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TRANSPORTATION ENGINEERING/COASTAL& HARBOUR ENGINEERING/HYDRAULIC ENGINEERING

Edited by

Özgür Eren
Abdulrezak Mohamed
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Preface

The first *Congress on Advances in Civil Engineering* was held at the Eastern Mediterranean University (EMU), Gazimağusa, Turkish Republic of Northern Cyprus in 1993, at the initiative of the Civil Engineering Departments of the Middle East Technical University (METU), Ankara, Turkey and EMU. It was then decided that such conferences would be repeated every two years. Thus, second congress took place at Bosphorus University (BU), İstanbul, Turkey in 1995. The third (1997), fourth (2000), fifth (2002), sixth (2004), and seventh (2006) congresses were held by METU, EMU, İstanbul Technical University (İTU), BU, Yıldız Technical University (YTU), respectively.

As its title implies the congress is intended to be a forum for discussion of advancements taking place in the field of civil engineering. Therefore, it is open to researchers and practitioners alike who wish to present and thus share their contributions in all aspect of civil engineering, with interested colleagues. International constribution to the congress has resulted in more than 200 international papers from more than 20 different countries from all parts of the world. We hope that all participants will benefit from the dissemination and share of knowledge and experience, and also use this occasion for social interaction for the enhancement of a better and more peaceful world.

The papers presented during *ACE2008 The 8th International Congress on Advances in Civil Engineering* are collected in four volumes. Contribution of keynote speakers Dr. A G Razaqpur, Dr. C H Benson, Dr. D Arditi, Dr. N P Banthia, Dr. O Akan, Dr. R Machemehl and Dr. R McCaffer to the congress is greatly acknowledged. We would like to thank our sponsors, and all the exhibitors for their interest and encouragement of this congress. We must thank the members of our Organizing Committee members A Günyaktı, E Soyer, H Bilsel and M Kunt, Scientific Commitee members, and Advisory Committee members E Güler, H Bilsel, M Aydoğan, T Tankut and Y Yüksel for their help before and during the congress. All research assistants (A H Payab, A Iravanian, A Khanlou, F Ibisevic, Ö Güçveren, G Erhan, H Yalçıner, T Yardımcı, O Onuaguluchi, A A Hedayat, J N Awwad, S Khorram, Y Baalousha), Departmental secretary B Balses, Departmental administrator H İnan, must be particularly mentioned for their hard work. And, last but not least we thank all the the authors and participants who came to Gazimağusa from all parts of the world and contributed in realization of a successful congress.

A. N. H. Mohamed Ö. Eren

15 September 2008,
Gazimağusa

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Transportation Engineering

Technical Papers

Investigation of Travel Time Reliability between the Origin and the Destination Points of Kozyatagi and Okmeydani

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Abstract

Travel time is one of the most important measures of transportation systems performance and service quality. Other measures such as fuel consumption, vehicle emissions, and accidents are related to travel time. Travel Time Reliability is defined; ability of travelers to predict travel time for a trip and to arrive at destination within an "on-time window" (Margiotta, 2002). Measured by how travel time of a trip varies from one time period to another.

In this study, the definition and the computation methods of travel time reliability are presented together with the literature review. Also, an investigation is conducted on travel time reliability the origin and the destination points of Kozyatagi and Okmeydani driving on Bosporus or Fatih Sultan Mehmet (FSM) Bridges respectively. As a result, some suggestions are introduced for Istanbul to improve the travel time reliability.

Average Travel time between Kozyatagi and Okmeydani are 46.3 min. driving on Bosphorus Bridge route and 38.9 min. Driving on FSM (Fatih Sultan Mehmet) bridge route during morning peak period. During this time, 90% reliable travel times are computed as 62 min. for Bosphorus Bridge route and 48 min. for FSM Bridge route. In other words, if the traveler wants to be 90% reliable at the scheduled meeting during the weekday peak period, he/she has to drive 16 min. for Bosphorus Bridge route and 9 min. for FSM Bridge route in advance before the expected travel time between Kozyatagi and Okmeydani.

Keywords: *travel time, travel time reliability, buffer index, planning time index.*

1 Introduction

Travel Time Reliability is defined; ability of travelers to predict travel time for a trip and to arrive at destination within an “on-time window”. Measured by how travel time of a trip varies from one time period to another. In other words, reliability is measured as the variability of travel times. Travel time reliability is a great concern by public and so by the agency it is desire to improve the travel time reliability along with the reducing travel time (Margiotta, 2002).

Sources of Reliability and causes of travel time’s vary are incidents, special events, work zones, weather, day-to-day demand (volume) fluctuations, traffic control devices and inadequate base capacity. In reality we add a lot of thinks that is important on the travel time reliability but important things are how much is effective on the travel time reliability.

The most effective methods of measuring travel time reliability are 90th or 95th percentile travel times, buffer index, planning time index. Several statistical measures, such as standard deviation and coefficient of variation, have been used to quantify travel time reliability.

In this study, the definition and the computation methods of travel time reliability are presented together with the literature review. Also, an investigation is conducted on travel time reliability the origin and the destination points of Kozyatagi and Okmeydani driving on Bosporus or FSM Bridges respectively. As a result, some suggestions are introduced for Istanbul to improve the travel time reliability.

2. Definition and Effective Variables of Travel Time Reliability

Travel Time Reliability is defined; ability of travelers to predict travel time for a trip and to arrive at destination within an “on-time window”. Measured by how travel time of a trip varies from one time period to another. In other words, reliability is measured as the variability of travel times (FHWA, 2004).

Travelers want travel time reliability—a consistency or dependability in travel times, as measured from day to day or across different times of day. Drivers want to know that a trip will take a half-hour today, a half-hour tomorrow, and so on. Most travelers are less tolerant of unexpected delays because such delays have larger consequences than drivers face with everyday congestion (FHWA, 2005)].

Timely, reliable goods movement allows businesses to reduce manufacturing and inventory costs and to improve responsiveness to rapidly changing markets and consumer desires (FHWA-HOP-05-036, 2005).

Sources of Reliability and causes of travel time’s vary are (FHWA, 2004).; Incidents, Special events, Work zones, Weather, Day-to-day demand (volume) fluctuations, Traffic control devices (RR crossing, poor signal timing) and Inadequate base capacity

And also, we could add some other effects that causes of travel times vary, are; configuration of traffic flow, on time level of service (LOS), number of lanes, median type, classification of road. In reality we add a lot of thinks that is important on the travel time reliability but important things are how much is effective on the travel time reliability.

Experience tells us that incidents can cause large delays. Researcher C. Chen, Eric van Zwet, et al. gathered incident information from the California Highway Patrol (CHP) website. Relationship of time of day and travel time with or without incident are depicted in Figure 1 by C. Chen, Eric van Zwet, et al (Chen, 2002).

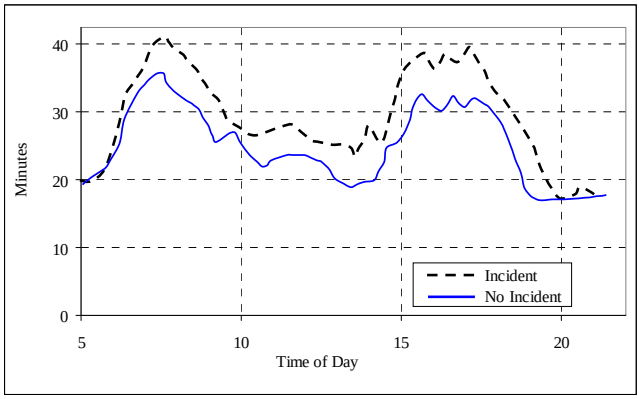

Figure 1. Travel times with and without incidents.

3. Measuring of TTR

The most effective methods of measuring travel time reliability are (FHWA, 2004); 90th or 95th percentile travel times, buffer index, and planning time index. Several statistical measures, such as standard deviation and coefficient of variation, have been used to quantify travel time reliability. However, they are not easy for a nontechnical audience to understand and would be less-effective communication tools. They also treat early and late arrivals with equal weight. But the public cares much more about late arrivals. Measuring methods and indexes are defined 90th or 95th percentile travel times, Buffer index, planning time index in reference (FHWA, 2004)

90th or 95th percentile travel times; This method, the 90th or 95th percentile travel times, is perhaps the simplest method to measure travel time reliability. It estimates how bad delay will be on specific routes during the heaviest traffic days. The one or two bad days each month mark the 95th or 90th percentile, respectively. Users familiar with the route (such as commuters) can see how bad traffic is during those few bad days and plan their trips accordingly.

Buffer index: The buffer index represents the extra time (or time cushion) that travelers must add to their average travel time when planning trips to ensure on-time arrival.

Planning time index: The planning time index represents how much total time a traveler should allow to ensure on-time arrival. While the buffer index shows the additional travel time that is necessary, the planning time index shows the total travel time that is necessary (see Figure 2).

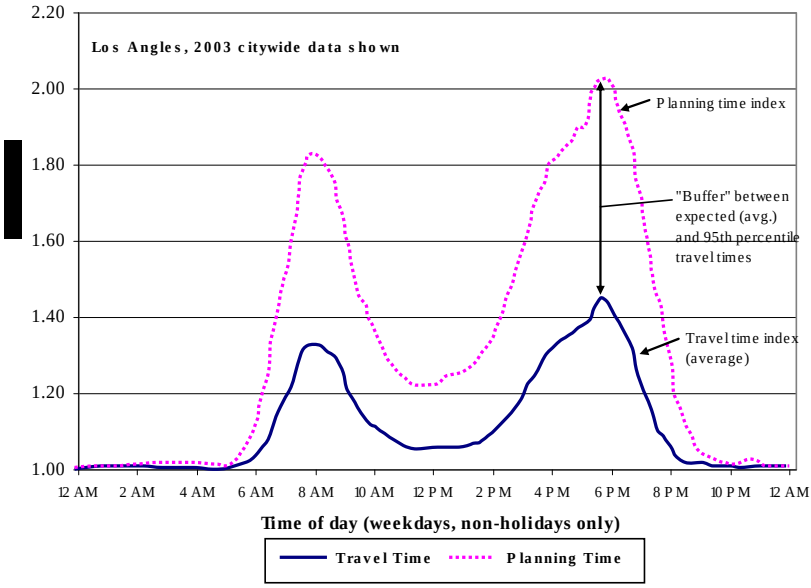

Figure 2. Reliability measures are related to average congestion measures *http://ops.fhwa.dot.gov/publications/tt_reliability/TTR_Report.htm#WhatisTTR*

4. Travel Time Reliability between Kozyatagi and Okmeydani

4.1. Definition of the Origin and the Destination Points of Kozyatagi and Okmeydani

In Asian side of the Istanbul, Bosporus and FSM bridges main roads are intersected in Kozyatagi, and in European side of the Istanbul, Bosporus Bridge main road and connection of the FSM Bridge Mahmutbey intersected in Okmeydani as shown in Figure 3. Bosporus and FSM bridges highway routes are there between Kozyatagi and Okmeydani as a connection of highway as seen in Figure 3. Respectively the length of the routes for Bosporus and FSM are approximately 17 and 29 km. If free flow speeds are assumed 80 km/h for Bosporus and 100 for km/h for FSM routes, free flow travel times are computed 12.8 min. for Bosporus and 17.4 min. for FSM routes.

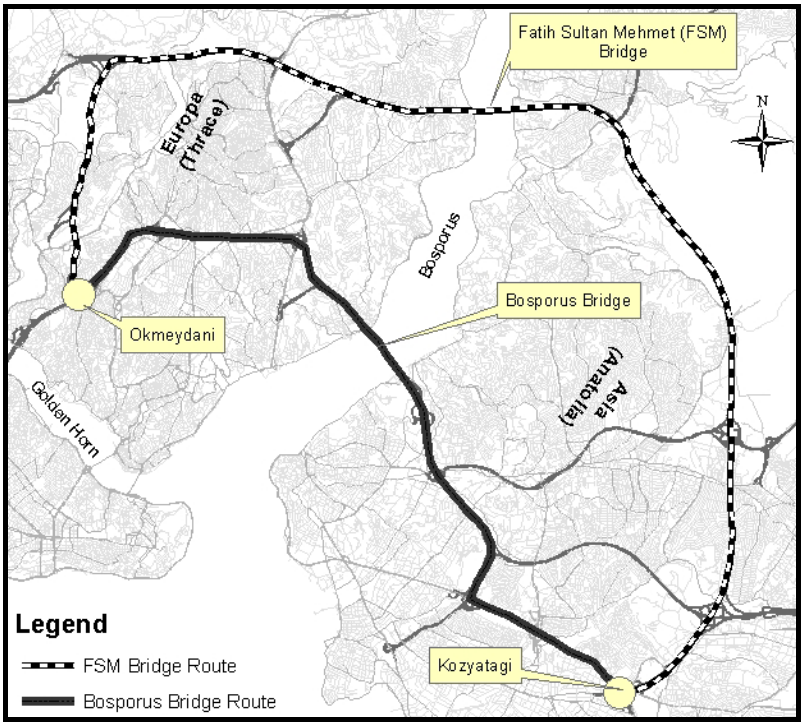

Figure 3. Main Highway Routes between Kozyatagi and Okmeydani

4.2. Evaluation of Travel Time Reliability for the Origin and the Destination Points of Kozyatagi and Okmeydani

Travel time data are provided by official web site of Istanbul Metropolitan Municipality (http://tkm.ibb.gov.tr/yolDurumu/SeyahatSuresi.aspx). In this study, accuracy of data has been assumed to be correct. Study carried out for April and May, 2007 weekdays and weekend, holidays and special events days for example May 1st are excluded. Bosporus and FSM Routes Travel Time Information are given below. On the Bosporus route, average travel time has been calculated 46.3 minutes, that value are calculated for the out of peak period is 17.05 min. Standard deviation and average speed also have been added to the Table 2.

Table 1. Bosporus and FSM Routes Travel Time Information (April, May, 2007)

Route		8:00	11:00	15:00	16:30
Bosporus	**Mean. Travel Time (min)**	46.30	32.70	19.65	17.05
	Stdv. Of Travel Time	9.60	12.21	7.90	2.56
	Avg. Speed (km/h)	22.03	31.19	51.91	59.82
FSM	**Mean. Travel Time (min)**	38.93	29.35	23.78	23.50
	Stdv. Of Travel Time	5.55	6.53	5.02	2.43
	Avg. Speed (km/h)	44.70	59.28	73.19	74.04

Figure 4 shows weekday variation of travel time for April and May 2007on the Bosporus bridge route.

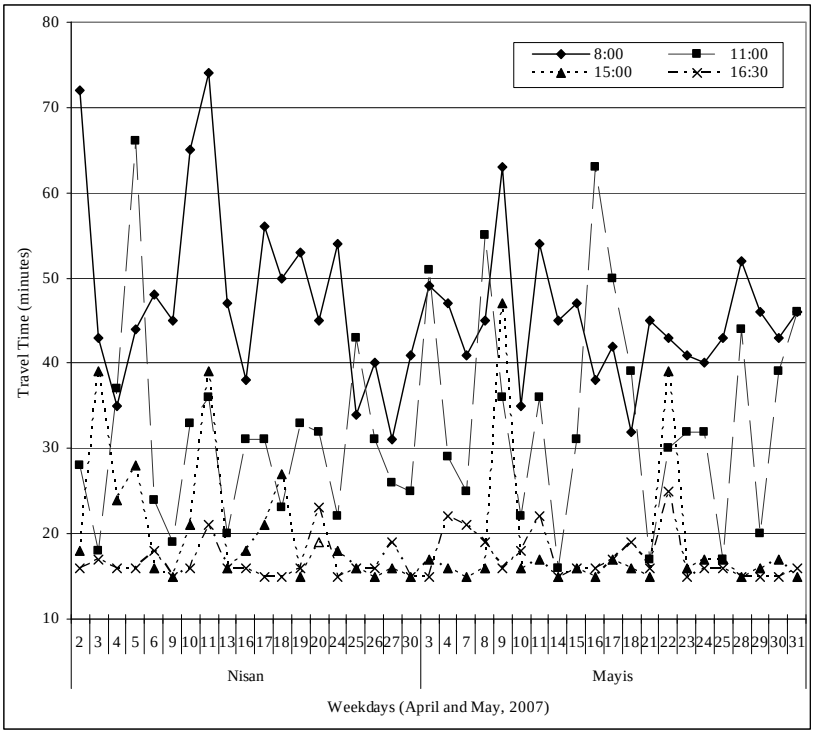

Figure 4. Weekday Variation of Travel Time on the Bosporus Route

Peak hour travel time variation and average travel time for Bosporus and FSM Routes are depicted in Figure 5. On the Bosporus route, generaly travel time standard deviation is higher than the FSM route as shown in Table 1, therefore in Figure 5, variation amplitude of the Bosporus route are wider than the FSM route.

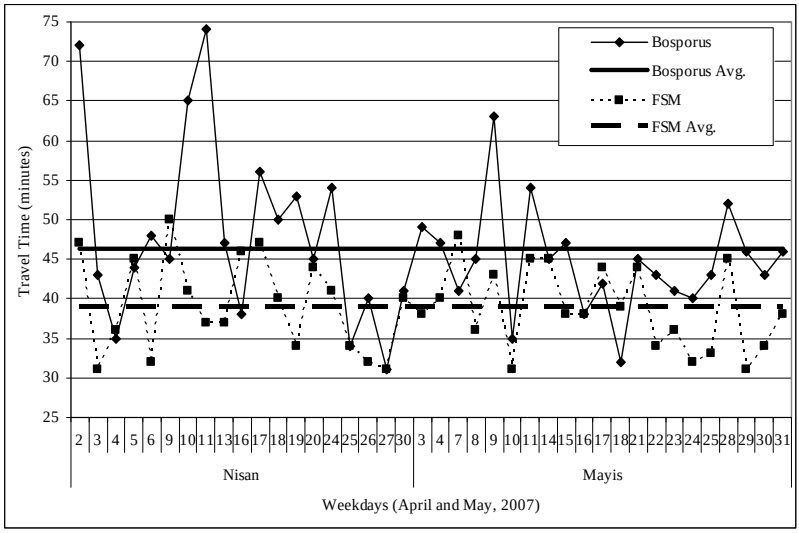

Figure 5. Variation of Peak hour Travel Time on Bosporus and FSM Routes
Indicators of the travel time reliability have been calculated for Bosporus and FSM routes and the results are given in Table 2.

Table 2. Travel Time Indicators for Bosporus and FSM Routes

	Route	8:00	11:00	15:00	16:30
90% Travel Time (minutes)	Bosporus	62.09	52.79	32.64	21.26
	FSM	48.06	40.09	32.03	27.49
95% Travel Time (minutes)	Bosporus	64.83	56.27	34.89	21.99
	FSM	49.64	41.95	33.45	28.19
Buffer Time Index (%)	Bosporus	40.02	72.08	77.55	29.00
	FSM	27.54	42.94	40.71	19.94

In figure 6, some states of the USA buffer index value are given for different years. Buffer time index for Bosporus is higher than the FSM routes. Also buffer time indexes for Bosporus and FSM route are high under the consideration of development countries value.

5. Conclusion and Suggestions

This study shows that buffer time index for Bosporus is higher especially for mid day period besides the peak period. FSM buffer time index is lower than the Bosporus but it is still high if compared with other developed countries' buffer time index. Therefore, some improvement needs to be done for travel time reliability for Bosporus and FSM routes, other than congestion. Some suggestions are introduced below for Istanbul to improve the travel time reliability:

The philosophy behind Transportation System Management and Operations (TSM&O) is to mitigate the effects of a wide variety of roadway events and to manage short-term demand for existing roadway capacity (FHWA, 2005). Therefore, Traffic Management Center (TMC) should be checked for the efficient use. Data collection methodology and data accuracy must be monitored for the evaluation of highway facilities.

TSM&O includes the application of advanced technologies using real-time information about highway conditions to implement control strategies. Collectively referred to as ITS, real-time control of highway operations through a transportation management center (TMC) has become a major activity undertaken by transportation agencies. ITS control strategies take many forms: metering flow onto freeways, dynamically retiming traffic signals, managing traffic flow during incidents, monitoring transit vehicles in real-time, electronic screening of trucks, and providing travelers with information about travel conditions, alternative routes, and other modes.

Encouraging travel and land use patterns that use the system in less congestion producing ways – travel demand management (TDM), non-automotive travel modes, and land use management (FHWA,2005)

In addition of that, implementation of (High Occupancy Vehicle) HOV/High Occupancy Toll (HOT) lane/s, variable Toll lane applications, etc. have to be considered.

Acknowledgements

Appreciation is to the Istanbul Metropolitan Municipality for providing travel time data via by web site.

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