
  - Need to clear new areas of land in order to build roads and bridges





# Greater efficiency in economic activities

- Smooth traffic flow will be achieved thus shorter commuter times and greater efficiency.
- International and intercity distribution will be more efficient because HGV's will be allowed on the bridge.



# Impact on historical structure

- Castle walls and a cemetery from Constantinople period stand next to access road. Several headstones will need to be relocated and several steps need to be taken in order to minimize the impact on the castle walls



# Conclusion



- The research project basically discusses the overall process in repairing the Golden Horn Bridge, which is one of the most crucial highways in Turkey. Being the core of the transportation services in Turkey, several problems arise which is extreme congestion and severe infrastructure corrosion due to damage to the steel created by the electrochemical reaction with its environment.
- In order to solve the problems, two alternatives are suggested which are widening the bridge to decrease congestion and offering coatings for corrosion protection.
- These alternatives were analyzed economically, environmentally, and historically to generate most beneficial bridge.

# Thank you

- Reference

- [http://www.jbic.go.jp/english/oec/post/2001/pdf/e\\_project\\_75\\_all.pdf](http://www.jbic.go.jp/english/oec/post/2001/pdf/e_project_75_all.pdf)
- [http://ihins.ihi.co.jp/ihi/file/technologygihou2/10008\\_9.pdf](http://ihins.ihi.co.jp/ihi/file/technologygihou2/10008_9.pdf)
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- [http://www.tanngethong.com/Istanbul/istanbul\\_and\\_the\\_seven\\_churches.htm](http://www.tanngethong.com/Istanbul/istanbul_and_the_seven_churches.htm)
- <http://www.enka.com/motorway.asp>