CALIBRATION OF DELAY FORMULAS FOR SATURATED AND UNSATURATED SIGNALIZED INTERSECTIONS IN ISTANBUL

by

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ABSTRACT

CALIBRATION OF DELAY FORMULAS FOR SATURATED AND UNSATURATED SIGNALIZED INTERSECTIONS IN ISTANBUL

In order to minimize delay incurred at signalized intersections and provide the intended improvements, the calculation of delay should have good correlation with the actual delay times.

This study is aimed to provide calibration for various delay formulas in order to adapt them to the local conditions in Istanbul. Delay formulas of Highway Capacity Manual (HCM) (1997 and 2000) and Percentile Delay Method (PDM) were tested for validity at unsaturated signalized intersections. These formulas and Akcelik's overflow delay formula were studied for an oversaturated intersection. The delay estimates were compared with field measurements and calibration models were generated for those formulas. Signal 97, Signal 2000 and Synchro 6 softwares were used for analysis of intersections and MS Excel was used for statistical analysis.

As a result of the analysis of unsaturated intersections, HCM 1997 delay formula underestimated the delay compared to the actual delay measurements. HCM 2000 delay formula overestimated the delay through analysis by Signal 2000 and Synchro softwares. Both HCM 1997 and HCM 2000 delay estimates resulted with good relationship with the field measurements with coefficient of determination (R^2) values around 0.85. The PDM has resulted with a poor relation with R^2 value of 0.51.

The analyses of the oversaturated intersection included testing the effects of queue length on HCM field measurement method for control delay, calculation of delay using HCM formulas (1997 and 2000) and PDM through computer softwares, and calculation of delay manually using HCM 2000 and Akcelik formulas and comparison of these delay estimates with the actual delay. The results of the analyses showed that the field delay measurement tends to be misleading for long queue lengths. Manual computation with HCM 2000 formulation resulted with delay estimates closest to the actual delay incurred among the other estimates.

ÖZET

ISTANBUL’DAKİ DOYGUN VE DOYGUN OLMAYAN SİNYALİZE KAVŞAKLAR İÇİN GECİKME FORMÜLLERİNİN KALİBRASYONU

Sinyalize kavşaklarda yaşanan gecikmelerin en aza indirilmesi ve amaçlanan iyileştirmelerin sağlanabilmesi için gecikme hesaplamalarının gerçekteki gecikme süreleri ile iyi bir korelasyona sahip olması gerekir.

Bu çalışma, çeşitli gecikme formüllerinin İstanbul’daki yerel şartlara uyarlanmaları için kalibrasyonlarının sağlanmasını amaçlamaktadır. Highway Capacity Manual (HCM) (1997 ve 2000) gecikme formüllerinin ve Percentile Delay Method (PDM) yönteminin doygun olmayan kavşaklardaki geçerlilikleri test edilmiştir. Bu formüller ve Akcelik’in aşırı akım gecikme formülü bir doygun kavşak üzerinde etüt edilmiştir. Gecikme hesaplamaları ile sahadaki gecikme ölçümleri karşılaştırılmış ve bu formüller için kalibrasyon modelleri geliştirilmiştir. Kavşakların analizleri için Signal 97, Signal 2000 ve Synchro 6 programları, istatistiksel analiz için MS Excel kullanılmıştır.

Doygun olmayan kavşakların analizlerinin bir sonucu olarak, HCM 1997 gecikme formülünün gecikme tahminleri, gerçek gecikmelerin altında çıkmıştır. Signal 2000 ve Synchro programları ile yapılan analizler neticesinde HCM 2000 formülü gecikmeyi fazla tahmin etmiştir. HCM 1997 ve HCM 2000 gecikme tahminlerinin her ikisi de doygun olmayan kavşaklardaki saha ölçümleri ile 0,85 civarında bir R^2’ye sahip iyi bir ilişki göstermiştir. PDM yöntemi sonuçları, 0,51’lik R^2 değeri ile zayıf bir ilişki göstermiştir.

Doygun kavşak üzerine yapılan analizler içerisinde kuyruk uzunluğunun HCM kontrol gecikmesi saha ölçüm metoduna etkisinin test edilmesi, HCM formülleri (1997 ve 2000) ve PDM kullanılarak bilgisayar programları ile gecikme hesaplaması, HCM 2000 ve Akcelik formülleri ile gecikmenin elle hesaplanması ve bu hesaplamaların gerçek gecikme ile karşılaştırılması bulunur. Analizlerin sonuçları uzun kuyruklarda arazi gecikme ölçümlerinin yanıltıcı olabileceğini göstermiştir. HCM 2000 formülünün elle uygulanması gerçek gecikmelere diğerleri içerisinde en yakın gecikme tahminlerini verdiği görülmüştür.

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LIST OF SYMBOLS/ABBREVIATIONS

c	Capacity
C	Cycle Length
d_1	Uniform Control Delay
d_2	Incremental Delay
d_3	Initial Queue Delay
E	End Gain
g_i	Effective Green Time
G_i	Green Interval
H	Saturation Headway
K	Incremental Delay Factor
L	Upstreaming Filtering/Metering Adjustment Factor
r_i	Effective Red Time
R_i	Red Interval
R^2	Coefficient of Determination
s	Saturation Flow Rate
v	Flow Rate
X	Volume-to-Capacity Ratio
Y	Change and Clearance Interval
Φ_i	Phase
EB	Eastbound
HCM	Highway Capacity Manual
LOS	Level of Service
NB	Northbound
OD	Overflow Delay
PDM	Percentile Delay Method
PF	Progression Factor
SB	Southbound
UD	Uniform Delay
WB	Westbound

1. INTRODUCTION

Vehicles in traffic flow are delayed by a combination of factors including interactions with other vehicles and pedestrians, and regulatory devices such as traffic signs and signals. In order to evaluate the improvements in traffic flow, effects of various regulatory devices on delays require to be estimated.

Optimization of the signal times at signalized intersections is important for efficient operation of traffic movements and reduction of the time lost in traffic. Optimization mainly depends on minimization of the delay through alterations in cycle time and green time allocated to signal phases. The calculation of delay in this process should have good correlation with real life delay times in order to provide the intended improvements when implemented.

In this study, field delay measurements were collected at saturated and unsaturated signalized intersections to calibrate delay formulas of HCM 1997, HCM 2000 and Percentile Delay Method.

1.1. Problem Statement

1.1.1. City of Istanbul and Traffic Statistics

Istanbul is one of the ten most populous cities of the world [1]. According to the Turkish Statistics Institution, the estimated population of Istanbul for mid-year 2006 is 11,622,000. The population estimates of Turkish Statistics Institution shows that the percentage of population of Istanbul over the total population of Turkey has increased from 14.7 per cent in year 2000 to 15.9 per cent in 2006 and it is estimated to reach 16.7 per cent by the year 2010 [2].

The large size of population reflects in to a large size of traffic that increases by years. According to the Turkish Statistics Institution, as of December 2005, the number of vehicles registered in Istanbul was around 2.16 million which constitute 21 per cent of the total registered vehicles in Turkey. The average number of new vehicles registered in 2005 was 432 out of which 244 are new passenger cars [3]. This indicates seven per cent increase in the number of vehicles in year 2005. Although it is lower than the average annual increase of 12.2 per cent in number of vehicles registered in Istanbul in the last five years, if this annual rate of increase (seven per cent) in number of vehicles remains the same, the number of vehicles will be doubled in the next 10 years.

1.1.2. Definition of Traffic Congestion

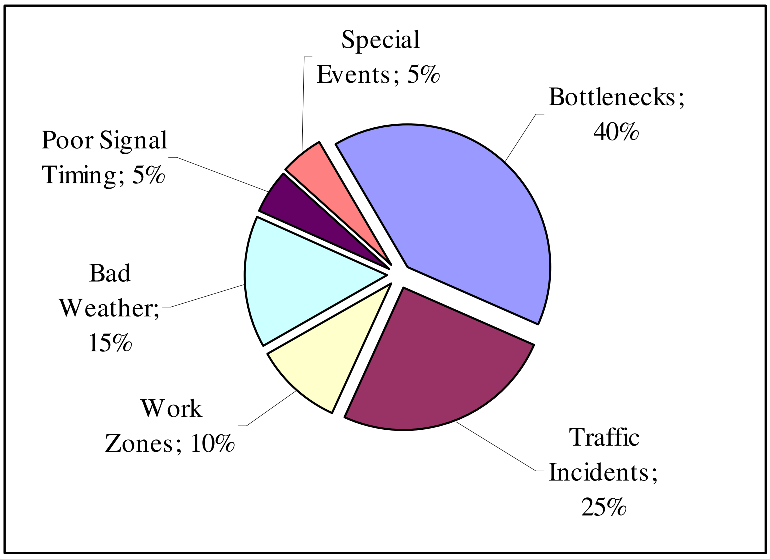
There are different definitions of traffic congestion in the literature. The Federal Highway Administration (FHWA) of USA defines the congestion as [4]

> *"Congestion occurs when the free flow of traffic on a roadway is impeded due to excess vehicle demand, construction, maintenance, traffic incidents, weather, or other road conditions and events."*

According to a study performed by Bertini (2005), transportation professionals and academics define the congestion by different measures. The responses relate the congestion to speed (28 per cent of the respondents), volume (19 per cent), time (18 per cent), and level of service (LOS) (15 per cent). 16 per cent of the survey respondents have mentioned cycle failures as the main source of congestion [5].

1.1.3. Reasons of Congestion

Traffic congestion is caused by various reasons. According to the study of FHWA the most important reason of traffic congestion in USA is bottlenecks (40 per cent) [4]. As shown on Figure 1.1, five per cent of traffic congestion in urban areas can be attributed to poor signal timing [4].



Source: FHWA [4]

Figure 1.1. Causes of traffic congestion in USA

1.1.4. Results of Congestion

Regardless of the cause of traffic congestion, the results of it reflect in the country resources in terms of excessive consumption of fuel and loss of productivity due to excessive trip durations. According to the study performed by Texas Transportation Institute in the 85 urban areas in 2003, congestion costs over $63 billion or $384 per person in wasted time and extra fuel [4]. According to the Congestion Management System 2005 Status Report of New York Metropolitan Transportation Council [6], the cost of congestion in the New York Metropolitan region is $ 26 million per day (or $ 9.36 billion per year). The study performed by Ergün (2005) [7] shows that the cost of congestion in Istanbul in terms of additional fuel and time consumption is $ 3.12 billion per year.

Traffic congestion does not only cause loss of country resources in terms of fuel; it also increases the air pollution due to the increased pollutant exhaust emission (especially CO, NOx) and therefore has an important role in global warming. Carbon monoxide and hydrocarbon emissions are higher in congested traffic due to the lower speeds [8]. The effect of pollutant emissions on the air quality and climate change has been an important issue of the European Conference of Ministers of Transport [9], [10]. In addition to these macro level problems, congestion affects drivers and riders in terms of time losses and psychological distortion.

1.1.5. Measurement of Congestion

There are various measures used for determining the magnitude of congestion. Bertini's study [5] shows that the most of the responses for the measures of congestion are related to the actual travel time. The respondents have indicated that the congestion can be measured by delay (29 per cent), LOS (20 per cent), travel time (14 per cent), volume-to-capacity ratio (14 per cent), speed (13 per cent), queue length (four per cent), and density (one per cent) [5].

Annual delay per capita in Istanbul due to the traffic congestion is estimated to be 73.9 hours/capita in the study of Ergün (2005) [7]. The same statistics for New York Metropolitan Region is defined as 54.75 hours/capita [6]. Thus, citizens of Istanbul experience 35 per cent more traffic delay in average than the citizens of New York Metropolitan Region.

The actual travel time or the delay in the desired travel time is the mostly used quantitative measure of congestion. However, the study of Bertini indicates that half of the respondents find the measurements of congestion "accurate" (18 per cent) or "somewhat accurate" (33 per cent) [5].

1.1.6. Effects of Traffic Signals in Congestion

Urban street network includes streets (links) and intersections (nodes) where vehicles compete with conflicting traffic and pedestrian flows. Therefore, traffic need to be controlled by means of traffic control devices in order to provide the necessary right-of-ways required by the traffic flow patterns, to control the speed of the vehicles and to provide safe environment to the users like pedestrians, drivers and passengers. These traffic control devices create an interrupted traffic flow on urban streets, and thus cause delays on the trips of the users. A common type of such devices is traffic signals at intersections where vehicular traffic and pedestrian flows conflict in space and time.

Increasing delay at signalized intersections has positive relationship with the increase in traffic congestion. Figure 1.1 shows that five per cent of the congestion in United States is due to poor signal timing. Although its contribution to the traffic congestion is not very much (five per cent), optimization of traffic signals can result with good improvements in local traffic congestion and savings in terms of fuel and time consumption. The signal optimization project performed by Ergün, Bayraksan and Coşkun (1999) shows that efficient operation of traffic signals provides benefits in terms of decrease in delay and therefore in cost of fuel and time consumption [11].

1.1.7. Calculation of Delay and Need for Calibration

Optimization of traffic signals depends upon calculation and minimization of delay at signalized intersections. There have been various formulas developed throughout the years for the calculation of delay at signalized intersections. These formulas have been developed and improved through field surveys and empirical studies. Therefore, they are generated for the local conditions of the country of their origin.

In order to achieve desired improvements at signalized intersections, the calculation of delay by using these formulas should represent the actual delay incurred at the intersection. This study is aimed to address this problem by testing the validity of widely used Highway Capacity Manual delay formulas and Percentile Delay Method of Synchro Software, and calibrating these delay formulas to use them at the local cases in Istanbul. The formulas were created considering the conditions of U.S.A. and therefore required to be calibrated for the conditions of Istanbul.

1.2. Goals and Objectives

The main goal of the thesis is to test the validity of HCM 1997, HCM 2000 and Percentile Delay Method delay formulations at unsaturated and saturated signalized intersections for local conditions in Istanbul. In order to achieve this ultimate goal, the following objectives were set.

- To do a through literature review on existing delay formulations at signalized intersections

- To collect delay data for unsaturated and saturated conditions

- To calculate the delay for all intersections, for which the data were obtained, using various delay formulations by utilizing computer programs and compare the results with the field measurements.

- To discuss the applicability of various delay formulations and study relationships with actual conditions.

An oversaturated intersection, Dolmabahce Intersection, was studied in order to develop the arrival and departure flow diagrams, to analyze the development of queue, to calculate the delay through the flow diagrams, field study, and delay formulas manually and by means of software programs, and to analyze and compare the results of these calculations.

2. LITERATURE REVIEW

The calculation of delay at signalized intersections is related to many parameters. A summary of the definitions for the terms and parameters used in this study are given below.

2.1. Terms and Definitions

The definitions of the basic terms used in the analysis of signalized intersections are as follows [12], [13]:

- *Cycle:* Cycle is one complete rotation of signal indications for all traffic approaches.

- *Cycle Length:* Cycle length is the time for a sequence of indicators in a complete cycle. It is expressed in seconds and given the symbol "C".

- *Interval:* It is the period of time during which a signal indicator (red, yellow and green) at an intersection remains unchanged. There exist four types of intervals in a cycle of signals:

  - *Change Interval:* The yellow indication between red and green intervals is called change interval.

  - *Clearance Interval:* After all change interval, a short period during which all movements at the intersection face red indication is applied. This interval is called clearance or all-red interval. The change interval and clearance interval are used for clearance of the intersection from conflicting movements. The period for the total of the change interval and the clearance interval is called "change and clearance" interval and used in the calculations with symbol "Y".

  - *Green Interval:* It is the time of "green" indication for a particular phase of movements and is shown with the symbol "G_i".

- *Red Interval:* The time for "red" indication for a given movement or set of movements is called red interval and is given the symbol "R_i".

- *Phase:* The total of time allocated for green interval and change and clearance interval for a given set of movements that receive right-of-way simultaneously is called a "phase". Phases are shown by symbol "Φ_i"

- *Lost Time:* It is the time lost during which the intersection is not effectively used by any movements.

- *Start-up Lost Time:* This period occurs between the clearance interval and green interval for a movement due to the time spent by the first few vehicles in a standing queue for starting up and passing the intersection line.

- *Clearance Lost Time:* The portion of the clearance interval during which the vehicles do not pass the intersection is called "clearance lost time".

- *End Gain:* The portion of the yellow interval used by some vehicles as an extension to green interval is called "end gain". This term is also named as extension of effective green is given the symbol "e".

- *Total Lost Time:* The total of start-up lost time and clearance lost time for a specific movement is called total lost time.

- *Effective Green Time:* Effective green time, called by symbol "g_i", is the time that is effectively available for a movement and is calculated as the green interval plus the change-and-clearance interval minus the total lost time for a designated movement.

- *Effective Green Ratio:* It is the ratio of effective green time to the cycle length, g_i/C.

- *Effective Red Time:* Effective red time is the time during which a specific movement or a set of movements is effectively not permitted to move. It is the time calculated as effective green time subtracted from the cycle length and is shown by "r_i".

- *Headway:* The time elapsed for a vehicle passing the curb line. The first headway is the time elapses between the start of the green indication and the first vehicle crossing the curb line. The other headways are calculated as the time between the successive vehicles crossing the curb line. As a common practice headways are measured as the rear wheels of the vehicles cross the curb line.

- *Saturation Headway:* The headway between the vehicles standing in a queue waiting for the green indication levels generally after the fourth or fifth vehicle. This level headway is called as saturation headway and shown as "h" in the equations of signalized intersection analysis.

- *Saturation Flow Rate:* Saturation flow rate is the number of vehicles in a single lane that can cross the curb line during an hour of green time. The vehicles are assumed to cross with the saturation headway and therefore the saturation flow rate, "s", is calculated in vehicles per hour of green per lane as follows:

$$s = \frac{3600}{h} \tag{2.1}$$

2.2. Measures of Effectiveness

The signalized intersections are analyzed for the quality of service by means of various measures of effectiveness. These measures are used in capacity analysis and simulation models in order to quantify the operation of the intersection. The most common measures of effectiveness are [13]:

- Length of Queue

- Number of Stops

- Delay

Length of Queue: The length of queue at any given time is an important measure of effectiveness especially for the intersections that are close to adjacent intersection.

The number of Stops: The number of stops made is used especially for air quality calculations.

Delay: Delay is the most commonly used criterion that is described by the amount of time consumed in traversing the intersection. Delay is calculated in many ways and is named differently for each way of calculation [13]:

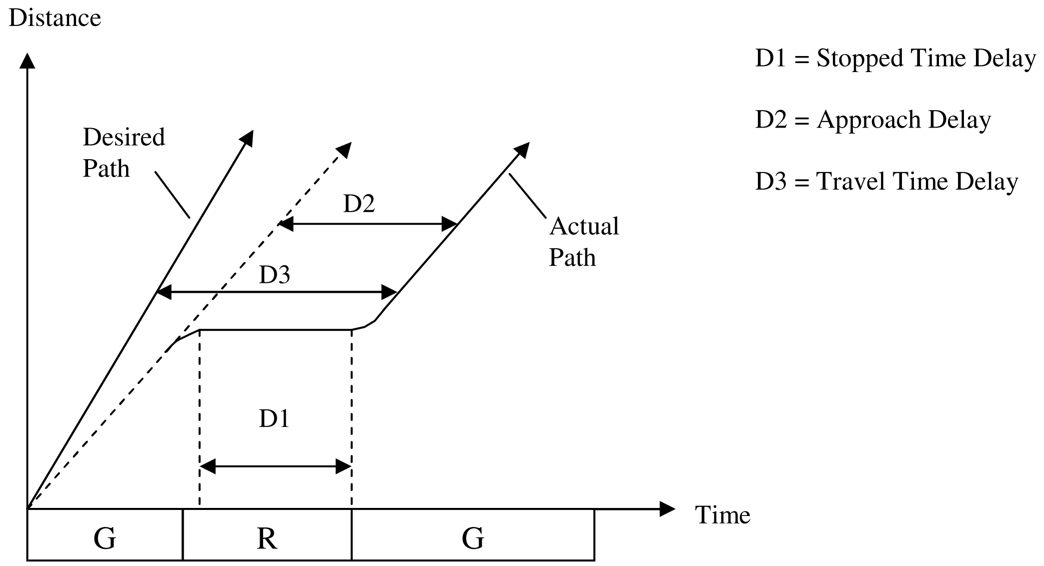
- *Stopped Time Delay* is the time that a vehicle stopped while waiting to pass the intersection

- *Approach Delay* is the total time consumed while decelerating from the ambient speed to stop, the time of stopping at the intersection and the time spent for accelerating back to the ambient speed after start-up. This delay is named as “Control Delay” in Highway Capacity Manual (“HCM 2000”) published by Transportation Research Board [12].

- *Travel Time Delay* is defined as the difference between the total time actually spent to traverse the intersection and the driver’s desired total time to traverse the intersection.

- *Time-in-Queue Delay* is the time starting from a vehicle joining the queue at the intersection to its discharge through the curb line.

The delay measurements described above give different results for a given intersection depending on the conditions of intersection. The difference of the figures measured at an intersection for these items are illustrated on Figure 2.1 [13].

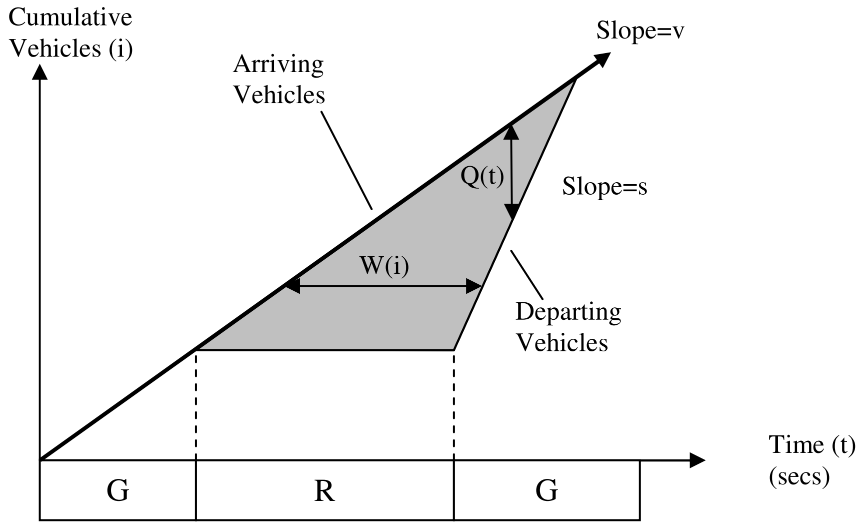


(Source: [13], pg 413)

Figure 2.1. Illustration of delay measures at an intersection

The concept of delay is better explained with the flow rate of the vehicles coming to the intersection and the saturation flow rate of the vehicles leaving the intersection when the phase turns to green. Vehicles arriving at the intersection with flow rate of v, pass the intersection without interruption at green phase if a queue does not exist. The vehicles start to accumulate and create queue at the intersection as the indicator turns to red. The number of vehicles in the queue increases at a rate of v until the indicator turns to green. As the phase turns to green for the approach, the vehicles start to leave the intersection with the saturation flow rate of s. Figure 2.2 shows the relationship between the flow rates and delay and queue length [13].

The total time for a vehicle (i) to traverse the intersection is shown as W(i) on Figure 2.2. The area shaded on the figure is the aggregate delay of the vehicles passing at this specific period of time. Aggregate delay is expressed in vehicle-hours (or vehicle-seconds or vehicle-minutes). The average individual delay is the average time consumed by any vehicle during a specific period. It is calculated as the aggregate delay divided by the number of vehicles that traverse the intersection during that period.



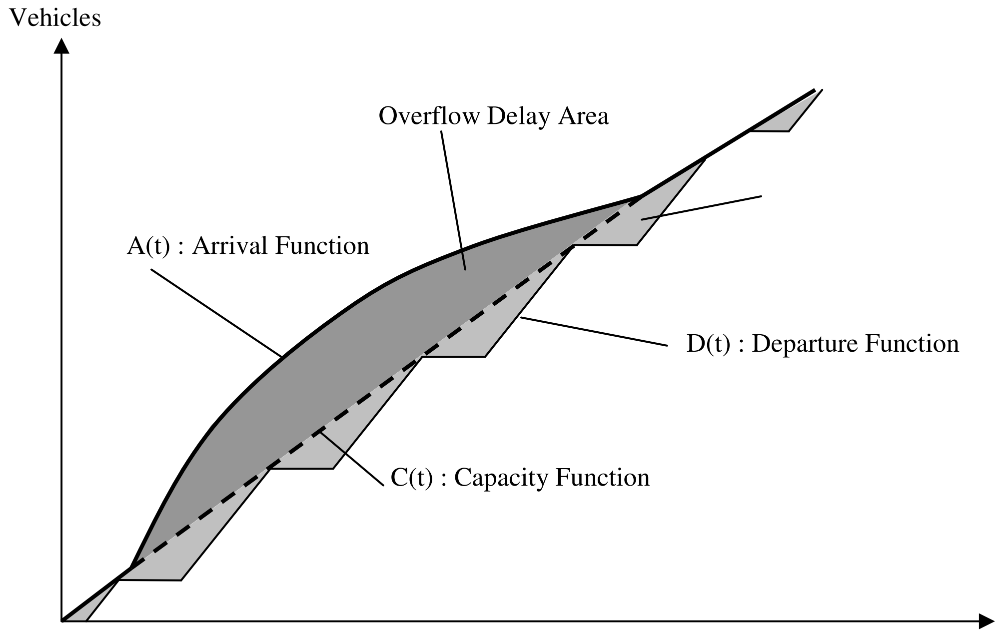
(Source: [13], pg 414)

Figure 2.2. Delay and queue length

The total number of vehicles queued at time t is shown as Q(t) on Figure 2.2. The figure shows the case in which the queue can be completely served during one green period and the vehicles do not wait for more than one red period. The delay calculated at these cases, where the saturation flow rate can catch up with the actual flow rate during one green period, is called *Uniform Delay*.

In the other cases, where some of the vehicles have to wait in the queue for more than one red period, overflow occurs. In these cases, the total delay has another component in addition to uniform delay, which is called *Overflow Delay*. Figure 2.3 shows the uniform and overflow components of delay. The area between the capacity function and departure function is uniform delay; and the area between the arrival function and capacity function is the overflow delay [13].

HCM 2000 [12] classifies the figures calculated for control delay and sets the Level of Service (LOS) criteria for the signalized intersections. The criteria based on the average control delay per vehicle are listed in Table 2.1. LOS A describes operations with very low delay up to 10 seconds per vehicle, which means that the progression is very favorable and most of the vehicles arrive at the intersection when the indicator is green. LOS F states the operation with an average control delay of over 80 seconds per vehicle which is not acceptable to most drivers.



(Source: [13], pg 415)

Figure 2.3. Uniform and overflow delay

Table 2.1. LOS criteria for signalized intersections

LOS	Control Delay per Vehicle (sec/veh)
A	≤ 10
B	> 10 and ≤20
C	> 20 and ≤35
D	> 35 and ≤55
E	> 55 and ≤80
F	> 80

(Source: [12], Ch. 16, pg 2)

2.3. Queuing and Delay at Signalized Intersections

Traffic flows interfere at merging points or intersections in a network. Therefore, the journey of a vehicle is interrupted at such points. The delay caused by these interruptions and consequent queues have been a popular research subject throughout the history. Gazis have summarized and explained the development of theories for calculation of delays and queues in Reference [14].

The researches on calculation of queues and delays are based on theory of stochastic processes. The basics of the queuing theories created are that the vehicles arrive to an intersection by an arrival function and depart by a departure function. When the number of vehicles arrived at a moment cannot depart, the queue starts to occur. Therefore, the main assumptions made for these researches are about the arrival functions and departure functions.

The vehicles in a traffic flow arrive the intersection at different $t_1, t_2, t_3, \ldots, t_r$ times. Therefore, we can define the headway or gap between two successive vehicles as,

$$G_r = t_r - t_{r-1} \tag{2.2}$$

Most of the traffic studies assume that the successive headways are independent and identically distributed random variables. If the probability function of successive gaps of a random arrival process is denoted as $\varphi(G)$, the probability density function for the gap G_1 at t=0 where the measurements start, $\varphi_0(G)$, is defined as follows:

$$\varphi_0(G) = \frac{1}{\mu}\int_0^\infty \varphi(x)dx \tag{2.3}$$

Where μ is the mean headway given by

$$\mu = \int_0^\infty G\varphi(G)dG \tag{2.4}$$

The most widely used form of $\varphi(G)$ in traffic studies is negative exponential where

$$\varphi(G) = \varphi_0(G) = \frac{1}{\mu}\exp\left(-\frac{G}{\mu}\right) \tag{2.5}$$

Theoretical justifications for this density function were made by Weiss and Herman (1962), Breiman (1963) and Theden (1964) [14]. The study of Weiss and Herman assumes that the vehicles travel at a constant speed v which is sampled from probability density function $f(v)$ and this function is not a delta function. Furthermore, it assumes that when a vehicle reaches a slower vehicle, it can pass the vehicle immediately without any delay [14].

Miller (1961) has introduced the concept of traveling queue as another contribution to the theory [14]. He observed that the limitations of passing a vehicle create platoons of vehicles traveling at the speed of leader vehicle. This observation eliminates the assumption of Weiss and Herman mentioned above. Instead of using individual vehicles in Equation 2.5, he assumes that the successive queues are independent and gap between queues follows a negative exponential distribution.

In order to describe the situation at points where the movement of a vehicle is impeded by a conflicting vehicle flow, the concept of "gap acceptance" is introduced. It defines the situation where the driver waits before passing or merging a conflicting flow until he finds the headway between two successive vehicles in that flow is acceptable to him for movement. Gap acceptance is the main assumption used for analysis of unsignalized intersections controlled by yield or stop sign. Although it is defined as a step function which is equal to *zero* for gaps lower than acceptable gap, the functions that can be generated for gap acceptance is heavily dependent on situation that need field observations.

In the cases of signalized intersections, the gap acceptance is not included since the gap between the sequence of conflicting flows of vehicles are defined by signal settings. Therefore, in order to calculate the expected delay for a single stream at a signalized intersection, it is required to specify the arrival process, the signal settings and the departure process.

Many of the studies for estimating the delay at signalized intersections assume a simple Poisson process of arrival. This assumption is observed to be reasonably satisfactory for light traffic conditions where there is no platoon created by a close upstream signalized intersection [14]. The interactions between the vehicles are neglected in light traffic conditions where Poisson process is acceptable. For heavy traffic a "compound Poison process" is considered instead of simple Poison [14].

The signal settings of an intersection can be specified through the distribution of total cycle length to the green phase where the vehicles are free to move and the red (and yellow) phase where the vehicles are stopped. It can be assumed that the departure intervals of vehicles are independent and identical random variables. However, it can be further assumed for a single lane of traffic that the departure headways are identical and correspond to a saturation flow rate. The effect of start-up loss incurred by the first vehicle can be accommodated by increasing the value for the length of red phase somewhat. The vehicles making right or left turns will have a different departure function than the vehicles moving straight. Therefore, it is reasonable to divide the movements in classes and assume that the departure times will be identically distributed independent random variables for each class if the classes do not interfere.

The signalized intersections are complicated compared to the classical queuing theory due to the fact that no service is possible during the red phase. Another difference from the classical queuing theory is that the vehicles do not necessarily depart at the order of arrival. Therefore, the analysis of delay at signalized intersection focuses on aggregate delay incurred by all vehicles during the cycle length instead of an individual vehicle. Besides its difficulty to be calculated due to the red phase, the total delay is important for use in improvement of the system.

The queuing process at a traffic signal creates a queue length of *Q(t)* at a time of *t*. Therefore, the total delay during a cycle length of *T* is,

$$W = \int_0^T Q(t)\,dt \tag{2.6}$$

Let *A(t)* be the function for number of vehicles arriving to the intersection. For an analysis period of one cycle length *T* starting at the beginning of the red phase, no departures will be possible during *(0,R)*, where *R* is the length of red phase, and the departure process will be unrestricted during *(R,T)*. The calculations for total delay incurred by the vehicles are described below for different arrival and departure functions [14].

Let us assume that A(t) is a Poisson process with E[A(t)]=λt and the vehicles depart from the queue at a constant time of s. If we define the total delays for the red phase and green phase as W_1 and W_2 respectively, the total delay for the total cycle length will be:

$$W = W_1 + W_2 \tag{2.7}$$

Where

$$W_1 = \int_0^R [Q(0) + A(t)]dt \tag{2.8}$$

$$W_2 = \int_R^T Q(t)dt \tag{2.9}$$

The expected values for Equation 2.8 and 2.9 are derived as follows:

$$E[W_1] = RE[Q(0)] + \frac{1}{2}\lambda R^2 \tag{2.10}$$

$$E[W_2] = \frac{sE[Q(R) - Q(T)]}{2(1-\lambda s)^2} + \frac{sE[Q^2(R) - Q^2(T)]}{2(1-\lambda s)} \tag{2.11}$$

If we further assume that the queue is in statistical equilibrium where average number of arrivals per cycle is less than the number of vehicles that can be served during the green phase, i.e. $\lambda T < (T-R)/s$, the expected total delay per cycle can be obtained as,

$$E[W] = \frac{2\lambda R}{2(1-\lambda s)}\left[R + \frac{2}{\lambda}E[Q(0)] + s\left(1 + \frac{1}{1-\lambda s}\right)\right] \tag{2.12}$$

In order to generalize the Equation 2.12, Gazis assumes that the arrival process is that postulated by Darroch (1964) while the departure times remain constant [14]. Assuming that the arrivals occur at random during *h* interval, we have E[A(t)]=λt. If it is further assumed that *s* is a multiple of *h*, Equation 2.12 generalizes to,

$$E[W]=\frac{\lambda R}{2(1-\lambda s)}\left[R+\frac{2}{\lambda}E[Q(0)]+s\left(1+\frac{1}{1-\lambda s}\right)\right] \tag{2.13}$$

If the arrivals are binomial with *h=s*, the Equation 2.13 takes a special simplified form of,

$$E[W]=\frac{\lambda R}{2(1-\lambda s)}\left[R+\frac{2}{\lambda}E[Q(0)]+2s\right] \tag{2.14}$$

If we further simplify the problem by assuming that the vehicles arrive at constant intervals of $1/\lambda$, we can obtain the equation for a minimum possible delay at an intersection:

$$E[W]=\frac{\lambda R}{2(1-\lambda s)}(R+s) \tag{2.15}$$

If we compare Equation 2.15 with Equation 2.13, we can regard the second term in Equation 2.13 is delay due to the overflow from the previous cycle and the forth term as delay due to randomness.

The above equations assume that the departure process is constant. We may consider randomness in departure due to different driver behaviors and interference between the straight through movement and turning vehicles. In that regard, let us assume that the departure times are independent, identically distributed random variables with a mean value of *s* and a coefficient of variation *C*. Let us also assume a Poisson arrival process. In this case, the expected delay during green phase, $E[W_2]$, changes while the expected delay during the red phase, $E[W_1]$, is same with Equation 2.10 since it is independent of departure process. The results of computations yield to a total expected delay during one cycle as,

$$E[W]=\frac{\lambda R}{2(1-\lambda s)}\left[R+\frac{2}{\lambda}\left(1+\frac{(1-\lambda s)(1-C^2)}{2}\right)E[Q(0)]+s\left(1+\frac{1+\lambda sC^2}{1-\lambda s}\right)\right] \tag{2.16}$$

2.4. Calculation of Delay

In addition to the theoretical studies mentioned in Section 2.3, delay at signalized intersections is studied by various scientists for many years as a measure of efficiency at a signalized intersection. Most of the recent formulations for calculation of delay at signalized intersections are based on the formula generated by Webster, which was initially published in 1958.

2.4.1. Webster's Formulation

Webster's original formula is an empirical formula that applies to the vehicles arriving randomly at fixed-cycle traffic signals. The formula was obtained by computer simulation assuming random arrivals and gives the average delay per vehicle. Webster's delay formula is [15]:

$$d = \frac{C(1-\lambda)^2}{2(1-\lambda x)} + \frac{x^2}{2q(1-x)} - 0.65\left(\frac{C}{q^2}\right)^{1/3} x^{(2+5\lambda)}, \tag{2.17}$$

Where

C=cycle length, sec

λ=proportion of effective green time in a cycle length; g/c

q=flow rate (vehicle/sec)

s=saturation flow rate (vehicle/sec)

x=degree of saturation; q/λs

When we reorganize the formula for the basic parameters used in analysis of intersections, the formula results as follows:

$$d = \frac{C(1-\frac{g}{C})^2}{2\left(1-\frac{v}{s}\right)} + \frac{\left(\frac{vC}{sg}\right)^2}{2v\left(1-\frac{vC}{sg}\right)} - 0.65\left(\frac{C}{v^2}\right)^{1/3}\left(\frac{vC}{sg}\right)^{\left(2+5 g/C\right)}, \tag{2.18}$$

Where

C=Cycle Length
g=Effective Green Time
v=Flow Rate
s=Saturation Flow rate

The first part of Webster's delay formula calculates the average uniform delay in seconds. This part of the formula is used for uniform delay calculation without any significant change in the later studies.

The second term accounts for the randomness of the arrivals. The third term is adopted for adjustment for the field observations made. The adjustment provides five per cent to 15 per cent decrease in the calculated delay.

Webster's formula considers the situations where the intersection is not over saturated; i.e. v/c (flow rate to capacity rate) ratio is below one. Although the second term of Webster's formula seems to account for overflow delay as it is added to the uniform delay, actually the term gives negative results for intersections with v/c ratio over one. In fact, the second term accounts for the individual cycle failures within an analysis period.

2.4.2. Overflow Delay Formulation

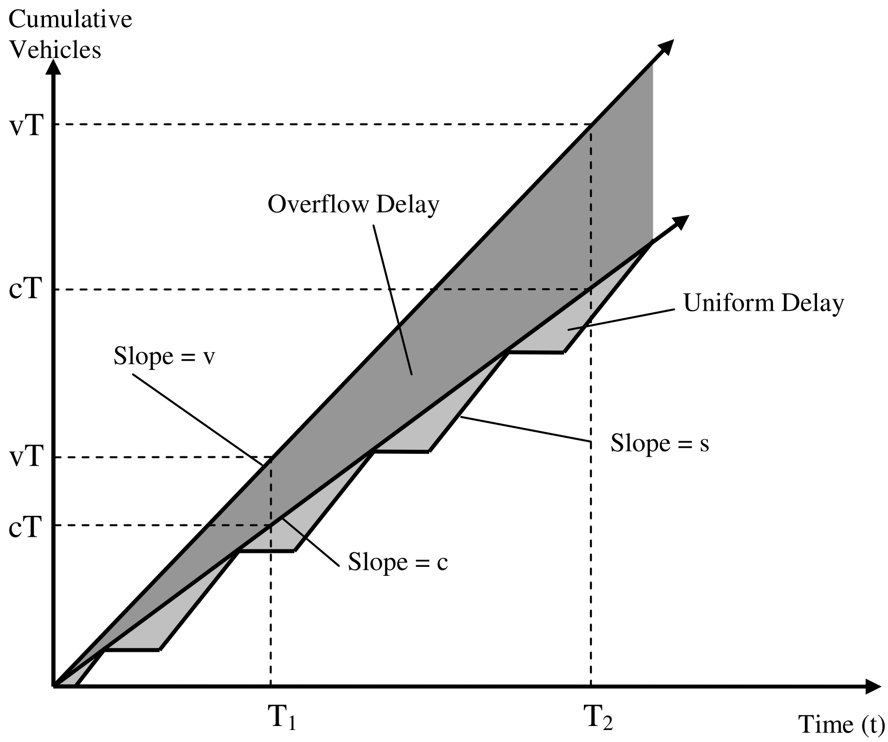
Since Webster's formula didn't count for the overflow delay, a new formulation is required for oversaturated intersections. Figure 2.4 illustrates the situation where the flow rate is over the rate that the signal can accommodate. As shown in the figure, the total delay is divided into two sections, uniform delay and overflow delay.

For calculation of the uniform delay part for the total delay at oversaturated intersections, the first term of Webster's formula can be used. When (v/s) is substituted with (g/C)(v/c) and v/c is taken as equal to one since only the uniform delay part is calculated (see Figure 2.4), the equation results as;

$$UD = \frac{C[1-(g/C)]}{2} \tag{2.19}$$

Overflow delay is dependent on the period of oversaturation. As the length of the oversaturation period increases, the delay of the vehicles added to the queue increases. The overflow delay area shown on Figure 2.4 is the aggregate overflow delay and is calculated as follows for the time between time T_1 and T_2.

$$OD_a = \frac{(T_2)^2 - (T_1)^2}{2}(v - c) \tag{2.20}$$



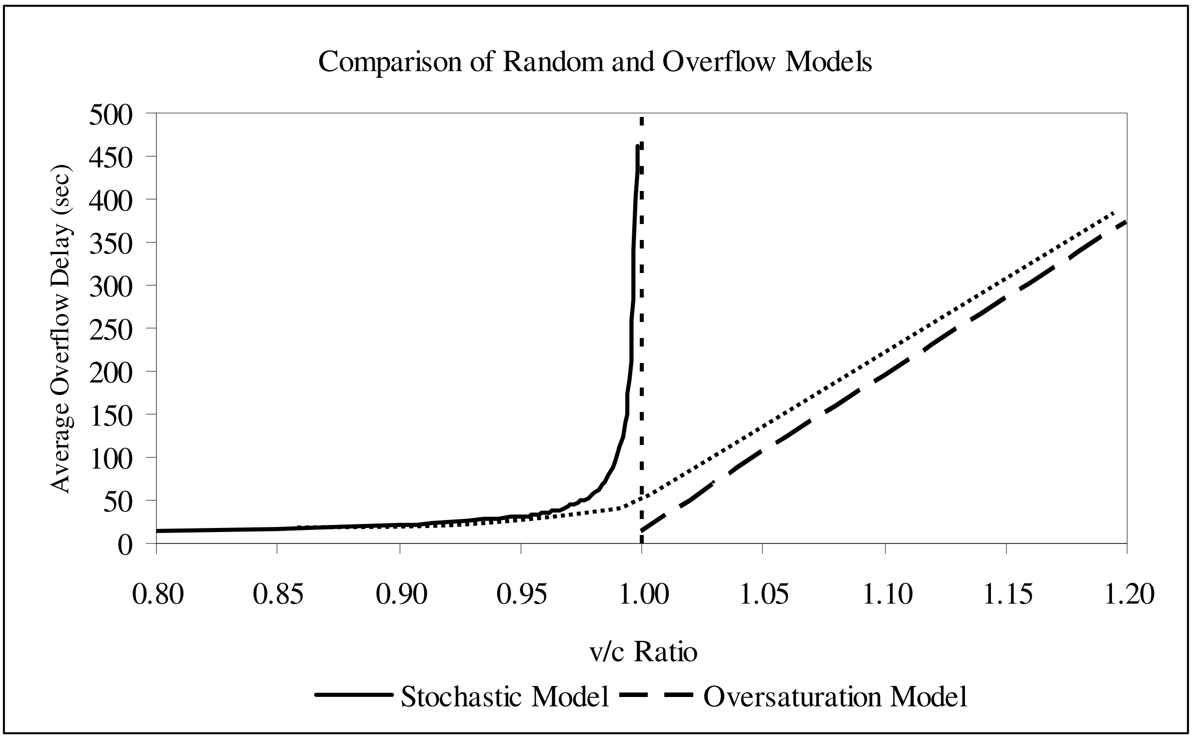
(Source: [13], pg 418)

Figure 2.4. Overflow delay

In order to find the average overflow delay, the aggregate delay is divided to the total number of vehicle discharged during the period, $c(T_2-T_1)$:

$$OD = \frac{(T_1 + T_2)}{2}[(v/c) - 1] \tag{2.21}$$

The researches show that for the intersections with v/c below 0.80-0.85, the stochastic model generated by Webster results with very close delay figures with the ones actually measured on the field. Also, the overflow delay formula explained above represents the field data for the v/c of over 1.15-1.20 [13]. However, the most of the intersections have a v/c ratio between 0.80-1.20 where both models do not have good representation. Figure 2.5 shown below illustrates the situation [13].



(Source: [13], pg 419)

Figure 2.5. Comparison of random and overflow models

The illustration in Figure 2.5 initiated the researches for development of formulas for combination of these two models. The formulas created had to be asymptotic to the oversaturation model for high v/c ratios and to the stochastic model for low v/c ratios as the dotted line shown on Figure 2.5.

2.4.3. TRANSYT Delay Formulation

One of the models was created as part of the TRANSYT signal optimization program in 1979 [13]. The simplified form of the overflow delay formula is shown below. The result of this formula should be added to the uniform delay to find the total delay.

$$OD = \frac{15T}{v}(v-c) + \sqrt{(v-c)^2 + \frac{240v}{T}} \tag{2.22}$$

Where

OD=Overflow delay, sec/veh

T=Time, minutes

v=Flow Rate, vph

c=Capacity, vph

The later versions of the program have improved this formulation. However, the latest version of the program uses the HCM 2000 formulation for overflow delay.

2.4.4. Akcelik's Delay Formulation

Another formula was generated by Akcelik for the intersections in Australia [13]. The formula generated in 1980 is as follows:

$$OD = \frac{T}{4}\left[(v/c-1)+\sqrt{(v/c-1)^2+\frac{12(v/c-v_0/c)}{cT}}\right] \tag{2.23}$$

Where

$v_0/c = 0.67 + s(g/600)$

T=Time, hours

v=Flow Rate, vph

c=Capacity, vph

s=Saturation Flow Rate, vphg

2.4.5. Highway Capacity Manual Formulation

The control delay formula of HCM [12] is composed of three parts: Uniform Control Delay (d_1), Incremental Delay (d_2) due to random arrivals or oversaturation and Initial Queue Delay (d_3) for the delay effect of the queue at the beginning of the analysis period. Therefore, the control delay formula of HCM is:

$$d = d_1(PF) + d_2 + d_3 \tag{2.24}$$

Where, PF is the progression adjustment factor to accommodate the effects of the signal progression.

2.4.5.1. Uniform Delay Component, d_1. The uniform control delay component of the formula accounts for the uniform delay assuming uniform arrivals and stable unsaturated flow. The formula which is based on the first part of Webster Formula is as follows:

$$d_1 = \frac{0.5C\left(1-\frac{g}{C}\right)^2}{1-\left[\min(1,X)\frac{g}{C}\right]} \tag{2.25}$$

Where

d_1=Uniform control delay (s/veh)

C=Cycle length (s)

g=Effective green time for lane group (s)

X= v/c ratio for the lane group

The Progression Adjustment Factor (PF) used in the delay formula to account for the effects of the signal progression on the calculated delay is determined according to the following formula:

$$PF = \frac{(1-P)f_{PA}}{1-\left(\frac{g}{C}\right)} \tag{2.26}$$

Where

PF=Progression Adjustment Factor

P=Proportion of vehicles arriving on green

g/C=proportion of green time

fPA=supplemental adjustment factor for platoon arriving during green

Progression adjustment factors for different g/C ratios and different arrival types are listed in Table 2.2 [12].

Table 2.2. Progression adjustment factors (PF)

Green Ratio (g/C)	AT 1	AT 2	AT 3	AT 4	AT 5	AT 6
0.20	1.167	1.007	1.000	1.000	0.833	0.750
0.30	1.286	1.063	1.000	0.986	0.714	0.571
0.40	1.445	1.136	1.000	0.895	0.555	0.333
0.50	1.667	1.240	1.000	0.767	0.333	0.000
0.60	2.001	1.395	1.000	0.576	0.000	0.000
0.70	2.556	1.653	1.000	0.256	0.000	0.000
f_{PA}	1.00	0.93	1.00	1.15	1.00	1.00

(Source: [12], Ch. 16, pg. 20)

2.4.5.2. Incremental Delay, d_2. The incremental delay component accounts for the delay due to the non-uniform arrivals, temporary cycle failures (random delay) and sustained periods of oversaturation (oversaturation delay). Incremental delay is calculated according to the following formula:

$$d_2 = 900T\left[(X-1)+\sqrt{(X-1)^2+\frac{8klX}{cT}}\right] \tag{2.27}$$

Where

d_2=Incremental delay (s/veh)

T=Duration of analysis period (h)

k=Incremental delay factor depending on the controller settings

l=Upstream filtering/metering adjustment factor

c=Lane group capacity (vph)

X= v/c ratio for the lane group

The adjustment term, *k*, is introduced in the equation to incorporate the effect of the controller type on the delay. The factor is equal to 0.50 for the pretimed signal controls, whereas the factor is below 0.50 for the actuated controls to reflect the ability of these controls to change the controller settings according to the demand, and therefore reduce the incremental delay.

Table 2.3 provides the values for k factor depending on the degree of saturation at the intersection and the unit extension of the controller.

Table 2.3. k-Values for different degree of saturation and unit extensions

Unit Extension (s)	Degree of Saturation (X) ≤0.50	0.60	0.70	0.80	0.90	≥1.0
≤2.0	0.04	0.13	0.22	0.32	0.41	0.50
2.5	0.08	0.16	0.25	0.33	0.42	0.50
3.0	0.11	0.19	0.27	0.34	0.42	0.50
3.5	0.13	0.20	0.28	0.35	0.43	0.50
4.0	0.15	0.22	0.29	0.36	0.43	0.50
4.5	0.19	0.25	0.31	0.38	0.44	0.50
5.0	0.23	0.28	0.34	0.39	0.45	0.50
Pretimed or Nonactuated Movement	0.50	0.50	0.50	0.50	0.50	0.50

(Source: [12], Ch. 16, pg. 22)

The upstream adjustment factor, *l*, in the equation incorporates the effects of metering arrivals from upstream signals. For the isolated intersections, the factor equals to 1.0.

2.4.5.3. Initial Queue Delay, d_3. Existence of queue at the beginning of the analysis period which is remaining from the previous period causes additional delays to the vehicles arriving during the period since first the vehicles in this queue need to clear the intersection. In order to define the reflection of this queue to the vehicles arriving during the period of analysis, the following formula is used.

$$d_3 = \frac{1800 Q_b (1+u) t}{cT} \tag{2.28}$$

Where

d_3=Initial queue delay (s/veh)

Q_b=Initial queue at start of period T (veh)

c=Lane group capacity (vph)

T=Duration of analysis period (h)

t=duration of unmet demand in T (h)

u=delay parameter

The parameters t and u are determined according to the following equations:

$$t = 0 \; if \; Q_b = 0 \text{, } else \;\; t = \min\left\{T, \frac{Q_b}{c[1-\min(1,X)]}\right\} \text{, and} \tag{2.29}$$

$$u = 0 \; if \; t < T \text{ , } else \;\; u = 1 - \frac{cT}{Q_b[1-\min(1,X)]} \tag{2.30}$$

Where

X= v/c ratio for the lane group

2.4.6. Computer Programs Used

2.4.6.1. TEAPAC/SIGNAL 97 and TEAPAC/SIGNAL 2000. One of the computer programs used for the purpose of this thesis was TEAPAC created by Strong Concepts Inc. [16]. Signal 97 and Signal 2000 are two modules generated for analysis and design of signalized intersection in accordance with HCM 1997 and HCM 2000 respectively. Signal 2000 is an updated version of Signal 97 to include the changes made in HCM 2000 version.

Both of the programs use the formulas and methodologies set out by HCM 1997 and HCM 2000 for analysis of signalized intersections.

2.4.6.2. Synchro 6. Synchro Version 6 (build 612) [17], created by Trafficware Corporation was also used for evaluation of the intersection data collected. The program utilizes HCM 2000 formulation and Percentile Delay Method for calculation of delay at signalized intersections. Both of the methods were executed for comparison with the actual field measures.

The basic premise of the Percentile Delay Method is that traffic arrivals will vary according to a Poisson distribution. The Percentile Delay Method calculates the vehicle delays for five different scenarios and takes a volume weighted average of the scenarios. The five scenarios are the 10th, 30th, 50th, 70th, and 90th percentile scenarios. If traffic is observed for 100 cycles, the 90th percentile would be the 90th busiest, the 10th percentile would be the 10th busiest, and the 50th percentile would represent average traffic. It is assumed that each of these scenarios will be representative for 20 per cent of the possible cycles.

The traffic volumes for each scenario are adjusted up or down according to the following formulas. The expected number of vehicles, λ, is the hourly flow rate divided by the number of cycles per hour.

$$\lambda = v * \frac{C}{3600} \tag{2.31}$$

Where

v = Volume (vph)

C = Cycle Length (s)

The variance, or standard deviation, in traffic is the square root of the expected number of vehicles for a Poisson arrival.

$$\rho = \text{Sqrt}(\lambda) = \text{standard deviation in expected arrivals per cycle} \tag{2.32}$$

The expected number of vehicles for a given percentile can be calculated using a Poisson distribution. This is given by the formula:

$$vP = (\lambda + z\rho) * \frac{3600}{C} = \text{volume for percentile P} \tag{2.33}$$

Where

C= Cycle Length

z is the number of standard deviations needed to reach a percentile from the mean. It can be determined from Table 2.4.

Table 2.4. z values for different percentiles

Percentile	z
10	-1.28
30	-0.52
50	0
70	0.52
90	1.28

The simplified formula to determine adjusted volumes is thus:

$$vP = v + \left[z * \sqrt{(v * C / 3600)}\right] * \frac{3600}{C} \tag{2.34}$$

with vP $\geq$ 0

3. METHODOLOGY

In order to achieve the goals of this study the data required were collected. Data collection was performed in two ways: The intersection data of the previous studies were gathered and reorganized and data at an oversaturated intersection were collected through site surveys. The data of previous studies included the studies made by (i) Ozdemir (2001) [18] ; (ii) Ergun, Bayraksan, and Coskun (2000) [19]; and (iii) Ergun (2006) [20].

The studies from which the data were obtained were with small sample sizes which indicate dependence on local conditions of intersections, weather conditions, surveyor, characteristics of the users of the intersection at that specific time, and similar factors. Therefore, one of the targets of this thesis was to collect as many data as possible in order to be more representative of real life delay occurrences at signalized intersections in Istanbul.

The intersections studied, as per the objective of this thesis, are the intersections for which field delay studies were conducted. Since the aim of this thesis is to analyze the relationship between the field measurements and calculations, the intersection data archive was reviewed to select the available data and suitable intersections.

The data collected included traffic flow volumes, existing signal timings, heavy vehicle percentages, lost time data, and the actual delay values measured in the field. The data gathered from the review of available data included 38 delay studies conducted for different approaches of different intersections with different locations and signal parameters.

The available data for analysis were mainly unsaturated intersections. All of the available studies for oversaturated intersections were either too oversaturated so that the end of the queue cannot be observed or the oversaturation was due to the spill back effect of the downstream intersection. Besides these unfavorable conditions, policemen were regulating the traffic at some of these intersections which means that the signals cannot be tested for these intersections. Therefore, in order to evaluate the oversaturated intersections, a field measurement survey was conducted for Dolmabahce Intersection in Istanbul.

After collection of the field data and field delay measurements, the software programs Signal 97, Signal 2000 and Synchro 6 were used to obtain the delay estimates by various delay formulas. The calculated delay and actual field measurements are then compared and linear regression is used to seek the relationship between the field values and calculated values.

The delay measurements of the oversaturated intersection were also compared with the delay calculation from the arrival-departure curves.

3.1. Measurement of Delay

For the measurement of delay in the field, the procedure described in HCM 2000 [12] for field measurement of control delay was used. Accordingly the physical data about the intersection geometry, signal parameters and traffic parameters were obtained. These data included number of lanes, cycle length, approaches and estimated free flow speed. The number of vehicles in queue was recorded at regular intervals throughout the survey time. The intervals were selected so that they were not an integer divisor of the cycle length.

The other information recorded while counting the number of vehicles in queue included end of queue at each cycle, total arriving vehicles, total stopping vehicles. The measurement of delay in the field depends on the assumption that the vehicles counted in the queue at the end of the count interval experience delay throughout the interval. The acceleration – deceleration delay correction factor (CF) is also calculated and applied in the calculation of the control delay.

3.2. Assumptions

The calculation of delay at the intersections studied requires some assumptions. The following assumptions were made for the indicated parameters.

3.2.1. Saturation Headway

The headway measured as the part of the study of Ozdemir [18] was assumed to be valid for all intersections studied. Therefore, the headway of 1.904 seconds was used for the objectives of this thesis. HCM uses default headway as 1.895 seconds which corresponds to 1,900 vphpl saturation flow rate.

3.2.2. Saturation Flow Rate

Based on the same study of Ozdemir [18], the saturation flow rate was used in the calculations as 1,891 vphpl. The HCM 2000 default value for saturation flow rate is 1,900 vphpl.

3.2.3. Lost Time

The study performed by Ozdemir [18] showed that the average start up lost time was 2.3 seconds, and the clearance lost time was 1.3 seconds. Based on these findings, the total lost time was taken as 3.6 seconds for the purpose of this thesis.

3.3. Analysis of Data

The intersection data were applied to obtain the results of delay calculations based on different models using different traffic analysis programs. These programs were *Signal 97*, which applies Highway Capacity Manual 97 formulation; *Signal 2000*, which implements HCM 2000 formulation; and Synchro, which provides calculations using both HCM 2000 formulation and Percentile Delay Method.

The applicability of the formulas to the oversaturated intersections was tested through analysis of the data collected from the oversaturated Dolmabahce Intersection. The queuing profile of the intersection was generated and the formulas were applied to the data obtained from the intersection.

The results of the calculations were compared with the actual delay measured in the field to find the validity of the models for the Istanbul. The relationship between the model results and actual measurements were analyzed by linear regression in order to create a formula for modification of the models to reflect the actual case in Istanbul. In this process, the Statistical Data Analysis tools of MS Excel were used.

The data obtained for the oversaturated intersection was also applied into the software programs and the results of the programs were obtained. Also time dependent queuing behavior of the observed approach was analyzed and the delay was calculated from the arrival and departure flows diagram created. The delay was measured in the field for two separate periods and the results of delay calculations through various methods were compared and analyzed.

4. DATA COLLECTION

In this study 38 intersection approaches from previous studies and one approach from the oversaturated Dolmabahce Intersection were analyzed. The existing intersection data used in these analyses were collected from three previous studies done in 2001 [18], 2000 [19] and recently in 2006 [20].

The study done in year 2001 [18] examined four intersections, namely Sarayburnu, Ahırkapı, Akmerkez and Silivrikapı intersections. The purpose of the study was to optimize the signaling parameters. However, delay studies were also conducted at two of these intersections, which were Sarayburnu and Ahırkapı intersections. The data for the purpose of this thesis were available for these two intersections. The delay measurements performed for these intersections included both before and after optimization situations. Therefore, the data available from this study included 14 approaches.

The data collected in the study conducted in year 2000 were for Silivrikapı intersection. This study also included optimization and resulted with two alternatives of optimized signal phases. As a result, delay field surveys were performed for three signaling situations and therefore provided delay data for 12 approaches.

The intersection data collected in 2005 includes five intersections (Unverdi, Yayla, Kocasinan Girisi, Sirinevler and UEFA Intersections) and 12 approaches.

The data obtained from these studies provided 38 approaches for which all the signal parameters, intersection characteristics, and traffic flow characteristics as well as control delay measured in the field were available. The data collected at these intersections were reorganized for analysis. The approaches that were analyzed were numbered and listed in Table 4.1.

Table 4.1. Summary intersection data worksheet

Intersection		Data Nr.	Analysis Period	Approach
Number	Name			
1109	Sarayburnu Intersection	1	AM PEAK (Existing)	EB
		2	AM PEAK (Optimized)	EB
		3	AM PEAK (Existing)	WB
		4	AM PEAK (Optimized)	WB
		5	PM PEAK (Existing)	EB
		6	PM PEAK (Optimized)	EB
		7	PM PEAK (Existing)	WB
		8	PM PEAK (Optimized)	WB
1102	Ahırkapı Intersection – A	9	AM PEAK (Existing)	SB
		10	PM PEAK (Existing)	SB
		11	PM PEAK (Optimized)	SB
	Ahırkapı Intersection – B	12	AM PEAK (Existing)	NB
		13	PM PEAK (Existing)	NB
		14	PM PEAK (Optimized)	NB
1162A	Unverdi Intersection	15	OFF-PEAK	WB
		16	OFF-PEAK	EB
		17	OFF-PEAK	NB
		18	OFF-PEAK	SB
1163	Yayla Intersection	19	OFF-PEAK	EB
		20	OFF-PEAK	WB
1164	Kocasinan Girisi Intersection	21	OFF-PEAK	EB
		22	OFF-PEAK	WB
1165	Şirinevler Intersection	23	OFF-PEAK	EB
		24	OFF-PEAK	WB
1426	UEFA Intersection	25	OFF-PEAK	EB
		26	OFF-PEAK	WB
1115	Silivrikapı Intersection	27	OFF-PEAK (Existing)	SB
		28	OFF-PEAK (Existing)	WB
		29	OFF-PEAK (Existing)	NB
		30	OFF-PEAK (Existing)	EB
		31	OFF-PEAK (Optimized – Alt1)	SB
		32	OFF-PEAK (Optimized – Alt1)	WB
		33	OFF-PEAK (Optimized – Alt1)	NB
		34	OFF-PEAK (Optimized – Alt1)	EB
		35	OFF-PEAK (Optimized – Alt2)	SB
		36	OFF-PEAK (Optimized – Alt2)	WB
		37	OFF-PEAK (Optimized – Alt2)	NB
		38	OFF-PEAK (Optimized – Alt2)	EB

The Dolmabahce Intersection was selected for oversaturated intersection analysis. The camera record of the intersection was obtained for the evening peak period. The traffic data and delay measurements were then collected from the camera record in accordance with the HCM procedures as explained in Section 3.

The data collected at Dolmabahce Intersection included arrival rates and departure rates for southbound approach, volumes of eastbound and westbound traffic, control delays incurred by the southbound approach, signal parameters and the intersection geometrical data.

In order to analyze the development of queue and delay at oversaturated intersection approaches, the field survey started at 16:30 just before the start of the peak period and the start of the queue. The vehicles arriving to and departing from the intersection were counted for every 10 seconds in order to develop the arrival and departure pattern for the southbound approach which was studied. The vehicles departing from the other approaches were also counted for every 10 seconds.

The length of the queue of southbound approach has grown beyond the range of observations in 30 minutes after the start of the study. Therefore, the study period was limited to 30 minutes field study since it was impossible to count the arriving vehicles.

Delay measurement in field was made for two separate 10-min periods in the study period in order to evaluate the effect of queue length in delay calculation and measurement. The first survey was done for the duration between the 1:30 and 11:30 minutes (survey period 1) and the second survey was conducted for the between 16^{th} and 26^{th} minutes (survey period 2) of the counting period. The field delay study procedure described in HCM 2000 was implemented for the purpose of this measurement. Count interval was selected as 15 seconds which is not an integer divisor of the cycle length. The delay measurement information collected for two periods were applied in the field control delay calculation procedure described in HCM 2000. The data and calculations for the two periods are shown in Table 4.2 and 4.3.

Table 4.2. Intersection control delay worksheet for survey period Nr. 1

Intersection : DOLMABAHCE **Date:** 08.05.2006

Survey Period: AM Peak **( )** Off Peak **( )** PM Peak **(x)**

Crossing Streets:

Observers: Volkan Coskun

Approach & Lane Group: Southbound (towards sea)

No. Of Lanes (L) = 3 ***Free Flow Speed =*** 40 *km/h*

Survey Count Interval (I) = 15 *sec.*

Survey Time = 10 *min.* ***Clock Time:*** 16:30 - 16:40

Cycle Length (C) = 110 *sec.* ***Green/Yellow Intervals =*** 48/2

		COUNT INTERVAL									
Clock Time	**Cycle No**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
16:30	1	38	48	60	72	59	47	24			
	2	32	50	61	67	67	55	45			
16:35	3	45	54	59	68	64	47	34	24		
	4	48	55	71	71	59	37	18			
	5	38	57	66	78	71	58	41			
16:40	6	38	54	66	74	59	41	27	20		
	7	20	20	20	9	0					
	8										
	9										
	10										
TOTALS :		259	338	403	439	379	285	189	44	0	0

Total Vehicle-In-Queue Count (π V_{iq}) = 2336 (sum Totals row)

No. Of Cycles Surveyed (N_c) = 5.45 (Survey Time / Cycle Length)

V_{tot} = 354

V_{stop} = 354

Fraction of Veh. Stopping (FVS) = 1.00 (V_{stop} / V_{tot})

Avg. No. Veh. Stopping per Lane each Cycle = 21.63 (V_{stop} / (N_c x L))

Acc.-Dec. Delay Correction Factor (CF) = -1

Time in Queue / Veh. = 89.08 sec. (I x (π V_{iq} / V_{tot}) x 0.9)

Correction = -1.00 sec. (CF x FVS)

Control Delay / Veh. = 88.08 sec. (Time in Queue/Veh. + Correction)

Table 4.3. Intersection control delay worksheet for survey period Nr. 2

Intersection : DOLMABAHCE ***Date:*** 08.05.2006

Survey Period: AM Peak **( )** Off Peak **( )** PM Peak **(x)**

Crossing Streets:

Observers: Volkan Coskun

Approach & Lane Group: Southbound (towards sea)

No. Of Lanes (L) = 3 ***Free Flow Speed =*** 40 *km/h*

Survey Count Interval (I) = 15 *sec.*

Survey Time = 10 *min.* ***Clock Time:*** 16:46 - 16:59

Cycle Length (C) = 110 *sec.* ***Green/Yellow Intervals =*** 48/2

		COUNT INTERVAL									
Clock Time	**Cycle No**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
16:46	1	14	23	33	39	49	59	45			
	2	48	68	77	88	85	83	77			
16:51	3	67	71	71	71	105	109	101	86		
	4	72	79	79	95	107	97	88			
	5	83	81	88	94	103	97	84			
16:56	6	76	66	66	95	95	69	51	34		
	7	34	34	34	34	34	34	18	4	0	
	8										
	9										
	10										
TOTALS :		394	422	448	516	578	548	464	124	0	0

Total Vehicle-In-Queue Count (ΣV_{iq}) = 3494 (sum Totals row)

No. Of Cycles Surveyed (N_c) = 5.45 (Survey Time / Cycle Length)

V_{tot} = 380

V_{stop} = 380

Fraction of Veh. Stopping (FVS) = 1.00 (V_{stop} / V_{tot})

Avg. No. Veh. Stopping per Lane each Cycle = 23.22 (V_{stop} / (N_c x L))

Acc.-Dec. Delay Correction Factor (CF) = -1

Time in Queue / Veh. = 124.13 sec. (I x (ΣV_{iq} / V_{tot}) x 0.9)

Correction = -1.00 sec. (CF x FVS)

Control Delay / Veh. = 123.13 sec. (Time in Queue/Veh. + Correction)

5. DATA ASSESSMENT

The data collected was used in Signal97, Signal2000, and Synchro 6 computer programs for analysis of the situation at the intersections and calculation of the control delay according to different delay formulas. Signal97 program uses the HCM 1997 formula and provides the delay results accordingly. Signal 2000 program uses HCM 2000 delay formula for calculation of delay. Synchro 6 program can provide results for delay calculation using both HCM 2000 formulation and Percentile Delay Method. The data were analyzed using both methods. The results of HCM 2000 formulation were compared with the ones obtained from Signal 2000 in order to evaluate any difference, if there were, between two applications of the same formulation. The outputs of the program runs for the intersections analyzed are provided in the Appendices.

The computer analyses were also compared for calculation of approach v/c ratios. Since the v/c ratio is directly related to the average delay on the approach, the differences on delay calculation outcomes were expected to be reflected to the v/c calculations of the programs.

5.1. Evaluation of Validity of Formulas

5.1.1. Unsaturated Intersections

The results of different delay calculations and the actual field measurement were used in assessment of relationships between the actual delays measured in the field and the estimated delays. The list of the program outputs and field measurements are summarized in Table 5.1. For the purpose of evaluating the relationship between the actual field data and computer calculations through regression analysis, Statistical Data Analysis tools of MS Excel were used.

Table 5.1. Delay measurements and calculations (sec/veh)

Intersection Nr.	Data Nr.	Field	Signal 97	Signal 2000	Synchro HCM	Synchro PDM*
1109	1	4.70	4.80	7.50	4.50	3.30
	2	3.87	3.60	6.20	3.50	2.50
	3	9.82	8.00	13.10	9.30	9.70
	4	5.93	6.10	10.70	7.10	7.30
	5	8.87	9.00	15.10	9.50	9.80
	6	6.09	6.30	11.60	6.70	6.80
	7	4.88	4.50	7.80	4.70	4.80
	8	3.80	3.20	6.10	3.30	3.40
1102	9	11.39	7.90	10.60	7.70	7.20
	10	12.86	9.70	14.60	9.10	9.30
	11	12.77	9.60	13.40	8.90	9.20
	12	2.35	5.50	9.40	5.20	5.40
	13	4.35	4.40	7.80	4.20	4.30
	14	4.21	4.30	7.10	4.10	4.20
1162A	15	67.68	115.70	128.80	99.10	97.40
	16	26.73	44.10	49.50	54.00	52.50
	17	36.99	55.80	67.90	49.80	51.30
	18	53.28	77.00	103.30	128.10	126.40
1163	19	24.66	20.00	21.80	21.60	22.00
	20	9.54	18.90	19.60	19.60	19.50
1164	21	8.46	6.30	6.70	10.00	36.90
	22	11.34	9.60	12.40	11.70	12.60
1165	23	5.04	4.50	4.90	4.80	4.90
	24	1.53	12.60	13.30	11.40	11.50
1426	25	13.14	12.00	12.80	12.60	12.90
	26	7.11	7.50	8.10	20.60	190.50
1115	27	14.55	15.10	15.30	14.70	14.80
	28	28.81	29.30	34.50	31.10	23.20
	29	11.48	13.70	13.50	13.00	13.30
	30	39.46	30.80	37.70	32.70	20.70
	31	6.81	9.40	9.60	9.50	9.60
	32	19.83	21.50	35.10	24.00	17.60
	33	6.21	8.50	8.30	8.40	8.60
	34	28.41	22.20	35.90	26.50	21.30
	35	8.39	10.90	10.30	10.30	10.30
	36	32.41	29.70	34.20	30.80	20.90
	37	8.98	10.30	9.70	9.70	9.90
	38	37.15	37.50	52.30	41.40	32.00

* PDM: Percentile Delay Method

The results of the analysis of the intersections were applied paired t-test in order to test the hypothesis that the means are not different at 95 per cent confidence level. The test for delay estimates according to HCM 1997 using Synchro 97 software and according to HCM 2000 using Signal 2000 resulted with the rejection of the hypothesis (P-value 8.74×10^{-06}). Also, the test for estimates of HCM 2000 formula by Signal 2000 and Synchro

HCM rejected the hypothesis (P-value 0.04). The hypothesis were not rejected by the other tests.

It was seen from the analyses that the estimates of HCM 1997 and HCM 2000 were different, although there is no change in delay formulation of HCM 1997 and HCM 2000. The differences between HCM 1997 and HCM 2000 regarding analysis of signalized intersections are [21];

- New adjustment factors are added for pedestrians and bicyclists in HCM 2000
- A back-of-queue model is developed in HCM 2000
- Saturation flow rate adjustment for protected plus permitted left turns from a shared lane now requires to be divided for protected and permitted.

The difference between the analyses made using Singal 97 and Signal 2000 were due to the new back-of-queue model developed in HCM 2000. Table 5.1 shows that the estimates of HCM 2000 formula using Synchro HCM method and using Signal 2000 were also different despite the fact that both apply HCM 2000. The main reason for this difference is that Synchro HCM method doesn’t consider initial queue delay component of HCM formula since it includes a measure for queue interaction to solve the intersections on an arterial. In addition to this difference, the platoon factor used does not match HCM, the input data are different and there are rounding differences [17].

The differences between the field measurement and computer calculations for some of the data were over 50 per cent of the field measurements. Especially data numbers 12, 20, and 24 shows differences more than 100 per cent of the actual field data. The comparison for data number 24 indicates a possible error in field measurement of delay for westbound approach in Sirinevler Intersection. Despite these high differences, all the data obtained were included in the analysis. Only one data item (#26) was not included in analysis of Synchro Percentile Delay Method outcomes due to the unreasonable difference with the actual field measurement (2579 per cent).

The Percentile Delay Method of Synchro software estimates delay using five different scenarios of the 10th, 30th, 50th, 70th, and 90th percentiles. The program assumes that each of these scenarios would be representative for 20 per cent of the possible cycles and takes a volume weighted average of the scenarios.

As mentioned above, the results of the computer simulations were also compared for consistency of the v/c ratios obtained shown in Table 5.2. The comparison showed that the v/c ratios calculated by different programs were similar although there were differences in delay estimates. It could be concluded from this comparison that the calculation of adjusted volumes and capacities were similar, and therefore the differences in delay estimates were not due to the calculation of adjusted volumes and capacities.

The delay estimates were analyzed for representation of the field delay measurements. The data numbers 15, 16, 17 and 18, which were obtained for Unverdi Intersection (Intersection Nr. 1162), were excluded from the evaluation since the intersection was saturated. The evaluation of delay estimates for this intersection is done in Section 5.1.2

As the first step of statistical analysis, linear relationship was assumed for the regression analyses of the delay estimates and actual delay measured. A linear relationship would allow developing an adjustment coefficient for the delay estimates. This assumption was tested for each regression model through analysis of the distribution of residuals. Residuals were randomly distributed for all of the regression models, which indicated that the assumption of linear relationship can be accepted valid. Therefore, nonlinear regression was not considered necessary.

Table 5.2. Volume/capacity ratios obtained from different programs

Intersection Nr.	Data Nr.	Signal 97	Signal 2000	Synchro HCM	Synchro PDM*
1109	1	0.34	0.31	0.28	0.29
	2	0.32	0.29	0.26	0.28
	3	0.72	0.71	0.74	0.74
	4	0.68	0.67	0.70	0.70
	5	0.80	0.78	0.77	0.77
	6	0.75	0.73	0.73	0.73
	7	0.37	0.37	0.38	0.38
	8	0.35	0.34	0.36	0.36
1102	9	0.27	0.23	0.24	0.24
	10	0.76	0.70	0.69	0.69
	11	0.79	0.72	0.72	0.72
	12	0.67	0.63	0.62	0.62
	13	0.41	0.39	0.38	0.38
	14	0.43	0.40	0.39	0.39
1162A	15	1.15	1.18	1.08	1.08
	16	0.92	0.95	0.93	0.93
	17	0.95	1.00	0.96	0.96
	18	1.01	1.09	1.18	1.18
1163	19	0.66	0.68	0.67	0.67
	20	0.56	0.57	0.57	0.57
1164	21	0.52	0.53	0.78	1.00
	22	0.44	0.45	0.45	0.45
1165	23	0.34	0.35	0.34	0.34
	24	0.58	0.59	0.45	0.45
1426	25	0.69	0.71	0.70	0.70
	26	0.66	0.67	0.91	1.37
1115	27	0.61	0.61	0.59	0.59
	28	0.58	0.64	0.48	0.55
	29	0.49	0.48	0.48	0.48
	30	0.35	0.42	0.21	0.34
	31	0.58	0.58	0.57	0.57
	32	0.65	0.83	0.56	0.65
	33	0.47	0.45	0.46	0.46
	34	0.38	0.53	0.29	0.42
	35	0.50	0.45	0.44	0.45
	36	0.56	0.61	0.42	0.51
	37	0.44	0.38	0.38	0.38
	38	0.46	0.54	0.30	0.43

* PDM: Percentile Delay Method

5.1.1.1. <u>Analysis of Signal 97 Program Delay Estimates.</u> The results obtained by HCM 1997 formulation from Signal 97 analysis were compared with the actual field measurements for searching a linear relationship. Accordingly, linear regression analysis was applied to the delay estimates of Signal 97. The analysis provided the results shown in Table 5.3.

Table 5.3. Regression analysis of delay estimates of Signal 97

Regression Statistics	
Multiple R	0.9356
R Square	0.8753
Adjusted R Square	0.8714
Standard Error	3.6409
Observations	34

ANOVA

	df	*SS*	*MS*	*F*	*Sig. F*
Regression	1	2978.06	2978.06	224.66	5.08E-16
Residual	32	424.19	13.26		
Total	33	3402.26			

	Coef.	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	-0.79	1.08	-0.73	0.4689	-2.98	1.40	-2.98	1.40
Signal 97	1.069	0.07	14.99	5.08E-16	0.92	1.21	0.92	1.21

The resulting regression model had a coefficient of determination, R^2, of 0.8753 which denotes a very good relationship. The F-test of the model showed that the relationship was valid with a significance of F-value of $5.08 x 10^{-16}$. Since the relationship was only for one variable, the significance of the coefficient was the same with significance of F-value as shown by the t-test of the coefficient.

The t-test for the intercept indicated that the intercept was not significant. Therefore, the intercept was not significantly different than zero.

It could be interpreted from the regression model that Signal 97 underestimated the delay by 6.9 per cent compared to the actual field delays for the data analyzed. Therefore, the results of the Signal 97 calculations can be adjusted with the following formula to represent the actual field data. The relationship is also shown on Figure 5.1:

$$y = -0.79 + 1.069x \tag{5.1}$$

Where

x= Signal 97 Estimate

y= Actual Delay

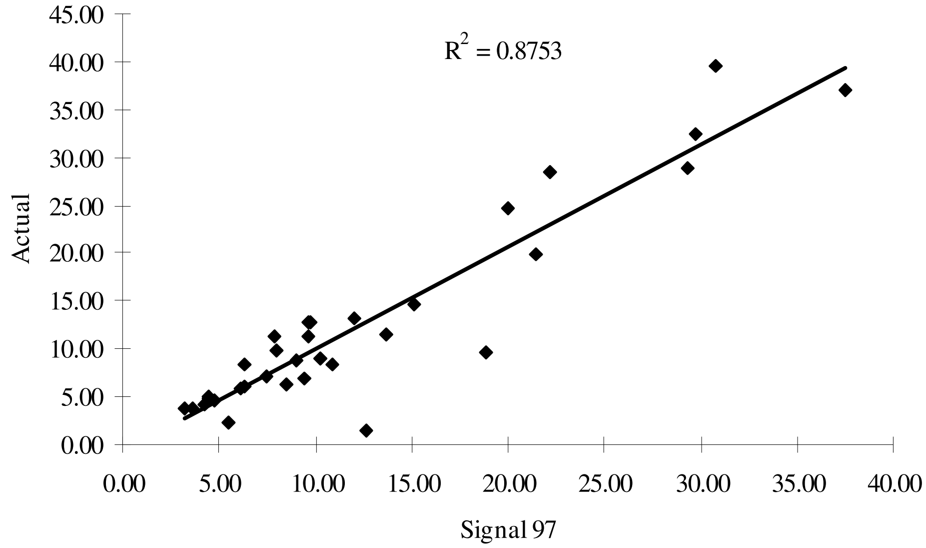


Figure 5.1. Relationship between Signal 97 estimate and actual delay

The study conducted in year 2001 by Ozdemir [18] has analyzed four intersections by using Signal97 which applied HCM 97 formulas and procedures for the calculation of control or approach delay. According to the comparison of the field delay measurement and HCM 97 delay estimation in that study, there was a strong correlation between the two values with an R^2 of 0.936. The analysis concluded that the intercept was insignificant and the estimates of the HCM 97 formula calculated using Signal 97 software were 14.5 per cent lower than the actual field data.

$$\text{Field Delay Measurement} = -0.933 + 1.145 * (\text{HCM97 Delay Estimate}) \tag{5.2}$$

According to a similar analysis conducted at an intersection in 2000 by Ergun [19], the field delay measurement and HCM97 delay estimates had the following relationship with an R^2 of 0.940. The intercept in this analysis was found to be significant at a confidence level of 97 per cent.

$$\text{Field Delay Measurement} = -4.45 + 1.22 * (\text{HCM97 Delay Estimate}) \quad (5.3)$$

As it is seen from the above equations, the analyses of the same parameters in two separate studies have resulted that the delay estimates of HCM 97 were below the actual field measurement by 14.5 – 22 per cent.

5.1.1.2. Analysis of Signal 2000 Program Outputs. Linear regression analysis for relationship between HCM 2000 delay estimates from calculations of Signal 2000 and the actual field delay measurements provided the results summarized in Table 5.4.

Table 5.4. Regression analysis of delay estimates of Signal 2000

Regression Statistics	
Multiple R	0.9264
R Square	0.8583
Adjusted R Square	0.8539
Standard Error	3.8814
Observations	34

ANOVA

	df	*SS*	*MS*	*F*	*Sig. F*
Regression	1	2920.18	2920.18	193.84	3.97E-15
Residual	32	482.08	15.07		
Total	33	3402.26			

	Coef	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	-0.58	1.14	-0.51	0.6121	-2.91	1.74	-2.91	1.74
Signal 2000	0.818	0.06	13.92	3.97E-15	0.70	0.94	0.70	0.94

The linear regression model for the delay estimates of Signal 2000 showed that the relationship was significant according to the F-test. The R^2 obtained for the relationship was 0.8583 which also indicated that there was a very good relationship. The t-test for the intercept and coefficient results that the intercept was not significantly different than zero. Therefore, it could be interpreted that Signal 2000 overestimated delay using HCM 2000 method and the delay estimates of Signal 2000 can be adjusted with a coefficient of 0.818. The relationship between the Signal 2000 calculation and actual field data was as in the formulation given below and shown on Figure 5.2.

$$y = -0.58 + 0.818x \quad (5.4)$$

Where

x= Signal 2000 Estimate

y= Actual Delay

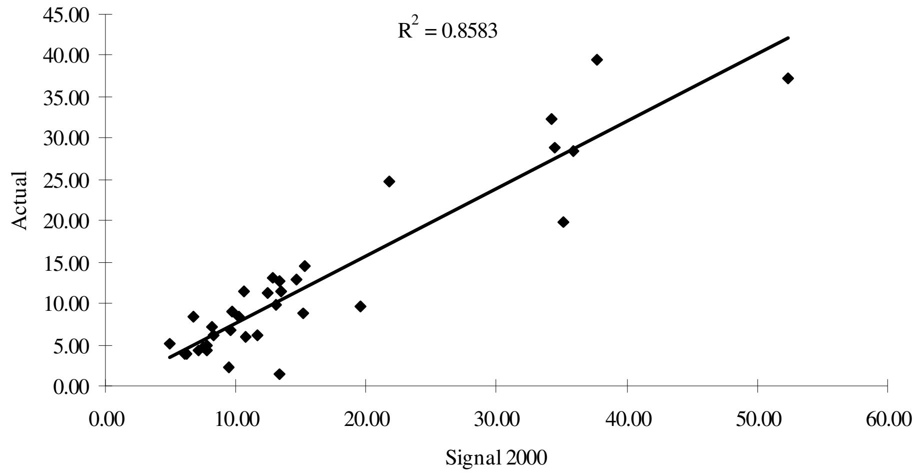


Figure 5.2. Relationship between Signal 2000 estimate and actual delay

5.1.1.3. Analysis of Synchro Program HCM Outputs. The relationship between delay estimates obtained by using the HCM 2000 option of Synchro Program and actual delay measurement on the field was analyzed. The results of the analysis are shown in Table 5.5.

Table 5.5. Regression analysis of delay estimates of Synchro HCM

Regression Statistics	
Multiple R	0.9205
R Square	0.8473
Adjusted R Square	0.8425
Standard Error	4.0297
Observations	34

ANOVA

	Df	*SS*	*MS*	*F*	*Sig. F*
Regression	1	2882.62	2882.62	177.52	1.33E-14
Residual	32	519.64	16.24		
Total	33	3402.26			

	Coef.	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	-0.39	1.18	-0.33	0.7447	-2.79	2.01	-2.79	2.01
Synchro HCM	0.956	0.07	13.32	1.33E-14	0.81	1.10	0.81	1.10

The analysis resulted with an R^2 value of 0.8473 which indicated a very good relationship. The F-test for the regression model also showed that the relationship was significant where the significance of F-value was 1.33 x 10^{-14}. The intercept included in the regression model was found to be insignificant as a result of the corresponding t-test and therefore could be accepted as zero. The results of the regression analysis showed that the HCM method of Synchro slightly overestimated the delay compared to the field value. The formula to adjust the Synchro HCM delay calculations to reflect the actual condition is as follows. The visual interpretation of the relationship is also provided in Figure 5.3.

$$y = -0.39 + 0.956x \tag{5.5}$$

Where

x= Synchro HCM Estimate

y= Actual Delay

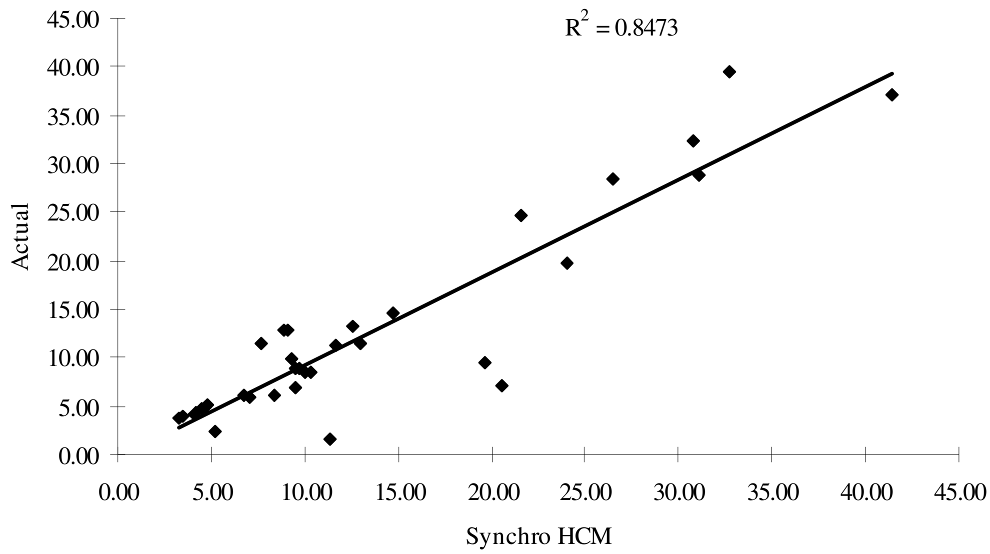


Figure 5.3. Relationship between Synchro HCM estimate and actual delay

5.1.1.4. Analysis of Synchro Program Percentile Delay Method Outputs. The delay estimates obtained from applying the data available to the Percentile Delay Method (PDM) of Synchro were compared with the actual field data. The data item #26 was excluded from the analysis due to the unreasonable difference between the field measurement and program output (2579 per cent). The outcomes of the regression analysis conducted are given in Table 5.6.

Table 5.6. Regression analysis of delay estimates of Synchro PDM

Regression Statistics	
Multiple R	0.7121
R Square	0.5071
Adjusted R Square	0.4912
Standard Error	7.3248
Observations	33

ANOVA

	df	*SS*	*MS*	*F*	*Sig. F*
Regression	1	1710.94	1710.94	31.89	3.36E-06
Residual	31	1663.25	53.65		
Total	32	3374.19			

	Coef.	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	1.56	2.32	0.67	0.5065	-3.17	6.28	-3.17	6.28
Synchro PDM	0.880	0.16	5.65	3.36E-06	0.56	1.20	0.56	1.20

As it is seen from the summary of the regression analysis, the coefficient of determination, R^2 value, of 0.5071 was obtained which showed a poor relationship. On the other hand, the F-test showed a significant relationship at a significance level of 3.36×10^{-6}. The intercept was found to be insignificant. Therefore, it was seen that Synchro PDM method has overestimated the delay at signalized intersections by 12 per cent at this significance and relationship levels. The equation for adjustment of the Synchro PDM delay estimates for representing the actual field delay is shown below. The visual interpretation of relationship is shown in Figure 5.4.

$$y = 1.56 + 0.880x \tag{5.6}$$

Where

x= Synchro PDM Estimate

y= Actual Delay

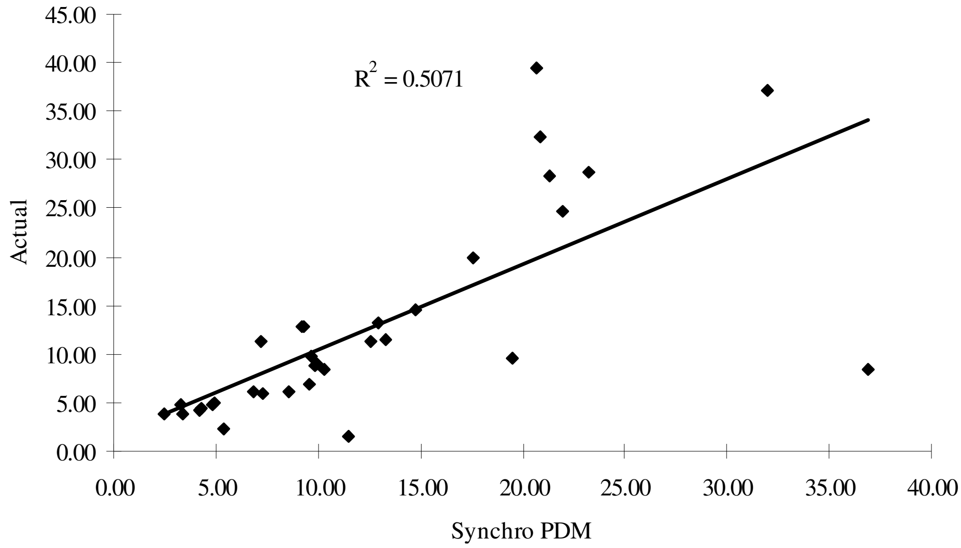


Figure 5.4. Relationship between Synchro PDM estimate and actual delay

The results of the regression analyses for the four delay estimates are summarized below in Table 5.7. The relations of the delay estimates with the actual delay are illustrated in Figure 5.5. According to these results of the regression analyses, delay estimates obtained by using Signal 97 which is based on HCM 1997 formulation showed the highest coefficient of determination with the actual delay compared to the other methods. The results also indicate that the delay estimates obtained from Signal 97 program were below the field measurement whereas the estimates of other methods were over the actual field delay.

Table 5.7. Summary of the regression analyses

	R Square	Significance F	Coefficient	Intercept
Signal 97	0.8753	5.08E-16	1.069	-0.79
Signal 2000	0.8583	3.97E-15	0.818	-0.58
Synchro HCM	0.8473	1.33E-14	0.956	-0.39
Synchro PDM	0.5071	3.36E-06	0.880	1.56

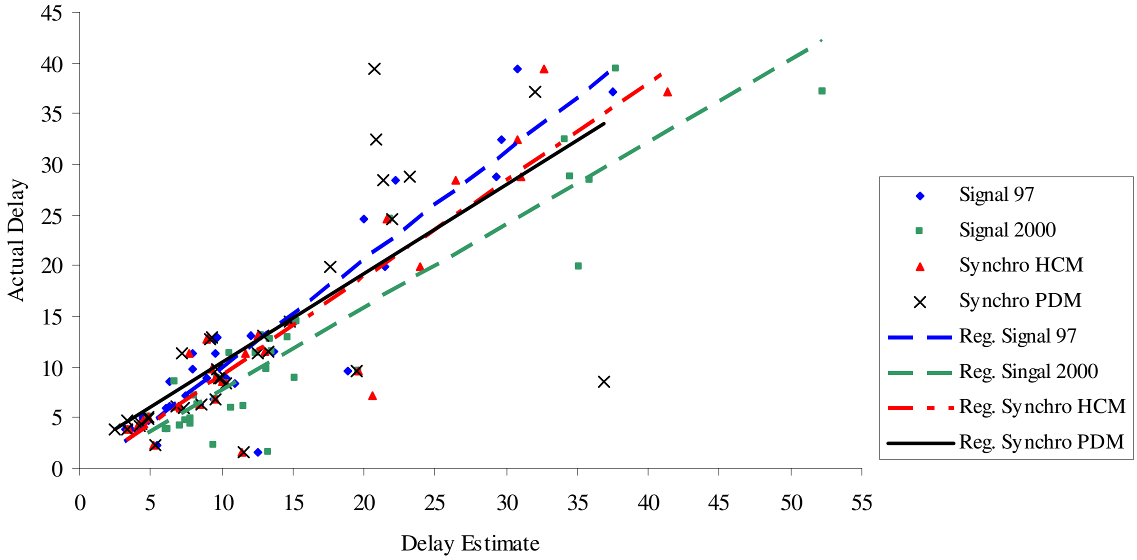


Figure 5.5. Summary of the delay estimates using different computer programs

5.1.2. Oversaturated Intersection Delay Analysis

In order to analyze the development of queue and delay at oversaturated intersection approaches, the field survey of the Dolmabahce Intersection, which was selected for analysis, started at 16:30 just before the start of the peak period and the start of the queue. The data collected at Dolmabahce Intersection included arrival rates and departure rates for southbound approach, volumes of eastbound and westbound traffic, control delays incurred by the southbound approach, signal parameters and the intersection geometrical data. The layout of the intersection studied is shown in Figure 5.6.

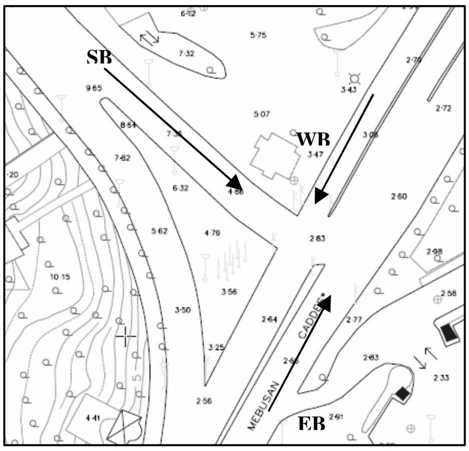


Figure 5.6. Layout of Dolmabahce Intersection

The vehicles arriving to and departing from the intersection were counted for every 10 seconds in order to develop the arrival and departure pattern for the southbound approach which was studied. The vehicles departing from the other approaches were also counted for every 10 seconds. The traffic flow pattern shown below on Figure 5.7 was obtained for the approach which indicates a typical oversaturated intersection performance. The traffic flow obtained was very similar to the theoretical oversaturated intersection flow diagram shown on Figure 2.4.

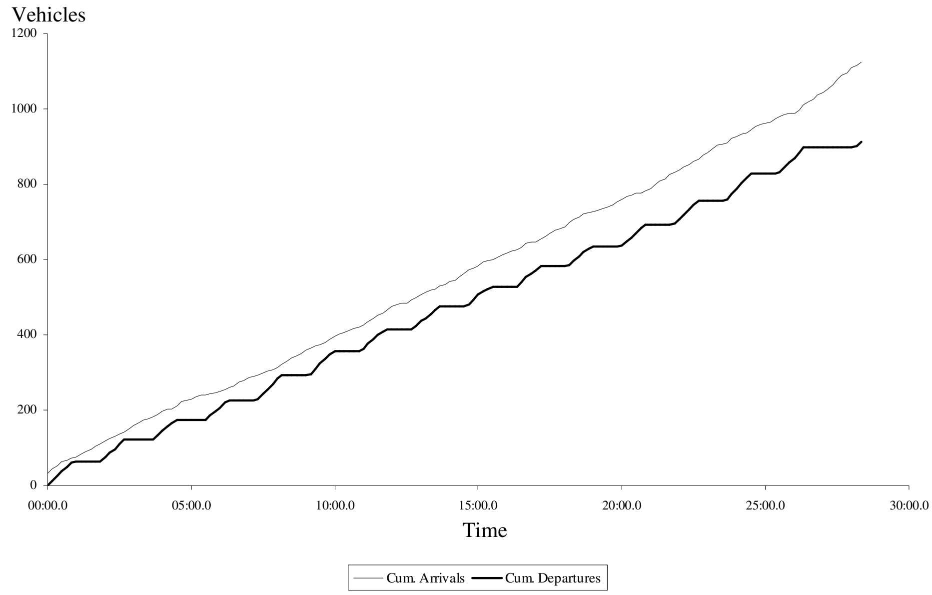


Figure 5.7. Traffic flow pattern for southbound approach of Dolmabahce Intersection

Field delay survey was also performed for two separate 10 minutes durations within the counting period. The first survey was done for the duration between the 1:30 and 11:30 minutes (survey period 1) and the second survey was conducted for the between 16th and 26th minutes (survey period 2) of the counting period. The aim of this was to test the sensitivity of the control delay field measurement method to the length of queue.

The delay was also calculated from the arrival and departure functions (Figure 5.7) and this calculation was used as comparison basis for the field delay measurements. The calculation of average delay using this graph was done by determining the area between the arrival and departure functions and dividing that by the departing vehicles within the period. This calculation method is named as "graph" method from this point forward.

The results of the field delay surveys and the graph calculations obtained for survey periods 1 and 2 and shown in Table 5.8. The average delay for the whole duration of study was also calculated from the graph and shown in the same table.

Table 5.8. Delay measurements through field surveys and flow diagrams

	Delay Measurements (sec/veh)				
	Survey Period 1 (01:30-11:30)		Survey Period 2 (16:00-26:00)		Whole Survey (00:00-30:00)
Approach	Field	Graph	Field	Graph	Graph
SB	88.08	83.57	123.13	187.22	142.29

As it is seen from Table 5.8, the field studies were close to match for the first survey period whereas the delay measurements through two different ways resulted with a considerable difference (34 per cent) for the survey period 2. HCM [12] states that the field surveys for control delay measurement are not very reliable for the cases where the average number of vehicles in the queue is over 30 per lane. This limit was exceeded many times during the second survey period. Based on the above-mentioned suggestions of HCM [12], it could be concluded that the control delay field survey for the second survey period may be misleading. Therefore the measurement through calculation of the area on the flow diagram, which was directly obtained from the arrival and departure rates of the traffic flow, could be accepted as more reliable for comparison with the delay estimates of formulas.

The overall study period at Dolmabahce intersection was limited at 30 minutes due to the extensive length of the queue at the end of the period which made it impossible to continue counting the length of queue and the arrival of vehicles. The average delay per vehicle for this period was measured as 142.29 seconds from the area between the arrival and departure graphs on Figure 5.7.

The data collected were implemented to the software programs and the results shown in Table 5.9 were obtained for the delay on the intersection approaches.

Table 5.9. Delay calculations of the software programs

	Delay Calculations (sec/veh)				
Approach	Graph	Signal 97	Signal 2000	Synchro HCM	Synchro PDM
SB*	142.29	59.02	122.40	61.20	61.60
EB	-	129.60	170.60	151.20	149.00
WB	-	30.04	32.90	31.40	31.90

* Approach used for oversaturated field delay study

As it is shown in Table 5.9 the delay estimates obtained from the computer analyses were below the average delay calculated from the graph. This result was contrary to the analyses of the unsaturated intersections shown in Section 5.1.1 which indicated that the delay estimates were over the field measurements (except HCM 1997 estimates). The analysis for the other oversaturated intersection data (Unverdi Intersection, Intersection Number 1162A) in Section 5.1.1 resulted that the analyses of the intersection overestimated delay which also contradicts with the analysis for the southbound approach of Dolmabahce Intersection.

The analyses performed using Signal 97 and Synchro resulted with substantially different (about 100 per cent) delay calculations than Signal 2000 for the oversaturated approaches. It was seen from the reports of the programs (see Appendices A, B, C and D) that the methods except Signal 2000 did not consider the initial queue delay component of HCM formula.

The data were also applied manually to the HCM delay formula in order to calculate the initial delay component (d_3) of the formula and add to the values obtained from Signal 97 and Synchro HCM method. The other components of the formula were also calculated in order to compare with computer analyses and actual field data. The equations for calculation of d_1, d_2, and d_3 components of HCM delay formula were given in previous sections as Equations (2.25), (2.27) and (2.28) respectively.

The manual calculation of delay components of HCM delay formula have resulted with the delay components shown in Table 5.10 for southbound approach of the analyzed intersection.

Table 5.10. Average delay for SB approach by manual HCM delay calculation (sec/veh)

Analysis Period (minutes)	d_1	d_2	d_3	Total Delay	Field Measured Delay	Delay from Graph
01:30 – 11:30	28.0	37.4	16.6	81.9	88.08	83.57
16:00 – 26:00	28.0	105.2	41.4	174.6	123.13	187.22
00:00 – 30:00	28.0	77.8	27.3	133.2	-	142.29

The result of the manual delay calculation using HCM formula has resulted with a delay figure relatively close to the delay measurements from the graph. The delays calculated for different periods were below the actual delay. The underestimation of the HCM formula manual calculation was in the range of 1.99 per cent for the first survey period, 6.74 per cent for the second period and 6.38 per cent for the whole survey. Table 5.11 indicates that the difference between the calculation using HCM formula and field measurement increased with the increasing oversaturation.

When the d_3 component obtained from the manual calculation was added to the results of the Signal 97 and Synchro HCM calculations, the total delay equaled to 86.32 and 88.50 sec/veh respectively.

The delay estimates according to the Percentile Delay Method of Synchro software were similar to the estimates of the same software using HCM 2000 formula.

In order to test its validity, the data were applied also to Akcelik's overflow delay formula shown in Equation 2.23. The calculated overflow delay using Akcelik's formula was added to the uniform delay formula result obtained in HCM delay calculation (d_1) and the average delay per vehicle for the period was obtained as shown in Table 5.11.

Table 5.11. Manual calculation of delay using Akcelik's overflow delay formula

Analysis Period (minutes)	Uniform Delay (sec/veh)	Overflow Delay (sec/veh)	Total Delay (sec/veh)	Delay from Graph
01:30 – 11:30	28.0	22.3	50.3	83.57
16:00 – 26:00	28.0	62.4	90.4	187.22
00:00 – 30:00	28.0	45.9	73.9	142.29

As it is seen from Table 5.11, Akcelik's formula underestimated the delay by 40 per cent to 52 per cent of the actual delay. The total delay did not include an initial queue delay component and therefore it was below the estimates of HCM formula. However, comparison of the overflow delay components of two formulas shows that Akcelik's formula has resulted with lower figures.

The results of all measurements and calculations explained above are summarized below in Table 5.12.

Table 5.12. Delay measurements and estimates for the oversaturated approach

	Delay (sec/veh)							
Analysis Period	Field	Graph	Signal 97*	Signal 2000	Synchro HCM*	Synchro PDM*	HCM Manual	Akcelik Manual
01:30 – 11:30	88.08	83.57	-	-	-	-	81.9	50.3
16:00 – 26:00	123.13	187.22	-	-	-	-	174.6	90.4
00:00 – 30:00	-	142.29	86.32	122.40	88.50	88.90	133.2	73.9

* Including Initial Queue Delay Component

6. SUMMARY AND CONCLUSIONS

The study included analysis of 38 approaches for unsaturated intersections and one oversaturated intersection. The data collected were analyzed using computer programs and delays were calculated using HCM 1997, HCM 2000 and Synchro PDM delay formulas. The estimates of these formulas were then compared with the actual field measurements. The comparisons were tested for linear regression and accordingly calibration models were obtained for these delay formulas. The conclusions obtained from the analyses are given below.

6.1. Unsaturated Intersections

The results of the field delay measurements and data analyses for the intersections analyzed under the scope of this thesis were described in Section 5. Accordingly, the following conclusions can be made for the analysis of the unsaturated intersections:

- The summary shown in Table 5.7 indicates that the coefficient of determination for the estimates of HCM 1997 by Signal 97 software was higher than the other estimates. It also shows that HCM 97 formulation underestimates the delay which was the results of the studies by Ozdemir and Ergun in years 2001 and 2000 respectively [18, 19] as well.

- The delay estimates of HCM 97 can be adjusted to reflect the field delay by using the coefficient of 1.069.

- The analysis of two different softwares, namely Signal 2000 and Synchro, using the HCM 2000 formulation resulted with different relations with the field data although both resulted with overestimation. The correction coefficients to represent the field delay for Signal 2000 and Synchro HCM estimates were found as 0.818 and 0.956 respectively. The main reason for this difference is that Synchro HCM method doesn’t include Queue Delay since it includes a measure for queue interaction to solve the intersections on an arterial. In addition to this difference, the platoon factor used does not match HCM and Signal 2000 factors.

- The analysis of the intersections using Percentile Delay Method (PDM) of Synchro software resulted delay estimates with a poor relationship to the actual delay with a coefficient of determination (R^2) of 0.5071. The F-test for the regression model resulted that there was a significant relation between the actual condition and delay estimates of PDM in which the delay estimates required to be multiplied by 0.88 in order to represent the actual delay. The creators of the software recommend this method as a better method for coordination of arterials and analysis of actuated signals. Also, it is noted in the manual of the software that the accuracy of the HCM method of Synchro is higher for delay estimates [17].

6.2. Oversaturated intersections

The conclusions of the analysis of the oversaturated intersections are as follows:

- The control delay field survey procedure described in HCM 2000 [12] resulted with delay figure close to the delay calculated from the arrival and departure rates of the vehicles when the queue length is not beyond 30 vehicles per lane. The result of the field measurement of control delay has departed from the actual delay, which was calculated from the arrival & departure graphs, as the queue length increased.

- Synchro intersection analysis program does not allow for an input of initial queue. This is because the software is aimed to be used for coordination of a series of intersections on an arterial and uses a measure for queue interaction to solve the intersections on the arterial.

- HCM 97 and HCM 2000 estimates for delay at the oversaturated approaches were found to be different using Signal software. The reason for this is that Signal 97 does not calculate initial queue component of HCM delay formula. According to the manual of Signal 97, the software uses Transyt formula for intersections with v/c ratio above 1.00 [22].

- The HCM 2000 analysis made for Unverdi intersection resulted with delay estimates over the actual delay measurements, whereas the Signal 2000 calculation for Dolmabahce intersection has underestimated the delay compared to the actual delay.

- Manual calculation of delay using HCM delay formula has resulted with delay estimates that were 1.99 – 6.74 per cent lower than the actual delay measurements.

- Akcelik's delay formula has underestimated the overflow delay by 40-50 per cent compared to the field measurements.

APPENDIX A: OUTPUTS OF THE SIGNAL 97 ANALYSIS

```
VOLKAN COSKUN THESIS                                                   02/25/06
INT. 1162A - UNVERDI - OFF-PEAK                                        14:07:55
EXISTING


SIGNAL97/TEAPAC[Ver 1.00] - HCM Input Worksheet

Intersection # 162 - .                                   Area Location Type: NONCBD

             |      |      |      ||      |                    Key:  VOLUMES -- >
             |  26  | 428  | 179  ||      |                           |   WIDTHS
             | 0.0  | 34.5 | 0.0  ||      |                           v      LANES
             |   0  |    3 |    0 ||       --------------------
             |      |      |      ||    \     0  23.0  1                 .
-------------    /     |      \          --------------------          /|\
                                      --  564  23.0  2                   |
------------------                       --------------------            |
      174   0.0  0  /          +        /  278   0.0  0                North
------------------                       ====================            |
      725  25.3  2  --
------------------             \      |      /    ------------
        3  16.0  1  \     ||      |      |      |
-------------------       ||  261 |  361 |  143 |      Phasing:  SEQUENCE      77
                   |      ||  0.0 | 34.5 |  0.0 |                PERMSV  N N N N
                   |      ||    0 |    3 |    0 |                OVERLP  Y Y Y Y
                   |      ||      |      |      |                LEADLAG    LD LD


Appr Grade   % Heavy Veh.   Adj.Pkg Bus   Pk.Hr.Factor   Conf.Ped Actuated Arr.Type
---- -----  -------------- ------- ---  -------------- -------- -------- --------
 -     %      RT    TH   LT Loc   Nm  Nb   RT   TH   LT  peds/hr RT TH LT RT TH LT
---- -----  -------------- ------- ---  -------------- -------- -------- --------
 SB   0.0   15.4   2.6  3.4  NO    0   0 0.95 0.95 0.95    0-      N  N  N  3  3  3
 WB   0.0    0.0   9.2  4.0  NO    0   0 0.96 0.96 0.96    0-      N  N  N  3  3  3
 NB   0.0    2.8   4.2 13.8  NO    0   0 0.93 0.93 0.93    0-      N  N  N  3  3  3
 EB   0.0    0.0   7.5  4.0  NO    0   0 0.91 0.91 0.91    0-      N  N  N  3  3  3
---- -----  -------------- ------- ---  -------------- -------- -------- --------

      ---------------------------------------------------------------------------
Sq 77 |  Phase 1   |  Phase 2   |  Phase 3   |  Phase 4   |  Phase 5   |  Phase 6   |
**/** ---------------------------------------------------------------------------
      | * * *      |            |            |            |            |            |
  .   | * * *      |            |            |            |            |            |
 /|\  |<* * *>     |            |      <****|            |            |            |
  |   |   v        |            |       ****|    ^       |            |            |
  |   |            |        ^   |       v    |****        |            |            |
North |            |     <* * *>|            |****>       |            |            |
  |   |            |      * * * |            |            |            |            |
      |            |      * * * |            |            |            |            |
      ---------------------------------------------------------------------------
      | G/C=0.133  | G/C=0.189  | G/C=0.233  | G/C=0.311  | G/C=0.000  | G/C=0.000  |
      | G=  12.0"  | G=  17.0"  | G=  21.0"  | G=  28.0"  | G=   0.0"  | G=   0.0"  |
      | Y+R= 3.0"  | Y+R= 3.0"  | Y+R= 3.0"  | Y+R= 3.0"  | Y+R= 0.0"  | Y+R= 0.0"  |
      | OFF= 0.0%  | OFF=16.7%  | OFF=38.9%  | OFF=65.6%  | OFF= 0.0%  | OFF= 0.0%  |
      ---------------------------------------------------------------------------
      C= 90 sec   G= 78.0 sec = 86.7%  Y=12.0 sec = 13.3%  Ped= 0.0 sec =  0.0%
```

VOLKAN COSKUN THESIS 02/25/06
INT. 1162A - UNVERDI - OFF-PEAK 14:07:55
EXISTING

SIGNAL97/TEAPAC[Ver 1.00] - HCM Volume Adjustment Worksheet

Appr -Mvt	Mvt Vol vph	PHF	Flow Rate vph	Lane Group	Adj Flow vph	Prop.of LT	Prop.of RT
SB-RT	26	0.95	27	--	0	0.00	0.00
SB-TH	428	0.95	451	LT+TH+RT	666	0.28	0.04
SB-LT	179	0.95	188	--	0	0.00	0.00
WB-RT	0	0.96	0	--	0	0.00	0.00
WB-TH	564	0.96	588	LT+TH	878	0.33	0.00
WB-LT	278	0.96	290	--	0	0.00	0.00
NB-RT	143	0.93	154	--	0	0.00	0.00
NB-TH	361	0.93	388	LT+TH+RT	823	0.34	0.19
NB-LT	261	0.93	281	--	0	0.00	0.00
EB-RT	0	0.91	0	--	0	0.00	0.00
EB-TH	725	0.91	797	LT+TH	988	0.19	0.00
EB-LT	174	0.91	191	--	0	0.00	0.00

SIGNAL97/TEAPAC[Ver 1.00] - HCM Saturation Flow Adjustment Worksheet

Appr-ch Lane Group Mvmts	Ideal Satfl pcphg	# Ln	Lane Width	Heavy Vehs	Grade	Parkg	Bus Block	Ar Loc	Lane Util	Right Turn	Left Turn	Adj Fact	Adj Sat-flow vphg
SB-LT+TH+RT	1891	3	0.983	0.968	1.000	1.000	1.000	1.0	0.91	0.994	0.986	1.00	4814
WB-LT+TH	1891	2	0.983	0.930	1.000	1.000	1.000	1.0	0.95	1.000	0.984	1.00	3234
NB-LT+TH+RT	1891	3	0.983	0.933	1.000	1.000	1.000	1.0	0.91	0.972	0.983	1.00	4525
EB-LT+TH	1891	2	1.022	0.936	1.000	1.000	1.000	1.0	0.95	1.000	0.990	1.00	3403

VOLKAN COSKUN THESIS 02/25/06
INT. 1162A - UNVERDI - OFF-PEAK 14:07:55
EXISTING

SIGNAL97/TEAPAC[Ver 1.00] - HCM Capacity Analysis Worksheet

Appr ch	Lane Group Mvts	LT Phase Type	Adj Flow Rate vph	Adj Satfl Rate vphg	Flow Ratio v/s	Green Ratio g/C	Lane Group Capac vph	V/C Ratio v/c	Crit Lane Grp
SB-LT+TH+RT			666	4814	0.138	0.137	658	1.012	*
WB-LT+TH			878	3234	0.272	0.237	765	1.148	*
NB-LT+TH+RT			823	4525	0.182	0.192	870	0.946	*
EB-LT+TH			988	3403	0.290	0.314	1070	0.923	*

Cycle Length, C 90 sec Yc = Sum crit(v/s) 0.882
Lost Time Per Cycle, L 10.8 sec Xc = Yc x C/(C-L) 1.002

SIGNAL97/TEAPAC[Ver 1.00] - HCM Level-of-Service Worksheet

Appr ch	Lane Group Mvts	Vol Ratio v/c	Green Ratio g/C	Unif Delay d1 sec/v	Progr Fact PF	Lane Group Capac vph	Calib Term k	Incr Delay d2 sec/v	Lane Group Delay sec/v	Lan Grp LOS	Appr Delay sec/v	Appr LOS
SB-LT+TH+RT		1.012	.137	38.8	1.00	658	0.500	38.14	77.0	E	77.0	E
WB-LT+TH		1.148	.237	34.3	1.00	765	0.500	81.40	115.7	F	115.7	F
NB-LT+TH+RT		0.946	.192	35.9	1.00	870	0.500	19.91	55.8	E+	55.8	E+
EB-LT+TH		0.923	.314	29.8	1.00	1070	0.500	14.32	44.1	D+	44.1	D+
Cycle= 90"												
Int Total		1.005									72.3	E

```
VOLKAN COSKUN THESIS                                                    02/25/06
INT. 1162A - UNVERDI - OFF-PEAK                                         14:07:55
EXISTING

SIGNAL97/TEAPAC[Ver 1.00] - Capacity Analysis Summary

Intersection Averages for Int # 162 - .
     Degree of Saturation (v/c) 1.01  Vehicle Delay  72.3   Level of Service E

      -------------------------------------------
Sq 77 |  Phase 1  |  Phase 2  |  Phase 3  |  Phase 4  |
**/** -------------------------------------------
      | * * *     |           |           |           |
  .   | * * *     |           |           |           |
 /|\  |<* * *>    |           |     <****|           |
  |   |    v      |           |      ****|    ^      |
  |   |           |       ^   |      v   |****       |
North |           |    <* * *>|           |****>      |
  |   |           |     * * * |           |           |
      |           |     * * * |           |           |
      -------------------------------------------
      | G/C=0.133 | G/C=0.189 | G/C=0.233 | G/C=0.311 |
      | G=  12.0" | G=  17.0" | G=  21.0" | G=  28.0" |
      | Y+R= 3.0" | Y+R= 3.0" | Y+R= 3.0" | Y+R= 3.0" |
      | OFF= 0.0% | OFF=16.7% | OFF=38.9% | OFF=65.6% |
      -------------------------------------------
     C= 90 sec   G= 78.0 sec = 86.7%  Y=12.0 sec = 13.3%  Ped= 0.0 sec =  0.0%

--------------------------------------------------------------------------------
| Lane    |Width/|    g/C     | Service Rate| Adj  |       | HCM   | L |90% Max|
|  Group  | Lanes| Reqd  Used | @C (vph) @E |Volume|  v/c  | Delay | S | Queue |
--------------------------------------------------------------------------------

SB Approach                                                   77.0   E
================================================================================
|LT+TH+RT| 35/3 |0.217 |0.137 |  120 |  658 |  666 |1.012 |  77.0 |*E | 244 ft|
--------------------------------------------------------------------------------

NB Approach                                                   55.8   E+
================================================================================
|LT+TH+RT| 35/3 |0.250 |0.192 |  462 |  870 |  823 |0.946 |  55.8 |*E+| 289 ft|
--------------------------------------------------------------------------------

WB Approach                                                  115.7   F
================================================================================
|LT+TH   | 23/2 |0.330 |0.237 |  491 |  765 |  878 |1.148 | 115.7 |*F | 438 ft|
--------------------------------------------------------------------------------

EB Approach                                                   44.1   D+
================================================================================
|LT+TH   | 25/2 |0.343 |0.314 |  867 | 1070 |  988 |0.923 |  44.1 |*D+| 441 ft|
--------------------------------------------------------------------------------
```

```
VOLKAN COSKUN THESIS                                                     02/25/06
INT 1163 - TAYLA - OFF-PEAK                                              14:28:33
EXISTING


SIGNAL97/TEAPAC[Ver 1.00] - HCM Input Worksheet

Intersection # 163 - .                                 Area Location Type: NONCBD

               |     |     |     ||     |                    Key:  VOLUMES -- >
               | 123 | 263 | 185 ||     |                          |   WIDTHS
               | 0.0 |16.0 | 0.0 ||     |                          v      LANES
               |   0 |   1 |   0 ||     ---------------------
               |     |     |     ||   \   83   0.0  0                 .
-------------    /     |     \          ---------------------        /|\
                                      —  709  26.0  2                  |
-------------------                     ---------------------          |
        0   0.0  0  /         +       /    0   0.0  0               North
-------------------                     ---------------------          |
      901  23.0  2  --
-------------------           \      |      /    -------------
       41  12.0  1  \     ||     |     |     |
--------------------      ||  120 | 163 |  27 |     Phasing:  SEQUENCE     71
                    |     ||  0.0 |16.0 | 0.0 |               PERMSV  N N N N
                    |     ||    0 |   1 |   0 |               OVERLP  Y Y Y Y
                    |     ||      |     |     |               LEADLAG    LG LD

Appr Grade  % Heavy Veh.  Adj.Pkg Bus  Pk.Hr.Factor  Conf.Ped Actuated Arr.Type
---- -----  ------------  ------- ---  ------------  -------- -------- --------
 -     %     RT   TH   LT Loc  Nm  Nb   RT   TH   LT peds/hr RT TH LT RT TH LT
---- -----  ------------  ------- ---  ------------  -------- -------- --------
 SB   0.0   6.5  6.1 18.3  NO   0   0 0.96 0.96 0.96   0-      N  N  N  3  3  3
 WB   0.0  15.6 11.5  2.0  NO   0   0 0.95 0.95 0.95   0-      N  N  N  3  3  3
 NB   0.0   3.7 10.4  6.7  NO   0   0 0.83 0.83 0.83   0-      N  N  N  3  3  3
 EB   0.0   2.4  9.1  2.0  NO   0   0 0.92 0.92 0.92   0-      N  N  N  3  3  3
---- -----  ------------  ------- ---  ------------  -------- -------- --------

      -------------------------------------------------------------------------
Sq 71 | Phase 1   | Phase 2   | Phase 3   | Phase 4   | Phase 5   | Phase 6   |
LG/** -------------------------------------------------------------------------
      |           | * * *     |        ^  |           |           |           |
  .   |           | * * *     |       ++++|           |           |           |
 /|\  |           |<* * *>    |      <++++|           |           |           |
  |   |           |   v       |           |           |           |           |
  |   |       ^   |           |           |           |           |           |
North |    <* * *>|           |****>      |           |           |           |
  |   |++++ * * * |           |++++       |           |           |           |
      |   v * * * |           |   v       |           |           |           |
      -------------------------------------------------------------------------
      | G/C=0.273 | G/C=0.159 | G/C=0.455 | G/C=0.000 | G/C=0.000 | G/C=0.000 |
      | G=  24.0" | G=  14.0" | G=  40.0" | G=    0.0"| G=    0.0"| G=    0.0"|
      | Y+R= 3.0" | Y+R= 4.0" | Y+R= 3.0" | Y+R= 0.0" | Y+R= 0.0" | Y+R= 0.0" |
      | OFF= 0.0% | OFF=30.7% | OFF=51.1% | OFF= 0.0% | OFF= 0.0% | OFF= 0.0% |
      -------------------------------------------------------------------------
      C= 88 sec   G= 78.0 sec = 88.6%  Y=10.0 sec = 11.4%  Ped= 0.0 sec =  0.0%
```

VOLKAN COSKUN THESIS 02/25/06
INT 1163 - YAYLA - OFF-PEAK 14:28:33
EXISTING

SIGNAL97/TEAPAC[Ver 1.00] - HCM Volume Adjustment Worksheet

Appr -Mvt --	Mvt Vol vph	PHF --	Flow Rate vph	Lane Group --	Adj Flow vph	Prop.of LT —	Prop.of RT --
SB-RT	123	0.96	128	--	0	0.00	0.00
SB-TH	263	0.96	274	LT+TH+RT	595	0.32	0.22
SB-LT	185	0.96	193	--	0	0.00	0.00
WB-RT	83	0.95	87	--	0	0.00	0.00
WB-TH	709	0.95	746	TH+RT	833	0.00	0.10
WB-LT	0	0.95	0	--	0	0.00	0.00
NB-RT	27	0.83	33	--	0	0.00	0.00
NB-TH	163	0.83	196	LT+TH+RT	374	0.39	0.09
NB-LT	120	0.83	145	--	0	0.00	0.00
EB-RT	41	0.92	45	RT	45	0.00	1.00
EB-TH	901	0.92	979	TH	979	0.00	0.00
EB-LT	0	0.92	0	--	0	0.00	0.00

SIGNAL97/TEAPAC[Ver 1.00] - HCM Saturation Flow Adjustment Worksheet

Appr ch --	Lane Group Mvmts --	Ideal Satfl pcphg	# L n -	Adjustment Factors: Lane Width	Heavy Vehs	Grade	Parkg	Bus Block	Ar Loc	Lane Util	Right Turn	Left Turn	Adj Fact	Adj Sat- flow vphg
SB-	LT+TH+RT	1891	1	1.133	0.908	1.000	1.000	1.000	1.0	1.00	0.871	0.984	1.00	1668
WB-	TH+RT	1891	2	1.033	0.893	1.000	1.000	1.000	1.0	0.95	0.984	1.000	1.00	3265
NB-	LT+TH+RT	1891	1	1.133	0.923	1.000	1.000	1.000	1.0	1.00	0.888	0.981	1.00	1723
EB-	RT	1891	1	1.000	0.976	1.000	1.000	1.000	1.0	1.00	0.850	1.000	1.00	1569
EB-	TH	1891	2	0.983	0.917	1.000	1.000	1.000	1.0	0.95	1.000	1.000	1.00	3238

VOLKAN COSKUN THESIS 02/25/06
INT 1163 - TAYLA - OFF-PEAK 14:28:33
EXISTING

SIGNAL97/TEAPAC[Ver 1.00] - HCM Capacity Analysis Worksheet

Appr ch	Lane Group Mvts	LT Phase Type	Adj Flow Rate vph	Adj Satfl Rate vphg	Flow Ratio v/s	Green Ratio g/C	Lane Group Capac vph	V/C Ratio v/c	Crit Lane Grp
SB-	LT+TH+RT		595	1668	0.357	0.163	271	2.196	*
WB-	TH+RT		833	3265	0.255	0.458	1495	0.557	
NB-	LT+TH+RT		374	1723	0.217	0.276	476	0.786	*
EB-	RT		45	1569	0.029	0.765	1200	0.038	
EB-	TH		979	3238	0.302	0.458	1483	0.660	*

Cycle Length, C 88 sec Yc = Sum crit(v/s) 0.876
Lost Time Per Cycle, L 9.1 sec Xc = Yc x C/(C-L) 0.977

SIGNAL97/TEAPAC[Ver 1.00] - HCM Level-of-Service Worksheet

Appr ch	Lane Group Mvts	Vol Ratio v/c	Green Ratio g/C	Unif Delay d1 sec/v	Progr Fact PF	Lane Group Capac vph	Calib Term k	Incr Delay d2 sec/v	Lane Group Delay sec/v	Lan Grp LOS	Appr Delay sec/v	Appr LOS
SB-	LT+TH+RT	2.196	.163	36.8	1.00	271	0.500	549.94	586.8	F	586.8	F
WB-	TH+RT	0.557	.458	17.4	1.00	1495	0.500	1.50	18.9	B	18.9	B
NB-	LT+TH+RT	0.786	.276	29.4	1.00	476	0.500	12.30	41.7	D+	41.7	D+
EB-	RT	0.038	.765	2.5	1.00	1200	0.500	0.06	2.6	A		
EB-	TH	0.660	.458	18.5	1.00	1483	0.500	2.32	20.9	C+	20.0	C+
Cycle= 88"												
Int Total		0.960									141.9	F

```
VOLKAN COSKUN THESIS                                                02/25/06
INT 1163 - TAYLA - OFF-PEAK                                         14:28:33
EXISTING


SIGNAL97/TEAPAC[Ver 1.00] - Capacity Analysis Summary

Intersection Averages for Int # 163 - .
      Degree of Saturation (v/c) 0.96  Vehicle Delay 141.9  Level of Service F

      -------------------------------------
Sq 71 |  Phase 1   |  Phase 2   |  Phase 3  |
LG/** -------------------------------------
      |            | * * *      |       ^   |
  .   |            | * * *      |      ++++|
 /|\  |            |<* * *>     |     <++++|
  |   |            |    v       |           |
  |   |       ^    |            |           |
North |    <* * *> |            |****>      |
  |   |++++ * * *  |            |++++       |
      |   v * * *  |            |   v       |
      -------------------------------------
      | G/C=0.273  | G/C=0.159  | G/C=0.455 |
      | G=  24.0"  | G=  14.0"  | G=  40.0" |
      | Y+R= 3.0"  | Y+R= 4.0"  | Y+R= 3.0" |
      | OFF= 0.0%  | OFF=30.7%  | OFF=51.1% |
      -------------------------------------
      C= 88 sec   G= 78.0 sec = 88.6%  Y=10.0 sec = 11.4%  Ped= 0.0 sec =  0.0%

-------------------------------------------------------------------------------
| Lane    |Width/|     g/C     | Service Rate| Adj |       |  HCM  | L |90% Max|
|  Group  | Lanes| Reqd   Used | @C (vph) @E |Volume|  v/c | Delay | S | Queue |
-------------------------------------------------------------------------------

SB Approach                                                 586.8   F
===============================================================================
|LT+TH+RT| 16/1 |0.421 |0.163 |   78 |  258 |   595 |2.196 | 586.8 |*F | 646 ft|
-------------------------------------------------------------------------------

NB Approach                                                  41.7   D+
===============================================================================
|LT+TH+RT| 16/1 |0.306 |0.276 |  312 |  476 |   374 |0.786 |  41.7 |*D+| 347 ft|
-------------------------------------------------------------------------------

WB Approach                                                  18.9   B
===============================================================================
|   TH+RT| 26/2 |0.313 |0.458 | 1400 | 1495 |   833 |0.557 |  18.9 | B | 296 ft|
-------------------------------------------------------------------------------

EB Approach                                                  20.0   C+
===============================================================================
|   RT   | 12/1 |0.146 |0.765 | 1195 | 1200 |    45 |0.038 |   2.6 | A |  25 ft|
|   TH   | 23/2 |0.352 |0.458 | 1388 | 1483 |   979 |0.660 |  20.9 |*C+| 342 ft|
-------------------------------------------------------------------------------
```

```
VOLKAN COSKUN THESIS                                                02/25/06
INT. 1164 - KOCASINAN GIRISI - OFF-PEAK                             14:49:18
EXISTING

SIGNAL97/TEAPAC[Ver 1.00] - HCM Input Worksheet

Intersection # 164 - .                               Area Location Type: NONCBD

              |     |     |     ||      |                 Key:  VOLUMES -- >
              | 127 |   0 | 143 ||      |                         |   WIDTHS
              | 0.0 |14.0 | 0.0 ||      |                         v       LANES
              |   0 |   1 |   0 ||      |------------------
              |     |     |     ||    \   298   8.2  1               .
-----------      /     |     \          ------------------           /|\
                                      --  848  25.0  2                |
-----------------                       ------------------            |
       142   0.0  0  /        +       /    0   0.0  0               North
-----------------                       ------------------            |
       988  23.0  2  --
-----------------             \     |     /    -----------
         0   0.0  0  \     ||     |     |     |
---------------------      ||   0 |   0 |   0 |    Phasing:  SEQUENCE      13
                     |     || 0.0 | 0.0 | 0.0 |              PERMSV   N N N N
                     |     ||   0 |   0 |   0 |              OVERLP   Y Y Y Y
                     |     ||     |     |     |              LEADLAG    LD LD

Appr Grade  % Heavy Veh.  Adj.Pkg Bus  Pk.Hr.Factor   Conf.Ped Actuated Arr.Type
---- -----  ------------  ------- ---  ------------   -------- -------- --------
 -     %     RT   TH   LT Loc  Nm  Nb   RT   TH   LT  peds/hr RT TH LT RT TH LT
---- -----  ------------  ------- ---  ------------   -------- -------- --------
 SB   0.0   4.7  0.0 11.1  NO   0   0 0.94 0.94 0.94   0-      N  N  N  3  3  3
 WB   0.0  11.7  5.7  0.0  NO   0   0 0.97 0.97 0.97   0-      N  N  N  3  3  3
 NB   0.0   0.0  0.0  0.0  NO   0   0 0.90 0.90 0.90   0-      N  N  N  3  3  3
 EB   0.0   0.0  4.3  4.9  NO   0   0 0.88 0.88 0.88   0-      N  N  N  3  3  3
---- -----  ------------  ------- ---  ------------   -------- -------- --------

      ---------------------------------------------------------------------------
Sq 13 |  Phase 1   |  Phase 2   |  Phase 3   |  Phase 4   |  Phase 5   |  Phase 6   |
**/** ---------------------------------------------------------------------------
      |     * ^    |            |         ^  |            |            |            |
  .   |     * ++++|             |       ++++|             |            |            |
 /|\  |     *>     |            |     <****|              |            |            |
  |   |            |    ^       |            |            |            |            |
  |   |            |****        |            |            |            |            |
North |            |****>       |++++>       |            |            |            |
  |   |            |            |            |            |            |            |
      |            |            |            |            |            |            |
      ---------------------------------------------------------------------------
      | G/C=0.200  | G/C=0.122  | G/C=0.567  | G/C=0.000  | G/C=0.000  | G/C=0.000  |
      | G=  18.0"  | G=  11.0"  | G=  51.0"  | G=   0.0"  | G=   0.0"  | G=   0.0"  |
      | Y+R= 4.0"  | Y+R= 3.0"  | Y+R= 3.0"  | Y+R= 0.0"  | Y+R= 0.0"  | Y+R= 0.0"  |
      | OFF= 0.0%  | OFF=24.4%  | OFF=40.0%  | OFF= 0.0%  | OFF= 0.0%  | OFF= 0.0%  |
      ---------------------------------------------------------------------------
      C= 90 sec   G= 80.0 sec = 88.9%  Y=10.0 sec = 11.1%  Ped= 0.0 sec =  0.0%
```

VOLKAN COSKUN THESIS 02/25/06
INT. 1164 - KOCASINAN GIRISI - OFF-PEAK 14:49:18
EXISTING

SIGNAL97/TEAPAC[Ver 1.00] - HCM Volume Adjustment Worksheet

Appr -Mvt --	Mvt Vol vph	PHF --	Flow Rate vph	Lane Group --	Adj Flow vph	Prop.of LT	Prop.of RT
SB-RT	0	0.94	0	--	0	0.00	0.00
SB-TH	0	0.94	0	LT+TH	152	1.00	0.00
SB-LT	143	0.94	152	--	0	0.00	0.00
WB-RT	298	0.97	307	RT	307	0.00	1.00
WB-TH	848	0.97	874	TH	874	0.00	0.00
WB-LT	0	0.97	0	--	0	0.00	0.00
EB-RT	0	0.88	0	--	0	0.00	0.00
EB-TH	988	0.88	1123	LT+TH	1284	0.13	0.00
EB-LT	142	0.88	161	--	0	0.00	0.00

SIGNAL97/TEAPAC[Ver 1.00] - HCM Saturation Flow Adjustment Worksheet

Appr ch	Lane Group Mvmts	Ideal Satfl pcphg	# Ln	Adjustment Factors: Lane Width	Heavy Vehs	Grade	Parkg	Bus Block	Ar Loc	Lane Util	Right Turn	Left Turn	Adj Fact	Adj Sat-flow vphg
SB-	LT+TH	1900	1	1.067	0.900	1.000	1.000	1.000	1.0	1.00	1.000	0.952	1.00	1737
WB-	RT	1900	1	0.873	0.895	1.000	1.000	1.000	1.0	1.00	0.850	1.000	1.00	1263
WB-	TH	1900	2	1.017	0.946	1.000	1.000	1.000	1.0	0.95	1.000	1.000	1.00	3472
EB-	LT+TH	1900	2	0.983	0.958	1.000	1.000	1.000	1.0	0.95	1.000	0.994	1.00	3380

SIGNAL97/TEAPAC[Ver 1.00] - HCM Capacity Analysis Worksheet

Appr ch	Lane Group Mvts	LT Phase Type	Adj Flow Rate vph	Adj Satfl Rate vphg	Flow Ratio v/s	Green Ratio g/C	Lane Group Capac vph	V/C Ratio v/c	Crit Lane Grp
SB-	LT+TH		152	1737	0.087	0.244	425	0.358	*
WB-	RT		307	1263	0.243	0.803	1014	0.303	
WB-	TH		874	3472	0.252	0.570	1979	0.442	
EB-	LT+TH		1284	3380	0.380	0.726	2452	0.524	*

Cycle Length, C 90 sec Yc = Sum crit(v/s) 0.467
Lost Time Per Cycle, L 2.7 sec Xc = Yc x C/(C-L) 0.482

VOLKAN COSKUN THESIS 02/25/06
INT. 1164 - KOCASINAN GIRISI - OFF-PEAK 14:49:18
EXISTING

SIGNAL97/TEAPAC[Ver 1.00] - HCM Level-of-Service Worksheet

Appr ch	Lane Group Mvts	Vol Ratio v/c	Green Ratio g/C	Unif Delay d1 sec/v	Progr Fact PF	Lane Group Capac vph	Calib Term k	Incr Delay d2 sec/v	Lane Group Delay sec/v	Lan Grp LOS	Appr Delay sec/v	Appr LOS
SB-	LT+TH	0.358	.244	28.1	1.00	425	0.500	2.34	30.5	C		
											30.5	C
WB-	RT	0.303	.803	2.3	1.00	1014	0.500	0.77	3.1	A		
WB-	TH	0.442	.570	11.1	1.00	1979	0.500	0.72	11.8	B+		
											9.6	A
EB-	LT+TH	0.524	.726	5.5	1.00	2452	0.500	0.80	6.3	A		
											6.3	A
Cycle= 90"												
Int Total		0.461									9.2	A

```
VOLKAN COSKUN THESIS                                                02/25/06
INT. 1164 - KOCASINAN GIRISI - OFF-PEAK                             14:49:18
EXISTING

SIGNAL97/TEAPAC[Ver 1.00] - Capacity Analysis Summary

Intersection Averages for Int # 164 - .
      Degree of Saturation (v/c) 0.46  Vehicle Delay   9.2   Level of Service A

      -------------------------------------
Sq 13 |  Phase 1   |  Phase 2   |  Phase 3   |
**/** -------------------------------------
      |      * ^   |            |        ^   |
  .   |      * ++++|            |        ++++|
 /|\  |      *>    |            |      <****|
  |   |            |    ^       |            |
  |   |            |****        |            |
North |            |****>       |++++>       |
  |   |            |            |            |
      |            |            |            |
      -------------------------------------
      | G/C=0.200  | G/C=0.122  | G/C=0.567  |
      | G=  18.0"  | G=  11.0"  | G=  51.0"  |
      | Y+R= 4.0"  | Y+R= 3.0"  | Y+R= 3.0"  |
      | OFF= 0.0%  | OFF=24.4%  | OFF=40.0%  |
      -------------------------------------
      C= 90 sec   G= 80.0 sec = 88.9%  Y=10.0 sec = 11.1%  Ped= 0.0 sec =  0.0%

--------------------------------------------------------------------------------
| Lane    |Width/|      g/C      | Service Rate|  Adj  |       |  HCM  | L |90% Max|
|  Group  | Lanes| Reqd    Used  | @C (vph) @E |Volume|  v/c  | Delay | S | Queue |
--------------------------------------------------------------------------------

SB Approach                                                        30.5    C
================================================================================
|LT+TH    | 14/1 |0.204 |0.244 |   238 |   425 |   152 |0.358 |   30.5 | C |  153 ft|
--------------------------------------------------------------------------------

WB Approach                                                         9.6    A
================================================================================
|    RT   |  8/1 |0.343 |0.803 | 1006 | 1014 |   307 |0.303 |    3.1 | A |   81 ft|
|    TH   | 25/2 |0.312 |0.570 | 1941 | 1979 |   874 |0.442 |   11.8 |*B+|  243 ft|
--------------------------------------------------------------------------------

EB Approach                                                         6.3    A
================================================================================
|LT+TH    | 23/2 |0.417 |0.726 | 2452 | 2452 |  1284 |0.524 |    6.3 |*A |  226 ft|
--------------------------------------------------------------------------------
```

```
VOLKAN COSKUN THESIS                                                    02/25/06
INT 1165 - SIRINEVLER - OFF-PEAK                                        15:15:30
EXISTING


SIGNAL97/TEAPAC[Ver 1.00] - HCM Input Worksheet

Intersection # 165 - .                                 Area Location Type: NONCBD

             |      |      |      ||      |                    Key:  VOLUMES -- >
             |   62 |    0 |  309 ||      |                          |   WIDTHS
             |  0.0 | 29.5 |  0.0 ||      |                          v       LANES
             |    0 |    2 |    0 ||       -------------------
             |      |      |      ||    \   240    0.0  0                  .
-------------    /     |      \          -------------------             /|\
                                        —   770   23.7  2                  |
-------------------                      -------------------               |
        0   0.0  0  /         +         /     0    0.0  0               North
-------------------                      ===================               |
      809  23.7  2  --
-------------------               \      |      /     -------------
        0   0.0  0  \      ||      |      |      |
--------------------       ||    0 |    0 |    0 |     Phasing:  SEQUENCE      13
                    |      ||  0.0 |  0.0 |  0.0 |               PERMSV  N N N N
                    |      ||    0 |    0 |    0 |               OVERLP  Y Y Y Y
                    |      ||      |      |      |               LEADLAG   LD LG


Appr Grade  % Heavy Veh.  Adj.Pkg Bus  Pk.Hr.Factor  Conf.Ped Actuated Arr.Type
---- -----  ------------- ------- ---  ------------- -------- -------- --------
 -     %      RT   TH   LT Loc  Nm  Nb   RT   TH   LT  peds/hr RT TH LT RT TH LT
---- -----  ------------- ------- ---  ------------- -------- -------- --------
 SB  -5.0    1.6  0.0  1.9  NO   0   0 0.78 0.90 0.91   0-      N  N  N  3  3  3
 WB   5.0    3.8  3.1  0.0  NO   0   0 0.90 0.91 0.90   0-      N  N  N  3  3  3
 NB   0.0    0.0  0.0  0.0  NO   0   0 0.90 0.90 0.90   0-      N  N  N  3  3  3
 EB  -7.0    0.0  3.0  0.0  NO   0   0 0.90 0.90 0.90   0-      N  N  N  3  3  3
---- -----  ------------- ------- ---  ------------- -------- -------- --------

      --------------------------------------------------------------------------
Sq 13 |  Phase 1   |  Phase 2   |  Phase 3   |  Phase 4   |  Phase 5   |  Phase 6   |
**/LG --------------------------------------------------------------------------
      |     *      |       ^    |            |            |            |            |
  .   |     *      |       **** |            |            |            |            |
 /|\  |     *>     |     <****  |            |            |            |            |
  |   |            |            |            |            |            |            |
  |   |            |            |            |            |            |            |
North |            |++++>       |****>       |            |            |            |
  |   |            |            |            |            |            |            |
      |            |            |            |            |            |            |
      --------------------------------------------------------------------------
      | G/C=0.189  | G/C=0.589  | G/C=0.111  | G/C=0.000  | G/C=0.000  | G/C=0.000  |
      | G=  17.0"  | G=  53.0"  | G=  10.0"  | G=   0.0"  | G=   0.0"  | G=   0.0"  |
      | Y+R= 4.0"  | Y+R= 3.0"  | Y+R= 3.0"  | Y+R= 0.0"  | Y+R= 0.0"  | Y+R= 0.0"  |
      | OFF=76.7%  | OFF= 0.0%  | OFF=62.2%  | OFF=76.7%  | OFF=76.7%  | OFF=76.7%  |
      --------------------------------------------------------------------------
      C= 90 sec   G= 80.0 sec = 88.9%  Y=10.0 sec = 11.1%  Ped= 0.0 sec =  0.0%
```

VOLKAN COSKUN THESIS 02/25/06
INT 1165 - SIRINEVLER - OFF-PEAK 15:15:30
EXISTING

SIGNAL97/TEAPAC[Ver 1.00] - HCM Volume Adjustment Worksheet

Appr -Mvt	Mvt Vol vph	PHF	Flow Rate vph	Lane Group	Adj Flow vph	Prop.of LT	Prop.of RT
SB-RT	0	0.78	0	--	0	0.00	0.00
SB-TH	0	0.90	0	LT+TH	340	1.00	0.00
SB-LT	309	0.91	340	--	0	0.00	0.00
WB-RT	240	0.90	267	--	0	0.00	0.00
WB-TH	770	0.91	846	TH+RT	1113	0.00	0.24
WB-LT	0	0.90	0	--	0	0.00	0.00
EB-RT	0	0.90	0	--	0	0.00	0.00
EB-TH	809	0.90	899	TH	899	0.00	0.00
EB-LT	0	0.90	0	--	0	0.00	0.00

SIGNAL97/TEAPAC[Ver 1.00] - HCM Saturation Flow Adjustment Worksheet

Appr ch	Lane Group Mvmts	Ideal Satfl pcphg	# Ln	Adjustment Factors: Lane Width	Heavy Vehs	Grade	Parkg	Bus Block	Ar Loc	Lane Util	Right Turn	Left Turn	Adj Fact	Adj Sat-flow vphg
SB-	LT+TH	1891	2	1.092	0.981	1.025	1.000	1.000	1.0	0.95	1.000	0.952	1.00	3757
WB-	TH+RT	1891	2	0.995	0.968	0.975	1.000	1.000	1.0	0.95	0.964	1.000	1.00	3254
EB-	TH	1891	2	0.995	0.971	1.030	1.000	1.000	1.0	0.95	1.000	1.000	1.00	3575

SIGNAL97/TEAPAC[Ver 1.00] - HCM Capacity Analysis Worksheet

Appr ch	Lane Group Mvts	LT Phase Type	Adj Flow Rate vph	Adj Satfl Rate vphg	Flow Ratio v/s	Green Ratio g/C	Lane Group Capac vph	V/C Ratio v/c	Crit Lane Grp
SB-	LT+TH		340	3757	0.090	0.233	877	0.388	*
WB-	TH+RT		1113	3254	0.342	0.592	1927	0.578	
EB-	TH		899	3575	0.251	0.737	2634	0.341	*

Cycle Length, C 90 sec Yc = Sum crit(v/s) 0.342
Lost Time Per Cycle, L 2.7 sec Xc = Yc x C/(C-L) 0.353

```
VOLKAN COSKUN THESIS                                                02/25/06
INT 1165 - SIRINEVLER - OFF-PEAK                                    15:15:30
EXISTING

SIGNAL97/TEAPAC[Ver 1.00] - HCM Level-of-Service Worksheet

Ap   Lane      Vol  Green  Unif Progr  Lane Calib   Incr   Lane  Lan
pr  Group    Ratio  Ratio Delay  Fact Group  Term  Delay  Group  Grp  Appr Appr
ch   Mvts      v/c    g/C    d1    PF Capac     k     d2  Delay  LOS Delay  LOS
--   --         --     -- sec/v    --   vph     -  sec/v  sec/v   -  sec/v   -
==============================================================================
SB-LT+TH     0.388   .233  29.1  1.00   877 0.500   1.29   30.4   C
-------------------------------------------------------------------> 30.4   C
WB-   TH+RT  0.578   .592  11.4  1.00  1927 0.500   1.27   12.6   B+
-------------------------------------------------------------------> 12.6   B+
EB-   TH     0.341   .737   4.2  1.00  2634 0.500   0.35    4.5   A
------------------------------------------------------------------->  4.5   A
Cycle= 90"                                                          ==========
Int Total    0.460 ------------------------------------------------> 12.1   B+
```

```
VOLKAN COSKUN THESIS                                                  02/25/06
INT 1165 - SIRINEVLER - OFF-PEAK                                      15:15:30
EXISTING


SIGNAL97/TEAPAC[Ver 1.00] - Capacity Analysis Summary

Intersection Averages for Int # 165 - .
      Degree of Saturation (v/c) 0.46  Vehicle Delay  12.1  Level of Service B+

      -------------------------------------
Sq 13 |  Phase 1   |  Phase 2   |  Phase 3   |
**/LG -------------------------------------
      |     *      |       ^    |            |
  .   |     *      |       **** |            |
 /|\  |     *>     |     <***** |            |
  |   |            |            |            |
  |   |            |            |            |
North |            |++++>       |****>       |
  |   |            |            |            |
      |            |            |            |
      -------------------------------------
      | G/C=0.189  | G/C=0.589  | G/C=0.111  |
      | G=  17.0"  | G=  53.0"  | G=  10.0"  |
      | Y+R= 4.0"  | Y+R= 3.0"  | Y+R= 3.0"  |
      | OFF=76.7%  | OFF= 0.0%  | OFF=62.2%  |
      -------------------------------------
      C= 90 sec   G= 80.0 sec = 88.9%  Y=10.0 sec = 11.1%  Ped= 0.0 sec =  0.0%

--------------------------------------------------------------------------------
| Lane    |Width/|     g/C      | Service Rate|  Adj |       |  HCM  | L |90% Max|
|  Group  | Lanes| Reqd   Used  | @C (vph) @E |Volume|  v/c  | Delay | S | Queue |
--------------------------------------------------------------------------------

SB Approach                                                     30.4   C
================================================================================
|LT+TH    | 30/2 |0.188 |0.233 |  574 |  877 |  340 |0.388 |  30.4 | C | 165 ft|
--------------------------------------------------------------------------------

WB Approach                                                     12.6   B+
================================================================================
|   TH+RT| 24/2 |0.387 |0.592 | 1897 | 1927 | 1113 |0.578 |  12.6 |*B+| 289 ft|
--------------------------------------------------------------------------------

EB Approach                                                      4.5   A
================================================================================
|   TH    | 24/2 |0.311 |0.737 | 2634 | 2634 |  899 |0.341 |   4.5 |*A | 151 ft|
--------------------------------------------------------------------------------
```

```
VOLKAN COSKUN THESIS                                                  02/25/06
INT 1426A - UEFA ANITI - OFF-PEAK                                     15:26:16
EXISTING

SIGNAL97/TEAPAC[Ver 1.00] - HCM Input Worksheet

Intersection #  26 - .                               Area Location Type: NONCBD

                |      |      |      ||      |                 Key:  VOLUMES -- >
                |   97 |   91 |   34 ||      |                        |   WIDTHS
                |  0.0 | 11.8 |  0.0 ||      |                        v       LANES
                |    0 |    1 |    0 ||      ---------------
                |      |      |      ||    \   212    0.0  0               .
------------      /      |      \          ---------------             /|\
                                        —  1060   21.3  2               |
==================                         ---------------              |
        0    0.0  0  /          +       /    65    0.0  0             North
------------------                         ===============              |
      886   22.6  2  --
------------------                  \      |      /     ------------
      243    0.0  0  \     ||      |      |      |
--------------------       ||    0 |    0 |    0 |     Phasing:  SEQUENCE      12
                     |     ||  0.0 |  0.0 |  0.0 |               PERMSV   N N N N
                     |     ||    0 |    0 |    0 |               OVERLP   Y Y Y Y
                     |     ||      |      |      |               LEADLAG    LD LD

Appr Grade  % Heavy Veh.  Adj.Pkg Bus  Pk.Hr.Factor  Conf.Ped Actuated Arr.Type
---- -----  ------------  ------- ---  ------------  -------- -------- --------
 -     %      RT   TH   LT Loc  Nm  Nb   RT   TH   LT  peds/hr RT TH LT RT TH LT
---- -----  ------------  ------- ---  ------------  -------- -------- --------
 SB   0.0    4.1  4.4  2.9  NO   0    0 0.83 0.83 0.83   0-      N  N  N  3  3  3
 WB   0.0    4.3  4.0  6.2  NO   0    0 0.86 0.86 0.86   0-      N  N  N  3  3  3
 NB   0.0    0.0  0.0  0.0  NO   0    0 0.90 0.90 0.90   0-      N  N  N  3  3  3
 EB   0.0    2.1  4.6  2.0  NO   0    0 0.77 0.77 0.77   0-      N  N  N  3  3  3
---- -----  ------------  ------- ---  ------------  -------- -------- --------

      ----------------------------------------------------------------------
Sq 12 |  Phase 1   |  Phase 2   |  Phase 3   |  Phase 4   |  Phase 5   |  Phase 6   |
**/** ----------------------------------------------------------------------
      | * * *      |       ^    |       ^    |            |            |            |
  .   | * * *      |       ****|       ++++|            |            |            |
 /|\  |<* * *>     |      <****|      <++++|            |            |            |
  |   |   v        |       ****|            |            |            |            |
  |   |            |       v    |            |            |            |            |
North |            |            |****>       |            |            |            |
  |   |            |            |****        |            |            |            |
      |            |            |   v        |            |            |            |
      ----------------------------------------------------------------------
      | G/C=0.189  | G/C=0.067  | G/C=0.644  | G/C=0.000  | G/C=0.000  | G/C=0.000  |
      | G=  17.0"  | G=   6.0"  | G=  58.0"  | G=   0.0"  | G=   0.0"  | G=   0.0"  |
      | Y+R= 4.0"  | Y+R= 2.0"  | Y+R= 3.0"  | Y+R= 0.0"  | Y+R= 0.0"  | Y+R= 0.0"  |
      | OFF= 0.0%  | OFF=23.3%  | OFF=32.2%  | OFF= 0.0%  | OFF= 0.0%  | OFF= 0.0%  |
      ----------------------------------------------------------------------
      C= 90 sec   G= 81.0 sec = 90.0%  Y= 9.0 sec = 10.0%  Ped= 0.0 sec =  0.0%
```

VOLKAN COSKUN THESIS 02/25/06
INT 1426A - UEFA ANITI - OFF-PEAK 15:26:16
EXISTING

SIGNAL97/TEAPAC[Ver 1.00] - HCM Volume Adjustment Worksheet

Appr -Mvt	Mvt Vol vph	PHF	Flow Rate vph	Lane Group	Adj Flow vph	Prop.of LT	Prop.of RT
SB-RT	97	0.83	117	--	0	0.00	0.00
SB-TH	91	0.83	110	LT+TH+RT	268	0.15	0.44
SB-LT	34	0.83	41	--	0	0.00	0.00
WB-RT	212	0.86	247	--	0	0.00	0.00
WB-TH	1060	0.86	1233	LT+TH+RT	1556	0.05	0.16
WB-LT	65	0.86	76	--	0	0.00	0.00
EB-RT	243	0.77	316	--	0	0.00	0.00
EB-TH	886	0.77	1151	TH+RT	1467	0.00	0.22
EB-LT	0	0.77	0	--	0	0.00	0.00

SIGNAL97/TEAPAC[Ver 1.00] - HCM Saturation Flow Adjustment Worksheet

Appr ch	Lane Group Mvmts	Ideal Satfl pcphg	# L n	Adjustment Factors: Lane Width	Heavy Vehs	Grade	Parkg	Bus Block	Ar Loc	Lane Util	Right Turn	Left Turn	Adj Fact	Adj Sat-flow vphg
SB-	LT+TH+RT	1891	1	0.993	0.961	1.000	1.000	1.000	1.0	1.00	0.841	0.992	1.00	1507
WB-	LT+TH+RT	1891	2	0.955	0.960	1.000	1.000	1.000	1.0	0.95	0.976	0.998	1.00	3208
EB-	TH+RT	1891	2	0.977	0.961	1.000	1.000	1.000	1.0	0.95	0.968	1.000	1.00	3263

SIGNAL97/TEAPAC[Ver 1.00] - HCM Capacity Analysis Worksheet

Appr ch	Lane Group Mvts	LT Phase Type	Adj Flow Rate vph	Adj Satfl Rate vphg	Flow Ratio v/s	Green Ratio g/C	Lane Group Capac vph	V/C Ratio v/c	Crit Lane Grp
SB-	LT+TH+RT		268	1507	0.178	0.192	290	0.924	*
WB-	LT+TH+RT		1556	3208	0.485	0.737	2363	0.658	*
EB-	TH+RT		1467	3263	0.450	0.648	2114	0.694	

Cycle Length, C 90 sec Yc = Sum crit(v/s) 0.663
Lost Time Per Cycle, L 6.4 sec Xc = Yc x C/(C-L) 0.714

```
VOLKAN COSKUN THESIS                                                      02/25/06
INT 1426A - UEFA ANITI - OFF-PEAK                                         15:26:16
EXISTING

SIGNAL97/TEAPAC[Ver 1.00] - HCM Level-of-Service Worksheet

Ap   Lane       Vol  Green  Unif Progr  Lane Calib   Incr   Lane  Lan
pr  Group     Ratio  Ratio Delay  Fact Group  Term  Delay  Group  Grp  Appr Appr
ch   Mvts       v/c    g/C    d1    PF Capac     k     d2  Delay  LOS Delay  LOS
--    --         --     -- sec/v    --   vph     -  sec/v  sec/v    - sec/v    -
==================================================================================
SB-LT+TH+RT 0.924   .192  35.7  1.00   290 0.500  36.53   72.2    E
---------------------------------------------------------------------->  72.2    E
WB-LT+TH+RT 0.658   .737   6.1  1.00  2363 0.500   1.45    7.5    A
---------------------------------------------------------------------->   7.5    A
EB-   TH+RT 0.694   .648  10.1  1.00  2114 0.500   1.90   12.0    B+
---------------------------------------------------------------------->  12.0    B+
Cycle= 90"                                                              ===========
Int Total   0.696 ---------------------------------------------------->  14.8    B+
```

```
VOLKAN COSKUN THESIS                                                  02/25/06
INT 1426A - UEFA ANITI - OFF-PEAK                                     15:26:16
EXISTING

SIGNAL97/TEAPAC[Ver 1.00] - Capacity Analysis Summary

Intersection Averages for Int #  26 - .
     Degree of Saturation (v/c) 0.70  Vehicle Delay  14.8  Level of Service B+

     --------------------------------
Sq 12 |  Phase 1  |  Phase 2  |  Phase 3  |
**/** --------------------------------
     | * * *     |      ^    |       ^   |
  .  | * * *     |     ****|       ++++|
 /|\ |<* * *>    |    <****|      <++++|
  |  |   v       |     ****|           |
  |  |           |     v   |           |
North |           |          |****>      |
  |  |           |          |****       |
     |           |          |  v        |
     --------------------------------
     | G/C=0.189 | G/C=0.067 | G/C=0.644 |
     | G=  17.0" | G=   6.0" | G=  58.0" |
     | Y+R= 4.0" | Y+R= 2.0" | Y+R= 3.0" |
     | OFF= 0.0% | OFF=23.3% | OFF=32.2% |
     --------------------------------
     C= 90 sec   G= 81.0 sec = 90.0%  Y= 9.0 sec = 10.0%  Ped= 0.0 sec =  0.0%

------------------------------------------------------------------------------
| Lane    |Width/|     g/C      | Service Rate|  Adj |       |  HCM  | L |90% Max|
|  Group  | Lanes| Reqd   Used  | @C (vph) @E |Volume|  v/c  | Delay | S | Queue |
------------------------------------------------------------------------------

SB Approach                                                    72.2   E
==============================================================================
|LT+TH+RT| 12/1 |0.283 |0.192 |  105 |  279 |  268 |0.924 |  72.2 |*E | 277 ft|
------------------------------------------------------------------------------

WB Approach                                                     7.5   A
==============================================================================
|LT+TH+RT| 21/2 |0.508 |0.737 | 2363 | 2363 | 1556 |0.658 |   7.5 |*A | 262 ft|
------------------------------------------------------------------------------

EB Approach                                                    12.0   B+
==============================================================================
|   TH+RT| 23/2 |0.477 |0.648 | 2111 | 2114 | 1467 |0.694 |  12.0 |*B+| 331 ft|
------------------------------------------------------------------------------
```

```
VOLKAN COSKUN THESIS                                                         05/18/06
INT # 2204 - DOLMABAHCE - PM PEAK                                            21:44:21
EXISTING (SIGNAL 97)

SIGNAL97/TEAPAC[Ver 1.00] - HCM Input Worksheet

Intersection # 204 - .                                  Area Location Type:     CBD

                    |       |       |      ||      |                Key:  VOLUMES -- >
                    |     0 |     0 | 2102 ||      |                        |    WIDTHS
                    |   0.0 |   0.0 | 28.2 ||      |                        v        LANES
                    |     0 |     0 |    3 ||      -------------------
                    |       |       |      ||    \     0    0.0   0              .
-------------      /       |       \                -------------------        /|\
                                              ---    910   21.0   2              |
=================                                   -------------------          |
        0   0.0   0  /        +        /       0    0.0   0             North
-----------------                                   =================           |
     1976  35.5   3  --
-----------------                 \      |      /     -------------
        0   0.0   0  \      ||       |       |       |
-------------------         ||     0 |     0 |     0 |     Phasing:  SEQUENCE      11
                    |       ||   0.0 |   0.0 |   0.0 |               PERMSV   N N N N
                    |       ||     0 |     0 |     0 |               OVERLP   Y Y Y Y
                    |       ||       |       |       |               LEADLAG     LD LD

Appr Grade   % Heavy Veh.   Adj.Pkg Bus   Pk.Hr.Factor   Conf.Ped Actuated Arr.Type
---- -----  -------------- ------- ---  -------------- -------- -------- --------
 -     %       RT   TH   LT  Loc   Nm   Nb    RT   TH   LT  peds/hr  RT TH LT  RT TH LT
---- -----  -------------- ------- ---  -------------- -------- -------- --------
 SB -10.0   0.0  0.0  3.6   NO    0    0 0.90 0.90 0.90   0-       N  N  N   3  3  3
 WB   0.0   0.0  6.4  0.0   NO    0    0 0.96 0.96 0.96   0-       N  N  N   3  3  3
 NB   0.0   0.0  0.0  0.0   NO    0    0 0.90 0.90 0.90   0-       N  N  N   3  3  3
 EB   0.0   0.0  5.6  0.0   NO    0    0 0.82 0.82 0.82   0-       N  N  N   3  3  3
---- -----  -------------- ------- ---  -------------- -------- -------- --------

      ---------------------------------------------------------------------------
Sq 11 |  Phase 1  |  Phase 2  |  Phase 3  |  Phase 4  |  Phase 5  |  Phase 6  |
**/** ---------------------------------------------------------------------------
      |     +     |           |           |           |           |           |
  .   |     +     |           |           |           |           |           |
 /|\  |     +>    |      <++++|           |           |           |           |
  |   |           |           |           |           |           |           |
  |   |           |           |           |           |           |           |
North |           |++++>      |           |           |           |           |
  |   |           |           |           |           |           |           |
      |           |           |           |           |           |           |
      ---------------------------------------------------------------------------
      | G/C=0.509 | G/C=0.421 | G/C=0.000 | G/C=0.000 | G/C=0.000 | G/C=0.000 |
      | G=  58.0" | G=  48.0" | G=   0.0" | G=   0.0" | G=   0.0" | G=   0.0" |
      | Y+R= 4.0" | Y+R= 4.0" | Y+R= 0.0" | Y+R= 0.0" | Y+R= 0.0" | Y+R= 0.0" |
      | OFF= 0.0% | OFF=54.4% | OFF= 0.0% | OFF= 0.0% | OFF= 0.0% | OFF= 0.0% |
      ---------------------------------------------------------------------------
      C=114 sec   G=106.0 sec = 93.0%  Y= 8.0 sec =  7.0%  Ped= 0.0 sec =  0.0%
```

VOLKAN COSKUN THESIS 05/18/06
INT # 2204 - DOLMABAHCE - PM PEAK 21:44:21
EXISTING (SIGNAL 97)

SIGNAL97/TEAPAC[Ver 1.00] - HCM Volume Adjustment Worksheet

Appr -Mvt --	Mvt Vol vph	PHF --	Flow Rate vph	Lane Group --	Adj Flow vph	Prop.of LT --	Prop.of RT --
SB-RT	0	0.90	0	--	0	0.00	0.00
SB-TH	0	0.90	0	--	0	0.00	0.00
SB-LT	2102	0.90	2336	LT	2336	1.00	0.00
WB-RT	0	0.96	0	--	0	0.00	0.00
WB-TH	910	0.96	948	TH	948	0.00	0.00
WB-LT	0	0.96	0	--	0	0.00	0.00
EB-RT	0	0.82	0	--	0	0.00	0.00
EB-TH	1976	0.82	2410	TH	2410	0.00	0.00
EB-LT	0	0.82	0	--	0	0.00	0.00

SIGNAL97/TEAPAC[Ver 1.00] - HCM Saturation Flow Adjustment Worksheet

Ap pr ch --	Lane Group Mvmts --	Ideal Satfl pcphg	# L n -	Adjustment Factors: Lane Width	Heavy Vehs	Grade	Parkg	Bus Block	Ar Loc	Lane Util	Right Turn	Left Turn	Adj Fact	Adj Sat-flow vphg
SB-	LT	1891	3	0.913	0.965	1.030	1.000	1.000	0.9	0.97	1.000	0.950	1.00	4272
WB-	TH	1891	2	0.950	0.940	1.000	1.000	1.000	0.9	0.95	1.000	1.000	1.00	2887
EB-	TH	1891	3	0.994	0.947	1.000	1.000	1.000	0.9	0.91	1.000	1.000	1.00	4375

SIGNAL97/TEAPAC[Ver 1.00] - HCM Capacity Analysis Worksheet

Ap pr ch --	Lane Group Mvts --	LT Phase Type --	Adj Flow Rate vph	Adj Satfl Rate vphg	Flow Ratio v/s --	Green Ratio g/C --	Lane Group Capac vph	V/C Ratio v/c --	Crit Lane Grp -
SB-	LT	Pri.	2336	4272	0.547	0.512	2189	1.067	*
WB-	TH		948	2887	0.328	0.425	1226	0.773	
EB-	TH		2410	4375	0.551	0.425	1858	1.297	*

Cycle Length, C 114 sec   Yc = Sum crit(v/s) 1.098
Lost Time Per Cycle, L 7.2 sec   Xc = Yc x C/(C-L) 1.172

```
VOLKAN COSKUN THESIS                                                      05/18/06
INT # 2204 - DOLMABAHCE - PM PEAK                                         21:44:21
EXISTING (SIGNAL 97)


SIGNAL97/TEAPAC[Ver 1.00] - HCM Level-of-Service Worksheet

Ap   Lane       Vol  Green  Unif Progr  Lane Calib   Incr   Lane  Lan
pr  Group     Ratio  Ratio Delay  Fact Group  Term  Delay  Group  Grp  Appr Appr
ch   Mvts       v/c    g/C    d1    PF Capac     k     d2  Delay  LOS Delay  LOS
--    --        --      -- sec/v    --   vph     -  sec/v  sec/v    -  sec/v   -
==============================================================================
SB-   LT     1.067    .512  27.8  1.00  2189 0.500  40.07   67.9    E
-----------------------------------------------------------------------> 67.9    E
WB-   TH     0.773    .425  28.1  1.00  1226 0.500   4.78   32.9    C
-----------------------------------------------------------------------> 32.9    C
EB-   TH     1.297    .425  32.8  1.00  1858 0.500 137.80  170.6    F
-----------------------------------------------------------------------> 170.6   F
Cycle=114"                                                              ===========
Int Total    1.116 =====================================================> 105.5   F
```

```
VOLKAN COSKUN THESIS                                                        05/18/06
INT # 2204 - DOLMABAHCE - PM PEAK                                           21:44:21
EXISTING (SIGNAL 97)

SIGNAL97/TEAPAC[Ver 1.00] - Evaluation of Intersection Performance

      Intersection # 204 - .
      -----------------------
Sq 11 |  Phase 1  |  Phase 2  |
**/** -----------------------
      |     +     |           |
  .   |     +     |           |
 /|\  |     +>    |      <++++|
  |   |           |           |
  |   |           |           |
North |           |++++>      |
  |   |           |           |
      |           |           |
      -----------------------
      | G/C=0.509 | G/C=0.421 |
      | G=  58.0" | G=  48.0" |
      | Y+R= 4.0" | Y+R= 4.0" |
      | OFF= 0.0% | OFF=54.4% |
      -----------------------
      C=114 sec   G=106.0 sec = 93.0%  Y= 8.0 sec =  7.0%  Ped= 0.0 sec =  0.0%

MVMT TOTALS     SB Approach    WB Approach    NB Approach    EB Approach   Int
Param:Units     RT   TH   LT   RT   TH   LT   RT   TH   LT   RT   TH   LT Total
----------- -------------- -------------- -------------- -------------- -----
AdjVol: vph      0    0 2336    0  948    0    0    0    0    0 2410    0  5694
Wid/Ln:ft/#    0/0  0/0 28/3  0/0 21/2  0/0  0/0  0/0  0/0  0/0 36/3  0/0
g/C Rqd@C: %     0    0   57    0   41    0    0    0    0    0   57    0
g/C Used: %      0    0   51    0   42    0    0    0    0    0   42    0
SV @E:  vph      0    0 2189    0 1226    0    0    0    0    0 1858    0  5273
----------- -------------- -------------- -------------- -------------- -----
Svc Lvl:LOS               E         C                             F         F
Deg Sat:v/c   0.00 0.00 1.07 0.00 0.77 0.00 0.00 0.00 0.00 0.00 1.30 0.00  1.12
Avg Del:s/v    0.0  0.0 59.2  0.0 30.4  0.0  0.0  0.0  0.0  0.0129.6  0.0  84.2
Tot Del:min      0    0  576    0  120    0    0    0    0    0 1301    0  1997
# Stops:veh      0    0  584    0  203    0    0    0    0    0  602    0  1389
----------- -------------- -------------- -------------- -------------- -----
Max Que:veh      0    0  104    0   35    0    0    0    0    0  206    0   345
Max Que: ft      0    0  889    0  448    0    0    0    0    0 1772    0  1772
----------- -------------- -------------- -------------- -------------- -----

APPR TOTALS                                                               Int
Param:Units    SB Approach    WB Approach    NB Approach    EB Approach   Total
----------- -------------- -------------- -------------- -------------- -----
AdjVol: vph         2336            948              0           2410     5694
----------- -------------- -------------- -------------- -------------- -----
Svc Lvl:LOS            E              C                             F        F
Deg Sat:v/c         1.07           0.77           0.00           1.30     1.12
Avg Del:s/v         59.2           30.4            0.0          129.6     84.2
Tot Del:min          576            120              0           1301     1997
# Stops:veh          584            203              0            602     1389
----------- -------------- -------------- -------------- -------------- -----
Max Que:veh          104             35              0            206      345
Max Que: ft          889            448              0           1772     1772
----------- -------------- -------------- -------------- -------------- -----
```

APPENDIX B: OUTPUTS OF THE SIGNAL 2000 ANALYSIS

```
VOLKAN COSKUN THESIS                                                03/26/06
INT 1109 - SARAYBURNU - AM PEAK                                     21:24:28
OPTIMUM


SIGNAL2000/TEAPAC[Ver 2.60.07] - HCM Input Worksheet

Intersection # 109 -                                 Area Location Type: NONCBD

             |      |      |      ||      |                  Key:  VOLUMES -- >
             |    0 |    0 |    0 ||      |                        |   WIDTHS
             |  0.0 |  0.0 |  0.0 ||      |                        v      LANES
             |    0 |    0 |    0 ||      ---------------
             |      |      |      ||   \     0   0.0  0                .
-------------    /      |      \        ---------------               /|\
                                  --  1503  22.1  2                     |
===================                   ---------------                   |
      0   0.0  0  /        +       /     0   0.0  0                  North
-------------------                   ===============                   |
    418  19.7  2  --
-------------------            \      |      /    ---------------
    169   0.0  0  \     ||      |      |      |
------------------      ||  108 |    0 |    8 |     Phasing:  SEQUENCE     11
                  |     ||  0.0 | 19.7 |  0.0 |               PERMSV  N N N N
                  |     ||    0 |    2 |    0 |               OVERLP  Y Y Y Y
                  |     ||      |      |      |               LEADLAG    LD LD


                           SB                   WB                  NB                  EB
                     RT    TH    LT      RT    TH    LT      RT    TH    LT      RT    TH    LT
================   ==============   ==============   ==============   ==============
Heavy veh, %HV       .0    .0    .0      .0   1.9    .0    25.0    .0  17.6    12.4   4.5    .0
Pk-hr fact, PHF     .90   .90   .90     .90   .90   .90     .73   .73   .73     .92   .92   .92
Pretimed or Act       P     P     P       P     P     P       P     P     P       P     P     P
Strtup lost, l1     2.3   2.3   2.3     2.3   2.3   2.3     2.3   2.3   2.3     2.3   2.3   2.3
Ext eff grn, e      2.7   2.7   2.7     2.7   2.7   2.7     1.7   1.7   1.7     2.7   2.7   2.7
Arrival typ, AT       3     3     3       2     2     2       3     3     3       2     2     2
----------------   --------------   --------------   --------------   --------------
Ped vol, vped              0                  0                  0                  0
Bike vol, vbic             0                  0                  0                  0
Parking locatns           NO                 NO                 NO                 NO
Park mnvrs, Nm             0                  0                  0                  0
Bus stops, NB              0                  0                  0                  0
Grade, %G                 .0                3.7               -8.4                 .0
================   ==============   ==============   ==============   ==============


      ---------------------------------------------------------------------------
Sq 11 | Phase 1   | Phase 2   | Phase 3   | Phase 4   | Phase 5   | Phase 6   |
**/** ---------------------------------------------------------------------------
      |           |           |           |           |           |           |
  .   |           |           |           |           |           |           |
 /|\  |           |      <++++|           |           |           |           |
  |   |           |           |           |           |           |           |
  |   |           |           |           |           |           |           |
North |    <+    +>|++++>     |           |           |           |           |
  |   |     +    + |++++      |           |           |           |           |
      |     +    + |   v      |           |           |           |           |
      ---------------------------------------------------------------------------
C= 75"| G=  13.0" | G=  55.0" | G=   0.0" | G=   0.0" | G=   0.0" | G=   0.0" |
      | Y+R= 3.0" | Y+R= 4.0" | Y+R= 0.0" | Y+R= 0.0" | Y+R= 0.0" | Y+R= 0.0" |
      ---------------------------------------------------------------------------
```

```
VOLKAN COSKUN THESIS                                                    03/26/06
INT 1109 - SARAYBURNU - AM PEAK                                         21:24:28
OPTIMUM


SIGNAL2000/TEAPAC[Ver 2.60.07] - HCM Volume Adjust & Satflow Worksheet

Volume                 SB                WB                NB                EB
Adjustment        RT   TH   LT      RT   TH   LT      RT   TH   LT      RT   TH   LT
===============  ==============  ==============  ==============  ==============
Volume, V          0    0    0       0 1503    0       8    0  108     169  418    0
Pk-hr fact, PHF  .00  .00  .00     .90  .90  .90     .73  .73  .73     .92  .92  .92
Adj mv flow, vp    0    0    0       0 1670    0      11    0  148     184  454    0
---------------  --------------  --------------  --------------  --------------
Lane group, LG                           TH            RT+TH+LT            RT+TH
Adj LG flow, v                         1670              159              638
Prop LT, PLT                           .000             .931             .000
Prop RT, PRT                           .000             .069             .288
---------------  --------------  --------------  --------------  --------------

Saturation             SB                WB                NB                EB
Flow Rate         RT   TH   LT      RT   TH   LT      RT   TH   LT      RT   TH   LT
===============  ==============  ==============  ==============  ==============
Base satflo, so                        1891             1891             1891
Number lanes, N                           2                2                2
Lane width, fW                         .968             .928             .928
Heavy veh, fHV                         .981             .847             .937
Grade, fg                              .982            1.030            1.000
Parking, fp                           1.000            1.000            1.000
Bus block, fbb                        1.000            1.000            1.000
Area type, fa                         1.000            1.000            1.000
Lane util, fLU                         .950             .950             .950
Left-turn, fLT                        1.000             .956            1.000
Right-turn, fRT                       1.000             .990             .957
PedBike LT,fLpb                       1.000            1.000            1.000
PedBike RT,fRpb                       1.000            1.000            1.000
Local adjustmnt                       1.000            1.000            1.000
Adj satflow, s                         3352             2750             2989
===============  ==============  ==============  ==============  ==============


SIGNAL2000/TEAPAC[Ver 2.60.07] - HCM Capacity and LOS Worksheet

Capacity               SB                WB                NB                EB
Analysis          RT   TH   LT      RT   TH   LT      RT   TH   LT      RT   TH   LT
===============  ==============  ==============  ==============  ==============
Lane group, LG                           TH            RT+TH+LT            RT+TH
Adj Flow, v                            1670              159              638
Satflow, s                             3352             2750             2989
Lost time, tL                           3.6              3.6              3.6
Effect green, g                        55.4             12.4             55.4
Grn ratio, g/C                         .739             .165             .739
LG capacity, c                         2476              455             2208
v/c ratio, X                           .674             .349             .289
Flow ratio, v/s                        .498             .058             .213
Crit lane group                           *                *
---------------  --------------  --------------  --------------  --------------
Sum crit v/s,Tc       0.556      Total lost, L        7.2
Crit v/c, Xc           .615
===============  ==============  ==============  ==============  ==============
```

VOLKAN COSKUN THESIS 03/26/06
INT 1109 - SARAYBURNU - AM PEAK 21:24:28
OPTIMUM

SIGNAL2000/TEAPAC[Ver 2.60.07] - HCM Capacity and LOS Worksheet

Delay and LOS	SB RT	SB TH	SB LT	WB RT	WB TH	WB LT	NB RT	NB TH	NB LT	EB RT	EB TH	EB LT
Lane group, LG					TH			RT+TH+LT			RT+TH	
Adj Flow, v					1670			159			638	
LG capacity, c					2476			455			2208	
v/c ratio, X					.674			.349			.289	
Grn ratio, g/C					.739			.165			.739	
Unif delay, d1					5.1			27.7			3.3	
Incr calib, k					.50			.50			.50	
Incr delay, d2					1.5			2.1			.3	
Queue Delay, d3					.0			.0			.0	
Unif delay, d1*					.0			.0			.0	
Prog factor, PF					1.81			1.00			1.81	
Contrl delay, d					10.7			29.8			6.2	
Lane group LOS					B+			C			A	
Final Queue,Qbi					0			0			0	
Appr delay, dA					10.7			29.8			6.2	
Approach LOS					B+			C			A	
Appr flow, vA					1670			159			638	

Intersection: Delay 10.8 LOS B+

VOLKAN COSKUN THESIS 03/26/06
INT 1109 - SARAYBURNU - AM PEAK 21:24:28
OPTIMUM

SIGNAL2000/TEAPAC[Ver 2.60.07] - HCM Back of Queue Worksheet

Queues in Worst Lanes	SB RT	SB TH	SB LT	WB RT	WB TH	WB LT	NB RT	NB TH	NB LT	EB RT	EB TH	EB LT
Lane group, LG					TH			RT+TH+LT			RT+TH	
Init queue, QbL					0			0			0	
Ln flow, vL					879			84			336	
Ln satflow, sL					1764			1448			1573	
Ln capacity, cL					1303			239			1162	
Flow ratio, yL					.498			.058			.213	
v/c ratio, XL					.674			.349			.289	
Effect green, g					55.4			12.4			55.4	
Grn ratio, g/C					.739			.165			.739	
Upstr filter, I					1.00			1.00			1.00	
Grn arrivals, P					.50			.17			.49	
Pltn ratio, Rp					.68			1.00			.67	
Prog factr, PF2					1.45			1.00			1.78	
Queue (1st), Q1					13.8			1.5			4.1	
Queue factr, kB					1.21			.37			1.12	
Queue (2nd), Q2					2.4			.2			.5	
Avg queue, Q					16.2			1.7			4.6	
90% factor, fB					1.52			1.85			1.70	
90% queue, Qp					24.6			3.2			7.8	
Avg spacing, Lh					25.3			27.7			26.0	
Avail storg, La					0			0			0	
Avg distance					409			48			119	
Avg ratio, RQ					.00			.00			.00	
90% distance					622			89			203	
90% ratio, RQp					.00			.00			.00	

```
VOLKAN COSKUN THESIS                                                         03/26/06
INT 1109 - SARAYBURNU - AM PEAK                                              21:24:28
OPTIMUM


SIGNAL2000/TEAPAC[Ver 2.60.07] - Capacity Analysis Summary

Intersection Averages for Int # 109 -
      Degree of Saturation (v/c) 0.55  Vehicle Delay  10.8  Level of Service B+

      -------------------------
Sq 11 |  Phase 1   |  Phase 2  |
**/** -------------------------
      |            |           |
  .   |            |           |
 /|\  |            |      <++++|
  |   |            |           |
  |   |            |           |
North |    <+   +>|++++>       |
  |   |      +   + |++++       |
      |      +   + |   v       |
      -------------------------
      | G/C=0.173  | G/C=0.733 |
      | G=  13.0"  | G=  55.0" |
      | Y+R= 3.0"  | Y+R= 4.0" |
      | OFF= 0.0%  | OFF=21.3% |
      -------------------------
      C= 75 sec   G= 68.0 sec = 90.7%  Y= 7.0 sec =  9.3%  Ped= 0.0 sec =  0.0%

-------------------------------------------------------------------------------
| Lane    |Width/|     g/C      | Service Rate|  Adj |       |  HCM  | L | Queue |
|  Group  | Lanes| Reqd   Used  | @C (vph) @E |Volume|  v/c  | Delay | S |Model 1|
-------------------------------------------------------------------------------

NB Approach                                                      29.8    C
===============================================================================
|RT+TH+LT| 20/2 |0.124 |0.165 |  277 |  455 |  159 |0.349 |  29.8 | C |  89 ft|
-------------------------------------------------------------------------------

WB Approach                                                      10.7    B+
===============================================================================
|   TH   | 22/2 |0.521 |0.739 | 2470 | 2476 | 1670 |0.674 |  10.7 | B+| 622 ft|
-------------------------------------------------------------------------------

EB Approach                                                       6.2    A
===============================================================================
|RT+TH   | 20/2 |0.267 |0.739 | 2194 | 2208 |  638 |0.289 |   6.2 | A | 203 ft|
-------------------------------------------------------------------------------
```

```
VOLKAN COSKUN THESIS                                                  03/26/06
INT 1109 - SARAYBURNU - AM PEAK                                       21:14:46
EXISTING


SIGNAL2000/TEAPAC[Ver 2.60.07] - HCM Input Worksheet

Intersection # 109 -                                  Area Location Type: NONCBD

          |     |     |     ||     |                         Key:  VOLUMES -- >
          |   0 |   0 |   0 ||     |                               |   WIDTHS
          | 0.0 | 0.0 | 0.0 ||     |                               v      LANES
          |   0 |   0 |   0 ||      -------------------
          |     |     |     ||    \      0   0.0  0                  .
-----------     /     |     \          -------------------          /|\
                                    --  1503  22.1  2                |
===============                         -------------------          |
      0   0.0  0  /        +        /      0   0.0  0              North
---------------                         ===================          |
    418  19.7  2  --
---------------          \     |     /    ------------
    169   0.0  0  \    ||     |     |     |
-----------------      ||  108 |   0 |   8 |    Phasing:  SEQUENCE    11
                  |    ||  0.0 | 19.7 | 0.0 |              PERMSV   N N N N
                  |    ||    0 |    2 |   0 |              OVERLP   Y Y Y Y
                  |    ||      |      |     |              LEADLAG    LD LD


                         SB               WB               NB               EB
                  RT    TH    LT    RT    TH    LT    RT    TH    LT    RT    TH    LT
===============  ==============  ==============  ==============  ==============
Heavy veh, %HV     .0    .0    .0    .0   1.9    .0  25.0    .0  17.6  12.4   4.5    .0
Pk-hr fact, PHF   .90   .90   .90   .90   .90   .90   .73   .73   .73   .92   .92   .92
Pretimed or Act     P     P     P     P     P     P     P     P     P     P     P     P
Strtup lost, l1   2.3   2.3   2.3   2.3   2.3   2.3   2.3   2.3   2.3   2.3   2.3   2.3
Ext eff grn, e    2.7   2.7   2.7   2.7   2.7   2.7   1.7   1.7   1.7   2.7   2.7   2.7
Arrival typ, AT     3     3     3     2     2     2     3     3     3     2     2     2
---------------  --------------  --------------  --------------  --------------
Ped vol, vped           0                 0                 0                 0
Bike vol, vbic          0                 0                 0                 0
Parking locatns        NO                NO                NO                NO
Park mnvrs, Nm          0                 0                 0                 0
Bus stops, NB           0                 0                 0                 0
Grade, %G              .0               3.7              -8.4                .0
===============  ==============  ==============  ==============  ==============

      ----------------------------------------------------------------------
Sq 11 |  Phase 1  |  Phase 2  |  Phase 3  |  Phase 4  |  Phase 5  |  Phase 6  |
**/** ----------------------------------------------------------------------
      |           |           |           |           |           |           |
  .   |           |           |           |           |           |           |
 /|\  |           |      <++++|           |           |           |           |
  |   |           |           |           |           |           |           |
  |   |           |           |           |           |           |           |
North |   <+    +>|++++>      |           |           |           |           |
  |   |    +    + |++++       |           |           |           |           |
      |    +    + |   v       |           |           |           |           |
      ----------------------------------------------------------------------
C= 75"| G=  16.0" | G=  52.0" | G=   0.0" | G=   0.0" | G=   0.0" | G=   0.0" |
      | Y+R= 3.0" | Y+R= 4.0" | Y+R= 0.0" | Y+R= 0.0" | Y+R= 0.0" | Y+R= 0.0" |
      ----------------------------------------------------------------------
```

VOLKAN COSKUN THESIS 03/26/06
INT 1109 - SARAYBURNU - AM PEAK 21:14:46
EXISTING

SIGNAL2000/TEAPAC[Ver 2.60.07] - HCM Volume Adjust & Satflow Worksheet

Volume	SB			WB			NB			EB		
Adjustment	RT	TH	LT	RT	TH	LT	RT	TH	LT	RT	TH	LT
Volume, V	0	0	0	0	1503	0	8	0	108	169	418	0
Pk-hr fact, PHF	.00	.00	.00	.90	.90	.90	.73	.73	.73	.92	.92	.92
Adj mv flow, vp	0	0	0	0	1670	0	11	0	148	184	454	0
Lane group, LG					TH			RT+TH+LT			RT+TH	
Adj LG flow, v					1670			159			638	
Prop LT, PLT					.000			.931			.000	
Prop RT, PRT					.000			.069			.288	

Saturation	SB			WB			NB			EB		
Flow Rate	RT	TH	LT	RT	TH	LT	RT	TH	LT	RT	TH	LT
Base satflo, so					1891			1891			1891	
Number lanes, N					2			2			2	
Lane width, fW					.968			.928			.928	
Heavy veh, fHV					.981			.847			.937	
Grade, fg					.982			1.030			1.000	
Parking, fp					1.000			1.000			1.000	
Bus block, fbb					1.000			1.000			1.000	
Area type, fa					1.000			1.000			1.000	
Lane util, fLU					.950			.950			.950	
Left-turn, fLT					1.000			.956			1.000	
Right-turn, fRT					1.000			.990			.957	
PedBike LT, fLpb					1.000			1.000			1.000	
PedBike RT, fRpb					1.000			1.000			1.000	
Local adjustmnt					1.000			1.000			1.000	
Adj satflow, s					3352			2750			2989	

SIGNAL2000/TEAPAC[Ver 2.60.07] - HCM Capacity and LOS Worksheet

Capacity	SB			WB			NB			EB		
Analysis	RT	TH	LT	RT	TH	LT	RT	TH	LT	RT	TH	LT
Lane group, LG					TH			RT+TH+LT			RT+TH	
Adj Flow, v					1670			159			638	
Satflow, s					3352			2750			2989	
Lost time, tL					3.6			3.6			3.6	
Effect green, g					52.4			15.4			52.4	
Grn ratio, g/C					.699			.205			.699	
LG capacity, c					2342			565			2088	
v/c ratio, X					.713			.281			.306	
Flow ratio, v/s					.498			.058			.213	
Crit lane group					*			*				

Sum crit v/s, Yc	0.556	Total lost, L	7.2
Crit v/c, Xc	.615		

VOLKAN COSKUN THESIS 03/26/06
INT 1109 - SARAYBURNU - AM PEAK 21:14:46
EXISTING

SIGNAL2000/TEAPAC[Ver 2.60.07] - HCM Capacity and LOS Worksheet

Delay and LOS	SB RT	SB TH	SB LT	WB RT	WB TH	WB LT	NB RT	NB TH	NB LT	EB RT	EB TH	EB LT
Lane group, LG					TH			RT+TH+LT			RT+TH	
Adj Flow, v					1670			159			638	
LG capacity, c					2342			565			2088	
v/c ratio, X					.713			.281			.306	
Grn ratio, g/C					.699			.205			.699	
Unif delay, d1					6.8			25.1			4.3	
Incr calib, k					.50			.50			.50	
Incr delay, d2					1.9			1.2			.4	
Queue Delay, d3					.0			.0			.0	
Unif delay, d1*					.0			.0			.0	
Prog factor, PF					1.65			1.00			1.65	
Contrl delay, d					13.1			26.4			7.5	
Lane group LOS					B+			C+			A	
Final Queue,Qbi					0			0			0	
Appr delay, dA					13.1			26.4			7.5	
Approach LOS					B+			C+			A	
Appr flow, vA					1670			159			638	
Intersection:	Delay	12.5		LOS	B+							

VOLKAN COSKUN THESIS 03/26/06
INT 1109 - SARAYBURNU - AM PEAK 21:14:46
EXISTING

SIGNAL2000/TEAPAC[Ver 2.60.07] - HCM Back of Queue Worksheet

Queues in Worst Lanes	SB RT	SB TH	SB LT	WB RT	WB TH	WB LT	NB RT	NB TH	NB LT	EB RT	EB TH	EB LT
Lane group, LG					TH			RT+TH+LT			RT+TH	
Init queue, QbL					0			0			0	
Ln flow, vL					879			84			336	
Ln satflow, sL					1764			1448			1573	
Ln capacity, cL					1233			297			1099	
Flow ratio, yL					.498			.058			.213	
v/c ratio, XL					.713			.281			.306	
Effect green, g					52.4			15.4			52.4	
Grn ratio, g/C					.699			.205			.699	
Upstr filter, I					1.00			1.00			1.00	
Grn arrivals, P					.47			.21			.47	
Platn ratio, Rp					.67			1.00			.67	
Prog factr, PF2					1.33			1.00			1.63	
Queue (1st), Q1					14.6			1.5			4.4	
Queue factr, kB					1.16			.43			1.07	
Queue (2nd), Q2					2.7			.2			.5	
Avg queue, Q					17.4			1.6			4.8	
90% factor, fB					1.52			1.86			1.69	
90% queue, Qp					26.3			3.0			8.2	
Avg spacing, Lh					25.3			27.7			26.0	
Avail storg, La					0			0			0	
Avg distance					439			45			126	
Avg ratio, RQ					.00			.00			.00	
90% distance					666			84			212	
90% ratio, RQp					.00			.00			.00	

```
VOLKAN COSKUN THESIS                                                    03/26/06
INT 1109 - SARAYBURNU - AM PEAK                                         21:14:46
EXISTING


SIGNAL2000/TEAPAC[Ver 2.60.07] - Capacity Analysis Summary

Intersection Averages for Int # 109 -
      Degree of Saturation (v/c) 0.58  Vehicle Delay  12.5  Level of Service B+

      -------------------------
Sq 11 |  Phase 1   |  Phase 2  |
**/** -------------------------
      |            |           |
  .   |            |           |
 /|\  |            |      <++++|
  |   |            |           |
  |   |            |           |
North |     <+   +>|++++>      |
  |   |      +   + |++++       |
      |      +   + |   v       |
      -------------------------
      | G/C=0.213  | G/C=0.693 |
      | G=  16.0"  | G=  52.0" |
      | Y+R= 3.0"  | Y+R= 4.0" |
      | OFF= 0.0%  | OFF=25.3% |
      -------------------------
      C= 75 sec   G= 68.0 sec = 90.7%  Y= 7.0 sec =  9.3%  Ped= 0.0 sec =  0.0%

--------------------------------------------------------------------------------
| Lane    |Width/|     g/C     | Service Rate| Adj |      |  HCM  | L | Queue |
|  Group  | Lanes| Reqd   Used | @C (vph) @E |Volume|  v/c | Delay | S |Model 1|
--------------------------------------------------------------------------------

NB Approach                                                  26.4   C+
================================================================================
|RT+TH+LT| 20/2 |0.124 |0.205 |  400 |  565 |  159 |0.281 |  26.4 | C+|  84 ft|
--------------------------------------------------------------------------------

WB Approach                                                  13.1   B+
================================================================================
|   TH   | 22/2 |0.521 |0.699 | 2323 | 2342 | 1670 |0.713 |  13.1 | B+| 666 ft|
--------------------------------------------------------------------------------

EB Approach                                                   7.5   A
================================================================================
|RT+TH   | 20/2 |0.267 |0.699 | 2062 | 2088 |  638 |0.306 |   7.5 | A | 212 ft|
--------------------------------------------------------------------------------
```

```
VOLKAN COSKUN THESIS                                               03/26/06
INT 1109 - SARAYBURNU - PM PEAK                                    21:33:07
OPTIMUM


SIGNAL2000/TEAPAC[Ver 2.60.07] - HCM Input Worksheet

Intersection # 109 -                               Area Location Type: NONCBD

          |    |    |    ||     |                        Key:  VOLUMES -- >
          |   0 |   0 |   0 ||     |                             |  WIDTHS
          | 0.0 | 0.0 | 0.0 ||     |                             v      LANES
          |   0 |   0 |   0 ||     |  --------------------
          |    |    |    ||    \   0   0.0  0                   .
----------   /    |    \        --------------------          /|\
                                --  859  22.1  2                |
====================            --------------------            |
       0   0.0  0  /      +      /   0   0.0  0                North
--------------------            ====================            |
    1473  19.7  2  --
--------------------        \     |     /    ------------
     134   0.0  0  \    ||     |     |     |
---------------------   ||  216 |    0 |  21 |    Phasing:  SEQUENCE    11
               |        ||  0.0 | 19.7 | 0.0 |              PERMSV  N N N N
               |        ||    0 |    2 |   0 |              OVERLP  Y Y Y Y
               |        ||      |      |     |              LEADLAG   LD LD


                          SB                WB                NB                EB
                   RT   TH   LT    RT   TH   LT    RT   TH   LT    RT   TH   LT
================ ================ ================ ================ ================
Heavy veh, %HV     .0   .0   .0    .0  1.4   .0   4.8   .0  1.4   3.7   .9   .0
Pk-hr fact, PHF   .90  .90  .90   .96  .96  .96   .85  .85  .85   .87  .87  .87
Pretimed or Act     P    P    P     P    P    P     P    P    P     P    P    P
Strtup lost, l1   2.3  2.3  2.3   2.3  2.3  2.3   2.3  2.3  2.3   2.3  2.3  2.3
Ext eff grn, e    2.7  2.7  2.7   2.7  2.7  2.7   1.7  1.7  1.7   2.7  2.7  2.7
Arrival typ, AT     3    3    3     2    2    2     3    3    3     2    2    2
---------------- ---------------- ---------------- ---------------- ----------------
Ped vol, vped           0                0                0                0
Bike vol, vbic          0                0                0                0
Parking locatns        NO               NO               NO               NO
Park mnvrs, Nm          0                0                0                0
Bus stops, NB           0                0                0                0
Grade, %G              .0              3.7             -8.4               .0
================ ================ ================ ================ ================

      -------------------------------------------------------------------------
Sq 11 |  Phase 1  |  Phase 2  |  Phase 3  |  Phase 4  |  Phase 5  |  Phase 6  |
**/** -------------------------------------------------------------------------
      |           |           |           |           |           |           |
  .   |           |           |           |           |           |           |
 /|\  |           |      <++++|           |           |           |           |
  |   |           |           |           |           |           |           |
  |   |           |           |           |           |           |           |
North |   <+    +>|++++>      |           |           |           |           |
  |   |    +    + |++++       |           |           |           |           |
      |    +    + |   v       |           |           |           |           |
      -------------------------------------------------------------------------
C= 82"| G=  12.0" | G=  63.0" | G=   0.0" | G=   0.0" | G=   0.0" | G=   0.0" |
      | Y+R= 3.0" | Y+R= 4.0" | Y+R= 0.0" | Y+R= 0.0" | Y+R= 0.0" | Y+R= 0.0" |
      -------------------------------------------------------------------------
```

VOLKAN COSKUN THESIS 03/26/06
INT 1109 - SARAYBURNU - PM PEAK 21:33:07
OPTIMUM

SIGNAL2000/TEAPAC[Ver 2.60.07] - HCM Volume Adjust & Satflow Worksheet

Volume Adjustment	SB RT	SB TH	SB LT	WB RT	WB TH	WB LT	NB RT	NB TH	NB LT	EB RT	EB TH	EB LT
Volume, V	0	0	0	0	859	0	21	0	216	134	1473	0
Pk-hr fact, PHF	.00	.00	.00	.96	.96	.96	.85	.85	.85	.87	.87	.87
Adj mv flow, vp	0	0	0	0	895	0	25	0	254	154	1693	0
Lane group, LG					TH			RT+TH+LT			RT+TH	
Adj LG flow, v					895			279			1847	
Prop LT, PLT					.000			.910			.000	
Prop RT, PRT					.000			.090			.083	

Saturation Flow Rate	SB RT	SB TH	SB LT	WB RT	WB TH	WB LT	NB RT	NB TH	NB LT	EB RT	EB TH	EB LT
Base satflo, so					1891			1891			1891	
Number lanes, N					2			2			2	
Lane width, fW					.968			.928			.928	
Heavy veh, fHV					.986			.983			.989	
Grade, fg					.982			1.030			1.000	
Parking, fp					1.000			1.000			1.000	
Bus block, fbb					1.000			1.000			1.000	
Area type, fa					1.000			1.000			1.000	
Lane util, fLU					.950			.950			.950	
Left-turn, fLT					1.000			.956			1.000	
Right-turn, fRT					1.000			.987			.987	
PedBike LT, fLpb					1.000			1.000			1.000	
PedBike RT, fRpb					1.000			1.000			1.000	
Local adjustmnt					1.000			1.000			1.000	
Adj satflow, s					3368			3187			3257	

SIGNAL2000/TEAPAC[Ver 2.60.07] - HCM Capacity and LOS Worksheet

Capacity Analysis	SB RT	SB TH	SB LT	WB RT	WB TH	WB LT	NB RT	NB TH	NB LT	EB RT	EB TH	EB LT
Lane group, LG					TH			RT+TH+LT			RT+TH	
Adj Flow, v					895			279			1847	
Satflow, s					3368			3187			3257	
Lost time, tL					3.6			3.6			3.6	
Effect green, g					63.4			11.4			63.4	
Grn ratio, g/C					.773			.139			.773	
LG capacity, c					2604			443			2518	
v/c ratio, X					.344			.630			.734	
Flow ratio, v/s					.266			.088			.567	
Crit lane group								*			*	
Sum crit v/s, Yc		0.655		Total lost, L				7.2				
Crit v/c, Xc		.718										

```
VOLKAN COSKUN THESIS                                                           03/26/06
INT 1109 - SARAYBURNU - PM PEAK                                                21:33:07
OPTIMUM


SIGNAL2000/TEAPAC[Ver 2.60.07] - HCM Capacity and LOS Worksheet


Delay                      SB               WB               NB               EB
and LOS              RT    TH    LT   RT    TH    LT   RT    TH    LT   RT    TH    LT
===============  ==============  ==============  ==============  ==============
Lane group, LG                           TH              RT+TH+LT          RT+TH
Adj Flow, v                             895               279              1847
LG capacity, c                         2604               443              2518
v/c ratio, X                           .344              .630              .734
Grn ratio, g/C                         .773              .139              .773
Unif delay, d1                          2.9              33.3               4.9
Incr calib, k                           .50               .50               .50
Incr delay, d2                           .4               6.6               1.9
Queue Delay, d3                          .0                .0                .0
Unif delay, d1*                          .0                .0                .0
Prog factor, PF                        1.99              1.00              1.99
Contrl delay, d                         6.1              40.0              11.6
Lane group LOS                            A                D+                B+
Final Queue,Qbi                           0                 0                 0
---------------  --------------  --------------  --------------  --------------
Appr delay, dA                          6.1              40.0              11.6
Approach LOS                              A                D+                B+
Appr flow, vA                           895               279              1847
---------------  --------------  --------------  --------------  --------------
Intersection:    Delay     12.6  LOS          B+
===============  ==============  ==============  ==============  ==============
```

VOLKAN COSKUN THESIS 03/26/06
INT 1109 - SARAYBURNU - PM PEAK 21:33:07
OPTIMUM

SIGNAL2000/TEAPAC[Ver 2.60.07] - HCM Back of Queue Worksheet

Queues in		SB			WB			NB			EB	
Worst Lanes	RT	TH	LT	RT	TH	LT	RT	TH	LT	RT	TH	LT
Lane group, LG					TH			RT+TH+LT			RT+TH	
Init queue, QbL					0			0			0	
Ln flow, vL					471			147			972	
Ln satflow, sL					1773			1678			1714	
Ln capacity, cL					1371			233			1325	
Flow ratio, yL					.266			.088			.567	
v/c ratio, XL					.344			.630			.734	
Effect green, g					63.4			11.4			63.4	
Grn ratio, g/C					.773			.139			.773	
Upstr filter, I					1.00			1.00			1.00	
Grn arrivals, P					.52			.14			.62	
Pltn ratio, Rp					.67			1.00			.80	
Prog factr, PF2					1.91			1.00			1.33	
Queue (1st), Q1					6.3			3.2			15.4	
Queue factr, kB					1.33			.39			1.30	
Queue (2nd), Q2					.7			.6			3.3	
Avg queue, Q					7.0			3.8			18.8	
90% factor, fB					1.62			1.73			1.51	
90% queue, Qp					11.4			6.6			28.4	
Avg spacing, Lh					25.2			25.3			25.2	
Avail storg, La					0			0			0	
Avg distance					177			95			472	
Avg ratio, RQ					.00			.00			.00	
90% distance					287			166			714	
90% ratio, RQp					.00			.00			.00	

```
VOLKAN COSKUN THESIS                                                        03/26/06
INT 1109 - SARAYBURNU - PM PEAK                                             21:33:07
OPTIMUM


SIGNAL2000/TEAPAC[Ver 2.60.07] - Capacity Analysis Summary

Intersection Averages for Int # 109 -
      Degree of Saturation (v/c) 0.61  Vehicle Delay  12.6  Level of Service B+

      -------------------------
Sq 11 |  Phase 1   |  Phase 2  |
**/** -------------------------
      |            |           |
  .   |            |           |
 /|\  |            |      <++++|
  |   |            |           |
  |   |            |           |
North |    <+   +> |++++>      |
  |   |     +   +  |++++       |
      |     +   +  |   v       |
      -------------------------
      | G/C=0.146  | G/C=0.768 |
      | G=  12.0"  | G=  63.0" |
      | Y+R= 3.0"  | Y+R= 4.0" |
      | OFF= 0.0%  | OFF=18.3% |
      -------------------------
      C= 82 sec   G= 75.0 sec = 91.5%  Y= 7.0 sec =  8.5%  Ped= 0.0 sec =  0.0%

-------------------------------------------------------------------------------------
| Lane   |Width/|     g/C     | Service Rate|  Adj |        |  HCM  | L | Queue |
| Group  | Lanes| Reqd   Used | @C (vph) @E |Volume|   v/c  | Delay | S |Model 1|
-------------------------------------------------------------------------------------

NB Approach                                                      40.0    D+
=====================================================================================
|RT+TH+LT| 20/2 |0.166 |0.139 |  181  |  443 |  279 |0.630 |  40.0 | D+| 166 ft|
-------------------------------------------------------------------------------------

WB Approach                                                       6.1    A
=====================================================================================
|   TH   | 22/2 |0.321 |0.773 | 2595 | 2604 |  895 |0.344 |   6.1 | A | 287 ft|
-------------------------------------------------------------------------------------

EB Approach                                                      11.6    B+
=====================================================================================
|RT+TH   | 20/2 |0.590 |0.773 | 2506 | 2518 | 1847 |0.734 |  11.6 | B+| 714 ft|
-------------------------------------------------------------------------------------
```

```
VOLKAN COSKUN THESIS                                                03/26/06
INT 1109 - SARAYBURNU - PM PEAK                                     21:30:34
EXISTING


SIGNAL2000/TEAPAC[Ver 2.60.07] - HCM Input Worksheet

Intersection # 109 -                                  Area Location Type: NONCBD

             |      |      |      ||      |                 Key:  VOLUMES -- >
             |    0 |    0 |    0 ||      |                       |   WIDTHS
             |  0.0 |  0.0 |  0.0 ||      |                       v      LANES
             |    0 |    0 |    0 ||      -------------------
             |      |      |      ||    \     0   0.0   0              .
-------------    /      |      \           -------------------        /|\
                                        --   859  22.1   2             |
===================                        -------------------         |
      0   0.0   0  /         +         /      0   0.0   0          North
-------------------                        ===================         |
    1473  19.7   2  --
-------------------         \       |       /    -------------
     134   0.0   0  \     ||      |      |      |
--------------------      ||  216 |    0 |   21 |     Phasing:  SEQUENCE     11
                    |     ||  0.0 | 19.7 |  0.0 |               PERMSV  N N N N
                    |     ||    0 |    2 |    0 |               OVERLP  Y Y Y Y
                    |     ||      |      |      |               LEADLAG   LD LD


                         SB                  WB                 NB                 EB
                   RT   TH   LT       RT   TH   LT       RT   TH   LT       RT   TH   LT
===============  ==============  ==============  ==============  ==============
Heavy veh, %HV     .0   .0   .0       .0  1.4   .0      4.8   .0  1.4      3.7   .9   .0
Pk-hr fact, PHF   .90  .90  .90      .96  .96  .96      .85  .85  .85      .87  .87  .87
Pretimed or Act     P    P    P        P    P    P        P    P    P        P    P    P
Strtup lost, l1   2.3  2.3  2.3      2.3  2.3  2.3      2.3  2.3  2.3      2.3  2.3  2.3
Ext eff grn, e    2.7  2.7  2.7      2.7  2.7  2.7      1.7  1.7  1.7      2.7  2.7  2.7
Arrival typ, AT     3    3    3        2    2    2        3    3    3        2    2    2
---------------  --------------  --------------  --------------  --------------
Ped vol, vped            0                  0                  0                  0
Bike vol, vbic           0                  0                  0                  0
Parking locatns         NO                 NO                 NO                 NO
Park mnvrs, Nm           0                  0                  0                  0
Bus stops, NB            0                  0                  0                  0
Grade, %G               .0                3.7               -8.4                 .0
===============  ==============  ==============  ==============  ==============

      ------------------------------------------------------------------------
Sq 11 | Phase 1  |  Phase 2  |  Phase 3  |  Phase 4  |  Phase 5  |  Phase 6  |
**/** ------------------------------------------------------------------------
      |          |           |           |           |           |           |
   .  |          |           |           |           |           |           |
  /|\ |          |      <++++|           |           |           |           |
   |  |          |           |           |           |           |           |
   |  |          |           |           |           |           |           |
North |    <+   +>|++++>      |           |           |           |           |
   |  |     +   + |++++       |           |           |           |           |
      |     +   + |   v       |           |           |           |           |
      ------------------------------------------------------------------------
C= 83"| G=  16.0" | G=  60.0" | G=   0.0" | G=   0.0" | G=   0.0" | G=   0.0" |
      | Y+R= 3.0" | Y+R= 4.0" | Y+R= 0.0" | Y+R= 0.0" | Y+R= 0.0" | Y+R= 0.0" |
      ------------------------------------------------------------------------
```

VOLKAN COSKUN THESIS 03/26/06
INT 1109 - SARAYBURNU - PM PEAK 21:30:34
EXISTING

SIGNAL2000/TEAPAC[Ver 2.60.07] - HCM Volume Adjust & Satflow Worksheet

Volume	SB			WB			NB			EB		
Adjustment	RT	TH	LT	RT	TH	LT	RT	TH	LT	RT	TH	LT
Volume, V	0	0	0	0	859	0	21	0	216	134	1473	0
Pk-hr fact, PHF	.00	.00	.00	.96	.96	.96	.85	.85	.85	.87	.87	.87
Adj mv flow, vp	0	0	0	0	895	0	25	0	254	154	1693	0
Lane group, LG					TH			RT+TH+LT			RT+TH	
Adj LG flow, v					895			279			1847	
Prop LT, PLT					.000			.910			.000	
Prop RT, PRT					.000			.090			.083	

Saturation	SB			WB			NB			EB		
Flow Rate	RT	TH	LT	RT	TH	LT	RT	TH	LT	RT	TH	LT
Base satflo, so					1891			1891			1891	
Number lanes, N					2			2			2	
Lane width, fW					.968			.928			.928	
Heavy veh, fHV					.986			.983			.989	
Grade, fg					.982			1.030			1.000	
Parking, fp					1.000			1.000			1.000	
Bus block, fbb					1.000			1.000			1.000	
Area type, fa					1.000			1.000			1.000	
Lane util, fLU					.950			.950			.950	
Left-turn, fLT					1.000			.956			1.000	
Right-turn, fRT					1.000			.987			.987	
PedBike LT,fLpb					1.000			1.000			1.000	
PedBike RT,fRpb					1.000			1.000			1.000	
Local adjustmnt					1.000			1.000			1.000	
Adj satflow, s					3368			3187			3257	

SIGNAL2000/TEAPAC[Ver 2.60.07] - HCM Capacity and LOS Worksheet

Capacity	SB			WB			NB			EB		
Analysis	RT	TH	LT	RT	TH	LT	RT	TH	LT	RT	TH	LT
Lane group, LG					TH			RT+TH+LT			RT+TH	
Adj Flow, v					895			279			1847	
Satflow, s					3368			3187			3257	
Lost time, tL					3.6			3.6			3.6	
Effect green, g					60.4			15.4			60.4	
Grn ratio, g/C					.728			.186			.728	
LG capacity, c					2451			591			2370	
v/c ratio, X					.365			.472			.779	
Flow ratio, v/s					.266			.088			.567	
Crit lane group								*			*	

Sum crit v/s,Yc	0.655	Total lost, L	7.2
Crit v/c, Xc	.717		

VOLKAN COSKUN THESIS 03/26/06
INT 1109 - SARAYBURNU - PM PEAK 21:30:34
EXISTING

SIGNAL2000/TEAPAC[Ver 2.60.07] - HCM Capacity and LOS Worksheet

Delay and LOS	SB RT	SB TH	SB LT	WB RT	WB TH	WB LT	NB RT	NB TH	NB LT	EB RT	EB TH	EB LT
Lane group, LG					TH			RT+TH+LT			RT+TH	
Adj Flow, v					895			279			1847	
LG capacity, c					2451			591			2370	
v/c ratio, X					.365			.472			.779	
Grn ratio, g/C					.728			.186			.728	
Unif delay, d1					4.2			30.2			7.1	
Incr calib, k					.50			.50			.50	
Incr delay, d2					.4			2.7			2.6	
Queue Delay, d3					.0			.0			.0	
Unif delay, d1*					.0			.0			.0	
Prog factor, PF					1.76			1.00			1.76	
Contrl delay, d					7.8			32.9			15.1	
Lane group LOS					A			C			B	
Final Queue,Qbi					0			0			0	
Appr delay, dA					7.8			32.9			15.1	
Approach LOS					A			C			B	
Appr flow, vA					895			279			1847	

Intersection: Delay 14.6 LOS B+

VOLKAN COSKUN THESIS 03/26/06
INT 1109 - SARAYBURNU - PM PEAK 21:30:34
EXISTING

SIGNAL2000/TEAPAC[Ver 2.60.07] - HCM Back of Queue Worksheet

Queues in Worst Lanes	SB RT	SB TH	SB LT	WB RT	WB TH	WB LT	NB RT	NB TH	NB LT	EB RT	EB TH	EB LT
Lane group, LG					TH			RT+TH+LT			RT+TH	
Init queue, QbL					0			0			0	
Ln flow, vL					471			147			972	
Ln satflow, sL					1773			1678			1714	
Ln capacity, cL					1290			311			1247	
Flow ratio, yL					.266			.088			.567	
v/c ratio, XL					.365			.472			.779	
Effect green, g					60.4			15.4			60.4	
Grn ratio, g/C					.728			.186			.728	
Upstr filter, I					1.00			1.00			1.00	
Grn arrivals, P					.49			.19			.54	
Platn ratio, Rp					.67			1.00			.75	
Prog factr, PF2					1.69			1.00			1.26	
Queue (1st), Q1					6.8			3.0			17.7	
Queue factr, kB					1.29			.48			1.26	
Queue (2nd), Q2					.7			.4			4.0	
Avg queue, Q					7.5			3.4			21.7	
90% factor, fB					1.61			1.75			1.51	
90% queue, Qp					12.1			6.0			32.7	
Avg spacing, Lh					25.2			25.3			25.2	
Avail storg, La					0			0			0	
Avg distance					190			87			547	
Avg ratio, RQ					.00			.00			.00	
90% distance					306			152			824	
90% ratio, RQp					.00			.00			.00	

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VOLKAN COSKUN THESIS                                                    03/26/06
INT 1109 - SARAYBURNU - PM PEAK                                         21:30:34
EXISTING


SIGNAL2000/TEAPAC[Ver 2.60.07] - Capacity Analysis Summary

Intersection Averages for Int # 109 -
      Degree of Saturation (v/c) 0.63  Vehicle Delay  14.6  Level of Service B+

      -------------------------
Sq 11 |  Phase 1   |  Phase 2  |
**/** -------------------------
      |            |           |
  .   |            |           |
 /|\  |            |      <++++|
  |   |            |           |
  |   |            |           |
North |    <+   +>|++++>       |
  |   |     +   + |++++        |
      |     +   + |   v        |
      -------------------------
      | G/C=0.193 | G/C=0.723 |
      | G=  16.0" | G=  60.0" |
      | Y+R= 3.0" | Y+R= 4.0" |
      | OFF= 0.0% | OFF=22.9% |
      -------------------------
      C= 83 sec   G= 76.0 sec = 91.6%  Y= 7.0 sec =  8.4%  Ped= 0.0 sec =  0.0%

--------------------------------------------------------------------------------
| Lane   |Width/|     g/C     | Service Rate|  Adj |       |  HCM  | L | Queue |
|  Group | Lanes| Reqd   Used | @C (vph)  @E |Volume|  v/c  | Delay | S |Model 1|
--------------------------------------------------------------------------------

NB Approach                                                     32.9   C
================================================================================
|RT+TH+LT| 20/2 |0.169 |0.186 |   344 |   591 |   279 |0.472 |   32.9 | C |  152 ft|
--------------------------------------------------------------------------------

WB Approach                                                      7.8   A
================================================================================
|   TH   | 22/2 |0.323 |0.728 | 2424 | 2451 |   895 |0.365 |    7.8 | A |  306 ft|
--------------------------------------------------------------------------------

EB Approach                                                     15.1   B
================================================================================
|RT+TH   | 20/2 |0.591 |0.728 | 2341 | 2370 |  1847 |0.779 |   15.1 | B |  824 ft|
--------------------------------------------------------------------------------
```

```
VOLKAN COSKUN THESIS                                                        03/26/06
INT 1102 - AHIRKAPI-A - AM PEAK                                             21:50:00
EXISTING


SIGNAL2000/TEAPAC[Ver 2.60.07] - HCM Input Worksheet

Intersection # 102 -                                        Area Location Type: NONCBD

             |      |      |      ||      |                   Key:  VOLUMES -- >
             |   44 |  366 |    0 ||      |                          |   WIDTHS
             |  0.0 | 21.3 |  0.0 ||      |                          v     LANES
             |    0 |    2 |    0 ||      --------------------
             |      |      |      ||    \    0   0.0   0             .
-------------    /      |      \         --------------------        /|\
                                      --    0   0.0   0               |
===================                      --------------------        |
        0   0.0   0  /         +        /    0   0.0   0            North
-------------------                      ===================          |
        0   0.0   0  --
-------------------           \      |      /    -------------
        0   0.0   0  \     ||      |      |      |
--------------------       ||  248 |    0 |    0 |     Phasing:  SEQUENCE    71
                     |     || 13.1 |  0.0 |  0.0 |               PERMSV  N N N N
                     |     ||    1 |    0 |    0 |               OVERLP  Y Y Y Y
                     |     ||      |      |      |               LEADLAG   LG LD


                             SB                  WB                  NB                  EB
                       RT    TH    LT     RT    TH    LT     RT    TH    LT     RT    TH    LT
===============      ==============     ==============     ==============     ==============
Heavy veh, %HV        2.3   5.5    .0     .0    .0    .0     .0    .0    .8     .0    .0    .0
Pk-hr fact, PHF       .93   .93   .93    .90   .90   .90    .84   .84   .84    .90   .90   .90
Pretimed or Act         P     P     P      P     P     P      P     P     P      P     P     P
Strtup lost, l1       2.3   2.3   2.3    2.3   2.3   2.3    2.3   2.3   2.3    2.3   2.3   2.3
Ext eff grn, e        2.7   2.7   2.7    2.0   2.0   2.0    2.0   2.0   1.7    2.0   2.0   2.0
Arrival typ, AT         2     2     2      3     3     3      3     3     3      3     3     3
---------------      --------------     --------------     --------------     --------------
Ped vol, vped               0                  0                  0                  0
Bike vol, vbic              0                  0                  0                  0
Parking locatns            NO                 NO                 NO                 NO
Park mnvrs, Nm              0                  0                  0                  0
Bus stops, NB               0                  0                  0                  0
Grade, %G                  .0                 .0                 .0                 .0
===============      ==============     ==============     ==============     ==============

      ------------------------------------------------------------------------------------
Sq 71 |  Phase 1   |  Phase 2   |  Phase 3   |  Phase 4   |  Phase 5   |  Phase 6   |
LG/** ------------------------------------------------------------------------------------
      |            | + +        |            |            |            |            |
  .   |            | + +        |            |            |            |            |
 /|\  |            |<+ +        |            |            |            |            |
  |   |            |   v        |            |            |            |            |
  |   |            |            |            |            |            |            |
North |     <+     |            |            |            |            |            |
  |   |      +     |            |            |            |            |            |
      |      +     |            |            |            |            |            |
      ------------------------------------------------------------------------------------
C= 77"| G=  25.0"  | G=  45.0"  | G=   0.0"  | G=   0.0"  | G=   0.0"  | G=   0.0"  |
      | Y+R= 3.0"  | Y+R= 4.0"  | Y+R= 0.0"  | Y+R= 0.0"  | Y+R= 0.0"  | Y+R= 0.0"  |
      ------------------------------------------------------------------------------------
```

```
VOLKAN COSKUN THESIS                                                    03/26/06
INT 1102 - AHIRKAPI-A - AM PEAK                                         21:50:00
EXISTING


SIGNAL2000/TEAPAC[Ver 2.60.07] - HCM Volume Adjust & Satflow Worksheet

Volume                  SB             WB             NB             EB
Adjustment         RT   TH   LT   RT   TH   LT   RT   TH   LT   RT   TH   LT
===============  ============== ============== ============== ==============
Volume, V          44  366    0    0    0    0    0    0  248    0    0    0
Pk-hr fact, PHF   .93  .93  .93  .00  .00  .00  .84  .84  .84  .00  .00  .00
Adj mv flow, vp    47  394    0    0    0    0    0    0  295    0    0    0
---------------  -------------- -------------- -------------- --------------
Lane group, LG       RT+TH                                  LT
Adj LG flow, v        441                                  295
Prop LT, PLT         .000                                1.000
Prop RT, PRT         .107                                 .000
---------------  -------------- -------------- -------------- --------------

Saturation              SB             WB             NB             EB
Flow Rate          RT   TH   LT   RT   TH   LT   RT   TH   LT   RT   TH   LT
===============  ============== ============== ============== ==============
Base satflo, so       1891                                 1891
Number lanes, N          2                                    1
Lane width, fW        .955                                1.037
Heavy veh, fHV        .951                                 .992
Grade, fg            1.000                                1.000
Parking, fp          1.000                                1.000
Bus block, fbb       1.000                                1.000
Area type, fa        1.000                                1.000
Lane util, fLU        .950                                1.000
Left-turn, fLT       1.000                                 .950
Right-turn, fRT       .984                                1.000
PedBike LT,fLpb      1.000                                1.000
PedBike RT,fRpb      1.000                                1.000
Local adjustmnt      1.000                                1.000
Adj satflow, s        3211                                 1848
===============  ============== ============== ============== ==============


SIGNAL2000/TEAPAC[Ver 2.60.07] - HCM Capacity and LOS Worksheet

Capacity                SB             WB             NB             EB
Analysis           RT   TH   LT   RT   TH   LT   RT   TH   LT   RT   TH   LT
===============  ============== ============== ============== ==============
Lane group, LG       RT+TH                                  LT
Adj Flow, v           441                                  295
Satflow, s           3211                                 1848
Lost time, tL         3.6                                  3.6
Effect green, g      45.4                                 24.4
Grn ratio, g/C       .590                                 .317
LG capacity, c       1893                                  585
v/c ratio, X         .233                                 .504
Flow ratio, v/s      .137                                 .160
Crit lane group
---------------  -------------- -------------- -------------- --------------
Sum crit v/s,Yc     0.000      Total lost, L         0.0
Crit v/c, Xc         .000
===============  ============== ============== ============== ==============
```

VOLKAN COSKUN THESIS 03/26/06
INT 1102 - AHIRKAPI-A - AM PEAK 21:50:00
EXISTING

SIGNAL2000/TEAPAC[Ver 2.60.07] - HCM Capacity and LOS Worksheet

Delay and LOS	SB RT	SB TH	SB LT	WB RT	WB TH	WB LT	NB RT	NB TH	NB LT	EB RT	EB TH	EB LT
Lane group, LG		RT+TH							LT			
Adj Flow, v		441							295			
LG capacity, c		1893							585			
v/c ratio, X		.233							.504			
Grn ratio, g/C		.590							.317			
Unif delay, d1		7.5							21.4			
Incr calib, k		.50							.50			
Incr delay, d2		.3							3.1			
Queue Delay, d3		.0							.0			
Unif delay, d1*		.0							.0			
Prog factor, PF		1.38							1.00			
Contrl delay, d		10.6							24.5			
Lane group LOS		B+							C+			
Final Queue,Qbi		0							0			
Appr delay, dA		10.6						24.5				
Approach LOS		B+						C+				
Appr flow, vA		441						295				
Intersection:	Delay		16.2	LOS		B						

VOLKAN COSKUN THESIS 03/26/06
INT 1102 - AHIRKAPI-A - AM PEAK 21:50:00
EXISTING

SIGNAL2000/TEAPAC[Ver 2.60.07] - HCM Back of Queue Worksheet

Queues in Worst Lanes	SB RT	SB TH	SB LT	WB RT	WB TH	WB LT	NB RT	NB TH	NB LT	EB RT	EB TH	EB LT
Lane group, LG		RT+TH							LT			
Init queue, QbL		0							0			
Ln flow, vL		232							295			
Ln satflow, sL		1690							1848			
Ln capacity, cL		996							585			
Flow ratio, yL		.137							.160			
v/c ratio, XL		.233							.504			
Effect green, g		45.4							24.4			
Grn ratio, g/C		.590							.317			
Upstr filter, I		1.00							1.00			
Grn arrivals, P		.39							.32			
Platn ratio, Rp		.67							1.00			
Prog factr, PF2		1.40							1.00			
Queue (1st), Q1		3.3							5.1			
Queue factr, kB		1.02							.70			
Queue (2nd), Q2		.3							.7			
Avg queue, Q		3.6							5.8			
90% factor, fB		1.74							1.66			
90% queue, Qp		6.3							9.7			
Avg spacing, Lh		25.8							25.1			
Avail storg, La		0							0			
Avg distance		93							147			
Avg ratio, RQ		.00							.00			
90% distance		163							243			
90% ratio, RQp		.00							.00			

```
VOLKAN COSKUN THESIS                                                        03/26/06
INT 1102 - AHIRKAPI-A - AM PEAK                                             21:50:00
EXISTING


SIGNAL2000/TEAPAC[Ver 2.60.07] - Capacity Analysis Summary

Intersection Averages for Int # 102 -
      Degree of Saturation (v/c) 0.34  Vehicle Delay  16.2   Level of Service B

      ------------------------------------
Sq 71 |  Phase 1   |  Phase 2   |  Phase 3   |
LG/** ------------------------------------
      |            | + +        |            |
  .   |            | + +        |            |
 /|\  |            |<+ +        |            |
  |   |            |   v        |            |
  |   |            |            |            |
North |     <+     |            |            |
  |   |      +     |            |            |
      |      +     |            |            |
      ------------------------------------
      | G/C=0.325  | G/C=0.584  | G/C=0.000  |
      | G=  25.0"  | G=  45.0"  | G=   0.0"  |
      | Y+R= 3.0"  | Y+R= 4.0"  | Y+R= 0.0"  |
      | OFF= 0.0%  | OFF=36.4%  | OFF= 0.0%  |
      ------------------------------------
      C= 77 sec   G= 70.0 sec = 90.9%  Y= 7.0 sec =  9.1%  Ped= 0.0 sec =  0.0%

------------------------------------------------------------------------------
| Lane    |Width/|     g/C      | Service Rate|  Adj |       |  HCM  | L | Queue |
|  Group  | Lanes| Reqd   Used  | @C (vph) @E |Volume|  v/c  | Delay | S |Model 1|
------------------------------------------------------------------------------

SB Approach                                                     10.6   B+
==============================================================================
|RT+TH    | 21/2 |0.198 |0.590 | 1831 | 1893 |  441 |0.233 |  10.6 | B+| 163 ft|
------------------------------------------------------------------------------

NB Approach                                                     24.5   C+
==============================================================================
|   LT    | 13/1 |0.236 |0.317 |  468 |  585 |  295 |0.504 |  24.5 | C+| 243 ft|
------------------------------------------------------------------------------
```

```
VOLKAN COSKUN THESIS                                                    03/26/06
INT 1102 - AHIRKAPI-A - PM PEAK                                         22:02:19
OPTIMUM


SIGNAL2000/TEAPAC[Ver 2.60.07] - HCM Input Worksheet

Intersection # 102 -                                   Area Location Type: NONCBD

           |     |      |      ||     |                           Key:  VOLUMES -- >
           |  45 | 1410 |    0 ||     |                                 |   WIDTHS
           | 0.0 | 21.3 |  0.0 ||     |                                 v      LANES
           |   0 |    2 |    0 ||      --------------------
           |     |      |      ||    \      0   0.0   0
-------------    /      |      \            --------------------          .
                                             --     0   0.0   0                  /|\
===================                         --------------------              |
       0   0.0   0  /          +           /     0   0.0   0                 |
-------------------                         ===================            North
       0   0.0   0  --                                                          |
-------------------            \       |       /   -------------
       0   0.0   0  \      ||      |      |      |
--------------------       ||  115 |    0 |    0 |    Phasing:  SEQUENCE     71
                    |      || 13.1 |  0.0 |  0.0 |              PERMSV  N N N N
                    |      ||    1 |    0 |    0 |              OVERLP  Y Y Y Y
                    |      ||      |      |      |              LEADLAG    LG LD


                              SB                  WB                 NB                  EB
                       RT    TH    LT      RT    TH    LT      RT    TH    LT      RT    TH    LT
================   ==============   ==============   ==============   ==============
Heavy veh, %HV       .0   2.1    .0      .0    .0    .0      .0    .0   2.6      .0    .0    .0
Pk-hr fact, PHF     .88   .88   .88     .90   .90   .90     .81   .81   .81     .90   .90   .90
Pretimed or Act       P     P     P       P     P     P       P     P     P       P     P     P
Strtup lost, l1     2.3   2.3   2.3     2.3   2.3   2.3     2.3   2.3   2.3     2.3   2.3   2.3
Ext eff grn, e      2.7   2.7   2.7     2.0   2.0   2.0     2.0   2.0   1.7     2.0   2.0   2.0
Arrival typ, AT       2     2     2       3     3     3       3     3     3       3     3     3
----------------   --------------   --------------   --------------   --------------
Ped vol, vped               0                 0                 0                 0
Bike vol, vbic              0                 0                 0                 0
Parking locatns            NO                NO                NO                NO
Park mnvrs, Nm              0                 0                 0                 0
Bus stops, NB               0                 0                 0                 0
Grade, %G                  .0                .0                .0                .0
================   ==============   ==============   ==============   ==============

      -------------------------------------------------------------------------
Sq 71 |  Phase 1   |  Phase 2   |  Phase 3   |  Phase 4   |  Phase 5   |  Phase 6   |
LG/** -------------------------------------------------------------------------
      |            | + +        |            |            |            |            |
  .   |            | + +        |            |            |            |            |
 /|\  |            |<+ +        |            |            |            |            |
  |   |            |   v        |            |            |            |            |
  |   |            |            |            |            |            |            |
North |    <+      |            |            |            |            |            |
  |   |     +      |            |            |            |            |            |
      |     +      |            |            |            |            |            |
      -------------------------------------------------------------------------
C= 71"| G=  16.0"  | G=  48.0"  | G=   0.0"  | G=   0.0"  | G=   0.0"  | G=   0.0"  |
      | Y+R= 3.0"  | Y+R= 4.0"  | Y+R= 0.0"  | Y+R= 0.0"  | Y+R= 0.0"  | Y+R= 0.0"  |
      -------------------------------------------------------------------------
```

```
VOLKAN COSKUN THESIS                                                       03/26/06
INT 1102 - AHIRKAPI-A - PM PEAK                                            22:02:19
OPTIMUM


SIGNAL2000/TEAPAC[Ver 2.60.07] - HCM Volume Adjust & Satflow Worksheet

Volume                  SB                WB                NB                EB
Adjustment         RT   TH   LT      RT   TH   LT      RT   TH   LT      RT   TH   LT
=============== ============== ============== ============== ==============
Volume, V          45 1410    0       0    0    0       0    0  115       0    0    0
Pk-hr fact, PHF   .88  .88  .88     .00  .00  .00     .81  .81  .81     .00  .00  .00
Adj mv flow, vp    51 1602    0       0    0    0       0    0  142       0    0    0
--------------- -------------- -------------- -------------- --------------
Lane group, LG       RT+TH                                       LT
Adj LG flow, v       1653                                       142
Prop LT, PLT         .000                                     1.000
Prop RT, PRT         .031                                      .000
--------------- -------------- -------------- -------------- --------------

Saturation              SB                WB                NB                EB
Flow Rate          RT   TH   LT      RT   TH   LT      RT   TH   LT      RT   TH   LT
=============== ============== ============== ============== ==============
Base satflo, so      1891                                      1891
Number lanes, N         2                                         1
Lane width, fW       .955                                     1.037
Heavy veh, fHV       .980                                      .975
Grade, fg           1.000                                     1.000
Parking, fp         1.000                                     1.000
Bus block, fbb      1.000                                     1.000
Area type, fa       1.000                                     1.000
Lane util, fLU       .950                                     1.000
Left-turn, fLT      1.000                                      .950
Right-turn, fRT      .995                                     1.000
PedBike LT,fLpb     1.000                                     1.000
PedBike RT,fRpb     1.000                                     1.000
Local adjustmnt     1.000                                     1.000
Adj satflow, s       3347                                      1815
=============== ============== ============== ============== ==============


SIGNAL2000/TEAPAC[Ver 2.60.07] - HCM Capacity and LOS Worksheet

Capacity                SB                WB                NB                EB
Analysis           RT   TH   LT      RT   TH   LT      RT   TH   LT      RT   TH   LT
=============== ============== ============== ============== ==============
Lane group, LG       RT+TH                                       LT
Adj Flow, v          1653                                       142
Satflow, s           3347                                      1815
Lost time, tL         3.6                                       3.6
Effect green, g      48.4                                      15.4
Grn ratio, g/C       .682                                      .217
LG capacity, c       2282                                       394
v/c ratio, X         .724                                      .360
Flow ratio, v/s      .494                                      .078
Crit lane group
--------------- -------------- -------------- -------------- --------------
Sum crit v/s,Yc     0.000       Total lost, L        0.0
Crit v/c, Xc         .000
=============== ============== ============== ============== ==============
```

VOLKAN COSKUN THESIS 03/26/06
INT 1102 - AHIRKAPI-A - PM PEAK 22:02:19
OPTIMUM

SIGNAL2000/TEAPAC[Ver 2.60.07] - HCM Capacity and LOS Worksheet

Delay and LOS	SB RT	SB TH	SB LT	WB RT	WB TH	WB LT	NB RT	NB TH	NB LT	EB RT	EB TH	EB LT
Lane group, LG		RT+TH							LT			
Adj Flow, v		1653							142			
LG capacity, c		2282							394			
v/c ratio, X		.724							.360			
Grn ratio, g/C		.682							.217			
Unif delay, d1		7.1							23.6			
Incr calib, k		.50							.50			
Incr delay, d2		2.0							2.6			
Queue Delay, d3		.0							.0			
Unif delay, d1*		.0							.0			
Prog factor, PF		1.59							1.00			
Contrl delay, d		13.4							26.2			
Lane group LOS		B+							C+			
Final Queue,Qbi		0							0			
Appr delay, dA		13.4						26.2				
Approach LOS		B+						C+				
Appr flow, vA		1653						142				
Intersection:	Delay		14.4	LOS		B+						

VOLKAN COSKUN THESIS 03/26/06
INT 1102 - AHIRKAPI-A - PM PEAK 22:02:19
OPTIMUM

SIGNAL2000/TEAPAC[Ver 2.60.07] - HCM Back of Queue Worksheet

Queues in	SB			WB			NB			EB		
Worst Lanes	RT	TH	LT	RT	TH	LT	RT	TH	LT	RT	TH	LT
Lane group, LG	RT+TH								LT			
Init queue, QbL	0								0			
Ln flow, vL	870								142			
Ln satflow, sL	1762								1815			
Ln capacity, cL	1201								394			
Flow ratio, yL	.494								.078			
v/c ratio, XL	.724								.360			
Effect green, g	48.4								15.4			
Grn ratio, g/C	.682								.217			
Upstr filter, I	1.00								1.00			
Grn arrivals, P	.45								.22			
Platn ratio, Rp	.67								1.00			
Prog factr, PF2	1.29								1.00			
Queue (1st), Q1	14.0								2.4			
Queue factr, kB	1.10								.50			
Queue (2nd), Q2	2.7								.3			
Avg queue, Q	16.7								2.7			
90% factor, fB	1.52								1.79			
90% queue, Qp	25.3								4.8			
Avg spacing, Lh	25.3								25.4			
Avail storg, La	0								0			
Avg distance	422								68			
Avg ratio, RQ	.00								.00			
90% distance	640								121			
90% ratio, RQp	.00								.00			

```
VOLKAN COSKUN THESIS                                                    03/26/06
INT 1102 - AHIRKAPI-A - PM PEAK                                         22:02:19
OPTIMUM


SIGNAL2000/TEAPAC[Ver 2.60.07] - Capacity Analysis Summary

Intersection Averages for Int # 102 -
      Degree of Saturation (v/c) 0.70  Vehicle Delay  14.4  Level of Service B+

      -------------------------------------
Sq 71 |  Phase 1  |  Phase 2  |  Phase 3  |
LG/** -------------------------------------
      |           | + +       |           |
  .   |           | + +       |           |
 /|\  |           |<+ +       |           |
  |   |           |   v       |           |
  |   |           |           |           |
North |    <+     |           |           |
  |   |     +     |           |           |
      |     +     |           |           |
      -------------------------------------
      | G/C=0.225 | G/C=0.676 | G/C=0.000 |
      | G=  16.0" | G=  48.0" | G=   0.0" |
      | Y+R= 3.0" | Y+R= 4.0" | Y+R= 0.0" |
      | OFF= 0.0% | OFF=26.8% | OFF= 0.0% |
      -------------------------------------
      C= 71 sec   G= 64.0 sec = 90.1%  Y= 7.0 sec =  9.9%  Ped= 0.0 sec =  0.0%

--------------------------------------------------------------------------------
| Lane    |Width/|     g/C     | Service Rate|  Adj |       |  HCM  | L | Queue |
|  Group  | Lanes| Reqd   Used | @C (vph) @E |Volume|  v/c  | Delay | S |Model 1|
--------------------------------------------------------------------------------

SB Approach                                                    13.4   B+
================================================================================
|RT+TH    | 21/2 |0.514 |0.682 | 2266 | 2282 | 1653 |0.724 |  13.4 | B+| 640 ft|
--------------------------------------------------------------------------------

NB Approach                                                    26.2   C+
================================================================================
|   LT    | 13/1 |0.149 |0.217 |  271 |  394 |  142 |0.360 |  26.2 | C+| 121 ft|
--------------------------------------------------------------------------------
```

```
VOLKAN COSKUN THESIS                                                    03/26/06
INT 1102 - AHIRKAPI-A - PM PEAK                                         21:59:16
EXISTING


SIGNAL2000/TEAPAC[Ver 2.60.07] - HCM Input Worksheet

Intersection # 102 -                                    Area Location Type: NONCBD

            |     |      |      ||     |                 Key:  VOLUMES -- >
            |  45 | 1410 |    0 ||     |                         |  WIDTHS
            | 0.0 | 21.3 |  0.0 ||     |                         v      LANES
            |   0 |    2 |    0 ||      -------------------
            |     |      |      ||    \    0   0.0  0                 .
------------    /      |      \         -------------------          /|\
                                     --    0   0.0  0                  |
==================                      -------------------            |
       0   0.0  0  /          +       /    0   0.0  0               North
------------------                      ===================            |
       0   0.0  0  --
------------------            \      |      /    -------------
       0   0.0  0  \      ||     |     |     |
-------------------       ||  115 |    0 |    0 |     Phasing:  SEQUENCE     71
                  |       || 13.1 |  0.0 |  0.0 |               PERMSV   N N N N
                  |       ||    1 |    0 |    0 |               OVERLP   Y Y Y Y
                  |       ||      |      |      |               LEADLAG   LG LD


                      SB                 WB                  NB                 EB
                RT    TH    LT     RT    TH    LT     RT    TH    LT     RT    TH    LT
===============  ==============  ==============  ==============  ==============
Heavy veh, %HV    .0   2.1    .0     .0    .0    .0     .0    .0   2.6     .0    .0    .0
Pk-hr fact, PHF  .88   .88   .88    .90   .90   .90    .81   .81   .81    .90   .90   .90
Pretimed or Act    P     P     P      P     P     P      P     P     P      P     P     P
Strtup lost, l1  2.3   2.3   2.3    2.3   2.3   2.3    2.3   2.3   2.3    2.3   2.3   2.3
Ext eff grn, e   2.7   2.7   2.7    2.0   2.0   2.0    2.0   2.0   1.7    2.0   2.0   2.0
Arrival typ, AT    2     2     2      3     3     3      3     3     3      3     3     3
---------------  --------------  --------------  --------------  --------------
Ped vol, vped          0                 0                  0                  0
Bike vol, vbic         0                 0                  0                  0
Parking locatns       NO                NO                 NO                 NO
Park mnvrs, Nm         0                 0                  0                  0
Bus stops, NB          0                 0                  0                  0
Grade, %G             .0                .0                 .0                 .0
===============  ==============  ==============  ==============  ==============

      ------------------------------------------------------------------------
Sq 71 |  Phase 1  |  Phase 2  |  Phase 3  |  Phase 4  |  Phase 5  |  Phase 6  |
LG/** ------------------------------------------------------------------------
      |           | + +       |           |           |           |           |
  .   |           | + +       |           |           |           |           |
 /|\  |           |<+ +       |           |           |           |           |
  |   |           |   v       |           |           |           |           |
  |   |           |           |           |           |           |           |
North |    <+     |           |           |           |           |           |
  |   |     +     |           |           |           |           |           |
      |     +     |           |           |           |           |           |
      ------------------------------------------------------------------------
C= 92"| G=  20.0" | G=  65.0" | G=   0.0" | G=   0.0" | G=   0.0" | G=   0.0" |
      | Y+R= 3.0" | Y+R= 4.0" | Y+R= 0.0" | Y+R= 0.0" | Y+R= 0.0" | Y+R= 0.0" |
      ------------------------------------------------------------------------
```

VOLKAN COSKUN THESIS 03/26/06
INT 1102 - AHIRKAPI-A - PM PEAK 21:59:16
EXISTING

SIGNAL2000/TEAPAC[Ver 2.60.07] - HCM Volume Adjust & Satflow Worksheet

Volume Adjustment	SB RT	SB TH	SB LT	WB RT	WB TH	WB LT	NB RT	NB TH	NB LT	EB RT	EB TH	EB LT
Volume, V	45	1410	0	0	0	0	0	0	115	0	0	0
Pk-hr fact, PHF	.88	.88	.88	.00	.00	.00	.81	.81	.81	.00	.00	.00
Adj mv flow, vp	51	1602	0	0	0	0	0	0	142	0	0	0
Lane group, LG		RT+TH							LT			
Adj LG flow, v		1653							142			
Prop LT, PLT		.000							1.000			
Prop RT, PRT		.031							.000			

Saturation Flow Rate	SB RT	SB TH	SB LT	WB RT	WB TH	WB LT	NB RT	NB TH	NB LT	EB RT	EB TH	EB LT
Base satflo, so		1891							1891			
Number lanes, N		2							1			
Lane width, fW		.955							1.037			
Heavy veh, fHV		.980							.975			
Grade, fg		1.000							1.000			
Parking, fp		1.000							1.000			
Bus block, fbb		1.000							1.000			
Area type, fa		1.000							1.000			
Lane util, fLU		.950							1.000			
Left-turn, fLT		1.000							.950			
Right-turn, fRT		.995							1.000			
PedBike LT, fLpb		1.000							1.000			
PedBike RT, fRpb		1.000							1.000			
Local adjustmnt		1.000							1.000			
Adj satflow, s		3347							1815			

SIGNAL2000/TEAPAC[Ver 2.60.07] - HCM Capacity and LOS Worksheet

Capacity Analysis	SB RT	SB TH	SB LT	WB RT	WB TH	WB LT	NB RT	NB TH	NB LT	EB RT	EB TH	EB LT
Lane group, LG		RT+TH							LT			
Adj Flow, v		1653							142			
Satflow, s		3347							1815			
Lost time, tL		3.6							3.6			
Effect green, g		65.4							19.4			
Grn ratio, g/C		.711							.211			
LG capacity, c		2379							383			
v/c ratio, X		.695							.371			
Flow ratio, v/s		.494							.078			
Crit lane group												

Sum crit v/s,Yc 0.000 Total lost, L 0.0
Crit v/c, Xc .000

VOLKAN COSKUN THESIS 03/26/06
INT 1102 - AHIRKAPI-A - PM PEAK 21:59:16
EXISTING

SIGNAL2000/TEAPAC[Ver 2.60.07] - HCM Capacity and LOS Worksheet

Delay and LOS	SB RT	SB TH	SB LT	WB RT	WB TH	WB LT	NB RT	NB TH	NB LT	EB RT	EB TH	EB LT
Lane group, LG		RT+TH							LT			
Adj Flow, v		1653							142			
LG capacity, c		2379							383			
v/c ratio, X		.695							.371			
Grn ratio, g/C		.711							.211			
Unif delay, d1		7.6							31.1			
Incr calib, k		.50							.50			
Incr delay, d2		1.7							2.7			
Queue Delay, d3		.0							.0			
Unif delay, d1*		.0							.0			
Prog factor, PF		1.69							1.00			
Contrl delay, d		14.6							33.8			
Lane group LOS		B+							C			
Final Queue,Qbi		0							0			
Appr delay, dA		14.6						33.8				
Approach LOS		B+						C				
Appr flow, vA		1653						142				
Intersection:	Delay		16.1	LOS		B						

VOLKAN COSKUN THESIS 03/26/06
INT 1102 - AHIRKAPI-A - PM PEAK 21:59:16
EXISTING

SIGNAL2000/TEAPAC[Ver 2.60.07] - HCM Back of Queue Worksheet

Queues in	SB			WB			NB			EB		
Worst Lanes	RT	TH	LT	RT	TH	LT	RT	TH	LT	RT	TH	LT
Lane group, LG	RT+TH								LT			
Init queue, QbL	0								0			
Ln flow, vL	870								142			
Ln satflow, sL	1762								1815			
Ln capacity, cL	1252								383			
Flow ratio, yL	.494								.078			
v/c ratio, XL	.695								.371			
Effect green, g	65.4								19.4			
Grn ratio, g/C	.711								.211			
Upstr filter, I	1.00								1.00			
Grn arrivals, P	.47								.21			
Platn ratio, Rp	.67								1.00			
Prog factr, PF2	1.37								1.00			
Queue (1st), Q1	17.4								3.1			
Queue factr, kB	1.36								.59			
Queue (2nd), Q2	2.9								.3			
Avg queue, Q	20.4								3.5			
90% factor, fB	1.51								1.75			
90% queue, Qp	30.7								6.0			
Avg spacing, Lh	25.3								25.4			
Avail storg, La	0								0			
Avg distance	515								88			
Avg ratio, RQ	.00								.00			
90% distance	777								153			
90% ratio, RQp	.00								.00			

```
VOLKAN COSKUN THESIS                                                   03/26/06
INT 1102 - AHIRKAPI-A - PM PEAK                                        21:59:16
EXISTING


SIGNAL2000/TEAPAC[Ver 2.60.07] - Capacity Analysis Summary

Intersection Averages for Int # 102 -
      Degree of Saturation (v/c) 0.67  Vehicle Delay  16.1   Level of Service B

      --------------------------------------
Sq 71 |  Phase 1   |  Phase 2   |  Phase 3   |
LG/** --------------------------------------
      |            | + +        |            |
  .   |            | + +        |            |
 /|\  |            |<+ +        |            |
  |   |            |   v        |            |
  |   |            |            |            |
North |    <+      |            |            |
  |   |     +      |            |            |
      |     +      |            |            |
      --------------------------------------
      | G/C=0.217  | G/C=0.707  | G/C=0.000  |
      | G=  20.0"  | G=  65.0"  | G=   0.0"  |
      | Y+R= 3.0"  | Y+R= 4.0"  | Y+R= 0.0"  |
      | OFF= 0.0%  | OFF=25.0%  | OFF= 0.0%  |
      --------------------------------------
      C= 92 sec   G= 85.0 sec = 92.4%  Y= 7.0 sec =  7.6%  Ped= 0.0 sec =  0.0%

--------------------------------------------------------------------------------
| Lane   |Width/|     g/C     | Service Rate|  Adj |       |  HCM  | L | Queue |
|  Group | Lanes| Reqd   Used | @C (vph) @E |Volume|  v/c  | Delay | S |Model 1|
--------------------------------------------------------------------------------

SB Approach                                                   14.6   B+
================================================================================
|RT+TH   | 21/2 |0.534 |0.711 | 2324 | 2379 | 1653 |0.695 |  14.6 | B+| 777 ft|
--------------------------------------------------------------------------------

NB Approach                                                   33.8   C
================================================================================
|   LT   | 13/1 |0.201 |0.211 |  165 |  380 |  142 |0.371 |  33.8 | C |  153 ft|
--------------------------------------------------------------------------------
```

```
VOLKAN COSKUN THESIS                                                03/26/06
INT 1102 - AHIRKAPI-B - AM PEAK                                     22:17:15
EXISTING


SIGNAL2000/TEAPAC[Ver 2.60.07] - HCM Input Worksheet

Intersection # 102 -                               Area Location Type: NONCBD

              |    |    |    ||    |                    Key:  VOLUMES -- >
              |   0 | 367 |   0 ||    |                          |   WIDTHS
              | 0.0 | 19.7 | 0.0 ||    |                          v      LANES
              |   0 |   2 |   0 ||    --------------------
              |    |    |    ||   \    0   0.0   0            .
-------------   /    |    \          --------------------      /|\
                                 --    0   0.0   0               |
===================                    --------------------       |
     81   0.0  0  /         +       /    0   0.0   0          North
-------------------                    ===================       |
      0  14.7  1  --
-------------------        \      |      /   -------------
     57   0.0  0  \    ||     |      |      |
--------------------   ||    0 | 1542 |    0 |     Phasing:  SEQUENCE     11
                  |    ||  0.0 | 21.1 |  0.0 |               PERMSV  N N N N
                  |    ||    0 |    2 |    0 |               OVERLP  Y Y Y Y
                  |    ||      |      |      |               LEADLAG   LG LD


                        SB               WB               NB               EB
                  RT   TH   LT     RT   TH   LT     RT   TH   LT     RT   TH   LT
===============  ==============  ==============  ==============  ==============
Heavy veh, %HV     .0  5.4   .0     .0   .0   .0     .0  1.8   .0   14.0   .0   .0
Pk-hr fact, PHF   .90  .90  .90    .90  .90  .90    .96  .96  .96    .88  .88  .88
Pretimed or Act     P    P    P      P    P    P      P    P    P      P    P    P
Strtup lost, l1   2.3  2.3  2.3    2.3  2.3  2.3    2.3  2.3  2.3    2.3  2.3  2.3
Ext eff grn, e    1.7  1.7  1.7    1.7  1.7  1.7    1.7  1.7  1.7    1.7  1.7  1.7
Arrival typ, AT     2    2    2      3    3    3      2    2    2      3    3    3
---------------  --------------  --------------  --------------  --------------
Ped vol, vped           0                0                0                0
Bike vol, vbic          0                0                0                0
Parking locatns        NO               NO               NO               NO
Park mnvrs, Nm          0                0                0                0
Bus stops, NB           0                0                0                0
Grade, %G              .0               .0               .0             -1.4
===============  ==============  ==============  ==============  ==============

      ------------------------------------------------------------------------
Sq 11 |  Phase 1  |  Phase 2  |  Phase 3  |  Phase 4  |  Phase 5  |  Phase 6  |
LG/** ------------------------------------------------------------------------
      |   +       |           |           |           |           |           |
  .   |   +       |           |           |           |           |           |
 /|\  |   +       |     ^     |           |           |           |           |
  |   |   v       |           |           |           |           |           |
  |   |       ^   |++++       |           |           |           |           |
North |       +   |           |           |           |           |           |
  |   |       +   |++++       |           |           |           |           |
      |       +   |     v     |           |           |           |           |
      ------------------------------------------------------------------------
C= 77"| G=  59.0" | G=  12.0" | G=   0.0" | G=   0.0" | G=   0.0" | G=   0.0" |
      | Y+R= 3.0" | Y+R= 3.0" | Y+R= 0.0" | Y+R= 0.0" | Y+R= 0.0" | Y+R= 0.0" |
      ------------------------------------------------------------------------
```

VOLKAN COSKUN THESIS 03/26/06
INT 1102 - AHIRKAPI-B - AM PEAK 22:17:15
EXISTING

SIGNAL2000/TEAPAC[Ver 2.60.07] - HCM Volume Adjust & Satflow Worksheet

Volume Adjustment	SB RT	SB TH	SB LT	WB RT	WB TH	WB LT	NB RT	NB TH	NB LT	EB RT	EB TH	EB LT
Volume, V	0	367	0	0	0	0	0	1542	0	57	0	81
Pk-hr fact, PHF	.90	.90	.90	.00	.00	.00	.96	.96	.96	.88	.88	.88
Adj mv flow, vp	0	408	0	0	0	0	0	1606	0	65	0	92
Lane group, LG		TH						TH			RT+TH+LT	
Adj LG flow, v		408						1606			157	
Prop LT, PLT		.000						.000			.586	
Prop RT, PRT		.000						.000			.414	

Saturation Flow Rate	SB RT	SB TH	SB LT	WB RT	WB TH	WB LT	NB RT	NB TH	NB LT	EB RT	EB TH	EB LT
Base satflo, so		1891						1891			1891	
Number lanes, N		2						2			1	
Lane width, fW		.928						.952			1.090	
Heavy veh, fHV		.949						.982			.945	
Grade, fg		1.000						1.000			1.007	
Parking, fp		1.000						1.000			1.000	
Bus block, fbb		1.000						1.000			1.000	
Area type, fa		1.000						1.000			1.000	
Lane util, fLU		.950						.950			1.000	
Left-turn, fLT		1.000						1.000			.972	
Right-turn, fRT		1.000						1.000			.944	
PedBike LT,fLpb		1.000						1.000			1.000	
PedBike RT,fRpb		1.000						1.000			1.000	
Local adjustmnt		1.000						1.000			1.000	
Adj satflow, s		3165						3359			1799	

SIGNAL2000/TEAPAC[Ver 2.60.07] - HCM Capacity and LOS Worksheet

Capacity Analysis	SB RT	SB TH	SB LT	WB RT	WB TH	WB LT	NB RT	NB TH	NB LT	EB RT	EB TH	EB LT
Lane group, LG		TH						TH			RT+TH+LT	
Adj Flow, v		408						1606			157	
Satflow, s		3165						3359			1799	
Lost time, tL		3.6						3.6			3.6	
Effect green, g		58.4						58.4			11.4	
Grn ratio, g/C		.758						.758			.148	
LG capacity, c		2400						2547			266	
v/c ratio, X		.170						.631			.590	
Flow ratio, v/s		.129						.478			.087	
Crit lane group								*			*	
Sum crit v/s,Yc		0.565		Total lost, L				7.2				
Crit v/c, Xc		.624										

VOLKAN COSKUN THESIS 03/26/06
INT 1102 - AHIRKAPI-B - AM PEAK 22:17:15
EXISTING

SIGNAL2000/TEAPAC[Ver 2.60.07] - HCM Capacity and LOS Worksheet

Delay and LOS	SB RT	SB TH	SB LT	WB RT	WB TH	WB LT	NB RT	NB TH	NB LT	EB RT	EB TH	EB LT
Lane group, LG		TH						TH			RT+TH+LT	
Adj Flow, v		408						1606			157	
LG capacity, c		2400						2547			266	
v/c ratio, X		.170						.631			.590	
Grn ratio, g/C		.758						.758			.148	
Unif delay, d1		2.6						4.3			30.6	
Incr calib, k		.50						.50			.50	
Incr delay, d2		.2						1.2			9.3	
Queue Delay, d3		.0						.0			.0	
Unif delay, d1*		.0						.0			.0	
Prog factor, PF		1.90						1.90			1.00	
Contrl delay, d		5.1						9.4			39.9	
Lane group LOS		A						A			D+	
Final Queue,Qbi		0						0			0	
Appr delay, dA		5.1						9.4			39.9	
Approach LOS		A						A			D+	
Appr flow, vA		408						1606			157	
Intersection:	Delay		10.8	LOS		B+						

```
VOLKAN COSKUN THESIS                                              03/26/06
INT 1102 - AHIRKAPI-B - AM PEAK                                   22:17:15
EXISTING


SIGNAL2000/TEAPAC[Ver 2.60.07] - HCM Back of Queue Worksheet

Queues in              SB                WB                NB                EB
Worst Lanes       RT   TH   LT      RT   TH   LT      RT   TH   LT      RT   TH   LT
=============== ============== ============== ============== ==============
Lane group, LG         TH                                  TH             RT+TH+LT
Init queue, QbL         0                                   0                  0
Ln flow, vL           215                                 845                157
Ln satflow, sL       1666                                1768               1799
Ln capacity, cL      1263                                1341                266
Flow ratio, yL       .129                                .478               .087
v/c ratio, XL        .170                                .631               .590
Effect green, g      58.4                                58.4               11.4
Grn ratio, g/C       .758                                .758               .148
Upstr filter, I      1.00                                1.00               1.00
Grn arrivals, P       .51                                 .52                .15
Platn ratio, Rp       .67                                 .69               1.00
Prog factr, PF2      1.95                                1.54               1.00
Queue (1st), Q1       2.5                                12.9                3.1
Queue factr, kB      1.21                                1.26                .41
Queue (2nd), Q2        .2                                 2.1                 .6
Avg queue, Q          2.7                                15.0                3.7
--------------- -------------- -------------- -------------- --------------
90% factor, fB       1.79                                1.52               1.74
90% queue, Qp         4.9                                22.9                6.4
Avg spacing, Lh      25.8                                25.3               25.9
Avail storg, La         0                                   0                  0
Avg distance           70                                 379                 96
Avg ratio, RQ         .00                                 .00                .00
90% distance          126                                 578                166
90% ratio, RQp        .00                                 .00                .00
=============== ============== ============== ============== ==============
```

```
VOLKAN COSKUN THESIS                                                    03/26/06
INT 1102 - AHIRKAPI-B - AM PEAK                                         22:17:15
EXISTING


SIGNAL2000/TEAPAC[Ver 2.60.07] - Capacity Analysis Summary

Intersection Averages for Int # 102 -
      Degree of Saturation (v/c) 0.54  Vehicle Delay  10.8  Level of Service B+

      -------------------------
Sq 11 |  Phase 1   |  Phase 2  |
LG/** -------------------------
      |   +        |           |
   .  |   +        |           |
  /|\ |   +        |           |
   |  |   v        |    ^      |
   |  |       ^    |++++       |
North |       +    |           |
   |  |       +    |++++       |
      |       +    |    v      |
      -------------------------
      | G/C=0.766  | G/C=0.156 |
      | G=  59.0"  | G=  12.0" |
      | Y+R= 3.0"  | Y+R= 3.0" |
      | OFF= 0.0%  | OFF=80.5% |
      -------------------------
      C= 77 sec   G= 71.0 sec = 92.2%  Y= 6.0 sec =  7.8%  Ped= 0.0 sec =  0.0%

--------------------------------------------------------------------------------
| Lane    |Width/|     g/C      | Service Rate| Adj |       |  HCM  | L | Queue |
|  Group  | Lanes| Reqd   Used  | @C (vph) @E |Volume|  v/c | Delay | S |Model 1|
--------------------------------------------------------------------------------

SB Approach                                                     5.1    A
================================================================================
|   TH    | 20/2 |0.191 |0.758 | 2391 | 2400 |  408 |0.170 |   5.1 | A | 126 ft|
--------------------------------------------------------------------------------

NB Approach                                                     9.4    A
================================================================================
|   TH    | 21/2 |0.505 |0.758 | 2543 | 2547 | 1606 |0.631 |   9.4 | A | 578 ft|
--------------------------------------------------------------------------------

EB Approach                                                    39.9    D+
================================================================================
|RT+TH+LT| 15/1 |0.170 |0.148 |  116 |  258 |  157 |0.590 |  39.9 | D+| 166 ft|
--------------------------------------------------------------------------------
```

```
VOLKAN COSKUN THESIS                                                03/26/06
INT 1102 - AHIRKAPI-B - PM PEAK                                     22:25:16
OPTIMUM


SIGNAL2000/TEAPAC[Ver 2.60.07] - HCM Input Worksheet

Intersection # 102 -                                  Area Location Type: NONCBD

          |     |      |     ||     |                     Key:  VOLUMES -- >
          |   0 | 1409 |   0 ||     |                            |   WIDTHS
          | 0.0 | 19.7 | 0.0 ||     |                            v     LANES
          |   0 |    2 |   0 ||     --------------------
          |     |      |     ||   \    0   0.0  0               .
-------------    /     |     \         --------------------      /|\
                                 --    0   0.0  0                |
===================                    --------------------      |
       81   0.0  0  /        +       /    0   0.0  0              North
-------------------                    ===================        |
        0  14.7  1  --
-------------------          \     |     /   -------------
      162   0.0  0  \    ||     |     |     |
--------------------     ||   0 |  906 |   0 |    Phasing:  SEQUENCE      11
                    |    ||  0.0 | 21.1 | 0.0 |              PERMSV   N N N N
                    |    ||    0 |    2 |   0 |              OVERLP   Y Y Y Y
                    |    ||      |      |     |              LEADLAG    LG LD


                          SB                 WB                 NB                 EB
                    RT    TH    LT     RT    TH    LT     RT    TH    LT     RT    TH    LT
===============  ==============  ==============  ==============  ==============
Heavy veh, %HV     .0   2.1    .0     .0    .0    .0     .0   1.9    .0     .0    .0    .0
Pk-hr fact, PHF   .88   .88   .88    .90   .90   .90    .93   .93   .93    .92   .92   .92
Pretimed or Act     P     P     P      P     P     P      P     P     P      P     P     P
Strtup lost, l1   2.3   2.3   2.3    2.3   2.3   2.3    2.3   2.3   2.3    2.3   2.3   2.3
Ext eff grn, e    1.7   1.7   1.7    1.7   1.7   1.7    1.7   1.7   1.7    1.7   1.7   1.7
Arrival typ, AT     2     2     2      3     3     3      2     2     2      3     3     3
---------------  --------------  --------------  --------------  --------------
Ped vol, vped               0                  0                  0                  0
Bike vol, vbic              0                  0                  0                  0
Parking locatns            NO                 NO                 NO                 NO
Park mnvrs, Nm              0                  0                  0                  0
Bus stops, NB               0                  0                  0                  0
Grade, %G                  .0                 .0                 .0               -1.4
===============  ==============  ==============  ==============  ==============

        ----------------------------------------------------------------------
Sq 11 |  Phase 1   |  Phase 2   |  Phase 3   |  Phase 4   |  Phase 5   |  Phase 6   |
LG/** ----------------------------------------------------------------------
      |   +        |            |            |            |            |            |
  .   |   +        |            |            |            |            |            |
 /|\  |   +        |            |            |            |            |            |
  |   |   v        |    ^       |            |            |            |            |
  |   |       ^    |++++        |            |            |            |            |
North |       +    |            |            |            |            |            |
  |   |       +    |++++        |            |            |            |            |
      |       +    |    v       |            |            |            |            |
        ----------------------------------------------------------------------
C= 71"| G=  52.0"  | G=  13.0"  | G=   0.0"  | G=   0.0"  | G=   0.0"  | G=   0.0"  |
      | Y+R= 3.0"  | Y+R= 3.0"  | Y+R= 0.0"  | Y+R= 0.0"  | Y+R= 0.0"  | Y+R= 0.0"  |
        ----------------------------------------------------------------------
```

VOLKAN COSKUN THESIS 03/26/06
INT 1102 - AHIRKAPI-B - PM PEAK 22:25:16
OPTIMUM

SIGNAL2000/TEAPAC[Ver 2.60.07] - HCM Volume Adjust & Satflow Worksheet

Volume Adjustment	SB RT	SB TH	SB LT	WB RT	WB TH	WB LT	NB RT	NB TH	NB LT	EB RT	EB TH	EB LT
Volume, V	0	1409	0	0	0	0	0	906	0	162	0	81
Pk-hr fact, PHF	.88	.88	.88	.00	.00	.00	.93	.93	.93	.92	.92	.92
Adj mv flow, vp	0	1601	0	0	0	0	0	974	0	176	0	88
Lane group, LG		TH						TH			RT+TH+LT	
Adj LG flow, v		1601						974			264	
Prop LT, PLT		.000						.000			.333	
Prop RT, PRT		.000						.000			.667	

Saturation Flow Rate	SB	WB	NB	EB
Base satflo, so	1891		1891	1891
Number lanes, N	2		2	1
Lane width, fW	.928		.952	1.090
Heavy veh, fHV	.979		.981	1.000
Grade, fg	1.000		1.000	1.007
Parking, fp	1.000		1.000	1.000
Bus block, fbb	1.000		1.000	1.000
Area type, fa	1.000		1.000	1.000
Lane util, fLU	.950		.950	1.000
Left-turn, fLT	1.000		1.000	.984
Right-turn, fRT	1.000		1.000	.910
PedBike LT, fLpb	1.000		1.000	1.000
PedBike RT, fRpb	1.000		1.000	1.000
Local adjustmnt	1.000		1.000	1.000
Adj satflow, s	3267		3355	1858

SIGNAL2000/TEAPAC[Ver 2.60.07] - HCM Capacity and LOS Worksheet

Capacity Analysis	SB	WB	NB	EB
Lane group, LG	TH		TH	RT+TH+LT
Adj Flow, v	1601		974	264
Satflow, s	3267		3355	1858
Lost time, tL	3.6		3.6	3.6
Effect green, g	51.4		51.4	12.4
Grn ratio, g/C	.724		.724	.175
LG capacity, c	2365		2429	324
v/c ratio, X	.677		.401	.815
Flow ratio, v/s	.490		.290	.142
Crit lane group	*			*

Sum crit v/s,Yc	0.632	Total lost, L	7.2
Crit v/c, Xc	.704		

VOLKAN COSKUN THESIS 03/26/06
INT 1102 - AHIRKAPI-B - PM PEAK 22:25:16
OPTIMUM

SIGNAL2000/TEAPAC[Ver 2.60.07] - HCM Capacity and LOS Worksheet

Delay and LOS	SB RT	SB TH	SB LT	WB RT	WB TH	WB LT	NB RT	NB TH	NB LT	EB RT	EB TH	EB LT
Lane group, LG		TH						TH			RT+TH+LT	
Adj Flow, v		1601						974			264	
LG capacity, c		2365						2429			324	
v/c ratio, X		.677						.401			.815	
Grn ratio, g/C		.724						.724			.175	
Unif delay, d1		5.3						3.8			28.2	
Incr calib, k		.50						.50			.50	
Incr delay, d2		1.6						.5			19.8	
Queue Delay, d3		.0						.0			.0	
Unif delay, d1*		.0						.0			.0	
Prog factor, PF		1.74						1.74			1.00	
Contrl delay, d		10.8						7.1			48.0	
Lane group LOS		B+						A			D	
Final Queue,Qbi		0						0			0	
Appr delay, dA		10.8						7.1			48.0	
Approach LOS		B+						A			D	
Appr flow, vA		1601						974			264	
Intersection:	Delay		13.0	LOS		B+						

VOLKAN COSKUN THESIS 03/26/06
INT 1102 - AHIRKAPI-B - PM PEAK 22:25:16
OPTIMUM

SIGNAL2000/TEAPAC[Ver 2.60.07] - HCM Back of Queue Worksheet

Queues in Worst Lanes	SB RT	SB TH	SB LT	WB RT	WB TH	WB LT	NB RT	NB TH	NB LT	EB RT	EB TH	EB LT
Lane group, LG		TH						TH			RT+TH+LT	
Init queue, QbL		0						0			0	
Ln flow, vL		843						513			264	
Ln satflow, sL		1719						1766			1858	
Ln capacity, cL		1245						1278			324	
Flow ratio, yL		.490						.290			.142	
v/c ratio, XL		.677						.401			.815	
Effect green, g		51.4						51.4			12.4	
Grn ratio, g/C		.724						.724			.175	
Upstr filter, I		1.00						1.00			1.00	
Grn arrivals, P		.48						.48			.17	
Pltn ratio, Rp		.67						.67			1.00	
Prog factr, PF2		1.42						1.65			1.00	
Queue (1st), Q1		12.8						6.5			5.0	
Queue factr, kB		1.13						1.15			.44	
Queue (2nd), Q2		2.3						.8			1.6	
Avg queue, Q		15.0						7.2			6.6	
90% factor, fB		1.52						1.62			1.63	
90% queue, Qp		22.9						11.7			10.8	
Avg spacing, Lh		25.3						25.3			25.0	
Avail storg, La		0						0			0	
Avg distance		381						183			165	
Avg ratio, RQ		.00						.00			.00	
90% distance		580						296			270	
90% ratio, RQp		.00						.00			.00	

```
VOLKAN COSKUN THESIS                                                     03/26/06
INT 1102 - AHIRKAPI-B - PM PEAK                                          22:25:16
OPTIMUM


SIGNAL2000/TEAPAC[Ver 2.60.07] - Capacity Analysis Summary

Intersection Averages for Int # 102 -
      Degree of Saturation (v/c) 0.60  Vehicle Delay  13.0  Level of Service B+

      -------------------------
Sq 11 |  Phase 1  |  Phase 2  |
LG/** -------------------------
      |   +       |           |
  .   |   +       |           |
 /|\  |   +       |           |
  |   |   v       |    ^      |
  |   |       ^   |++++       |
North |       +   |           |
  |   |       +   |++++       |
      |       +   |    v      |
      -------------------------
      | G/C=0.732 | G/C=0.183 |
      | G=  52.0" | G=  13.0" |
      | Y+R= 3.0" | Y+R= 3.0" |
      | OFF= 0.0% | OFF=77.5% |
      -------------------------
      C= 71 sec   G= 65.0 sec = 91.5%  Y= 6.0 sec =  8.5%  Ped= 0.0 sec =  0.0%

---------------------------------------------------------------------------------
| Lane   |Width/|     g/C     | Service Rate|  Adj |       |  HCM  | L | Queue |
|  Group | Lanes| Reqd   Used | @C (vph) @E |Volume|  v/c  | Delay | S |Model 1|
---------------------------------------------------------------------------------

SB Approach                                                   10.8   B+
=================================================================================
|   TH   | 20/2 |0.511 |0.724 | 2360 | 2365 | 1601 |0.677 |  10.8 | B+| 580 ft|
---------------------------------------------------------------------------------

NB Approach                                                    7.1   A
=================================================================================
|   TH   | 21/2 |0.328 |0.724 | 2427 | 2429 |  974 |0.401 |   7.1 | A | 296 ft|
---------------------------------------------------------------------------------

EB Approach                                                   48.0   D
=================================================================================
|RT+TH+LT| 15/1 |0.210 |0.175 |  195 |  324 |  264 |0.815 |  48.0 | D | 270 ft|
---------------------------------------------------------------------------------
```

```
VOLKAN COSKUN THESIS                                              03/26/06
INT 1102 - AHIRKAPI-B - PM PEAK                                   22:22:49
EXISTING


SIGNAL2000/TEAPAC[Ver 2.60.07] - HCM Input Worksheet

Intersection # 102 -                                Area Location Type: NONCBD

              |      |      |      ||      |                Key:  VOLUMES -- >
              |    0 | 1409 |    0 ||      |                      |   WIDTHS
              |  0.0 | 19.7 |  0.0 ||      |                      v      LANES
              |    0 |    2 |    0 ||      ---------------------
              |      |      |      ||     \     0   0.0   0              .
-------------     /     |     \           ---------------------         /|\
                                         --     0   0.0   0              |
===================                       ---------------------          |
      81   0.0   0  /        +        /     0   0.0   0             North
-------------------                       =====================          |
       0  14.7   1  --
-------------------          \      |      /    -------------
     162   0.0   0  \     ||      |      |      |
--------------------      ||    0 |  906 |    0 |     Phasing:  SEQUENCE     11
                    |     ||  0.0 | 21.1 |  0.0 |               PERMSV   N N N N
                    |     ||    0 |    2 |    0 |               OVERLP   Y Y Y Y
                    |     ||      |      |      |               LEADLAG     LG LD


                         SB                WB                NB                EB
                    RT   TH   LT     RT   TH   LT     RT   TH   LT     RT   TH   LT
===============  ==============  ==============  ==============  ==============
Heavy veh, %HV      .0  2.1   .0     .0   .0   .0     .0  1.9   .0     .0   .0   .0
Pk-hr fact, PHF    .88  .88  .88    .90  .90  .90    .93  .93  .93    .92  .92  .92
Pretimed or Act      P    P    P      P    P    P      P    P    P      P    P    P
Strtup lost, l1    2.3  2.3  2.3    2.3  2.3  2.3    2.3  2.3  2.3    2.3  2.3  2.3
Ext eff grn, e     1.7  1.7  1.7    1.7  1.7  1.7    1.7  1.7  1.7    1.7  1.7  1.7
Arrival typ, AT      2    2    2      3    3    3      2    2    2      3    3    3
---------------  --------------  --------------  --------------  --------------
Ped vol, vped             0                0                0                0
Bike vol, vbic            0                0                0                0
Parking locatns          NO               NO               NO               NO
Park mnvrs, Nm            0                0                0                0
Bus stops, NB             0                0                0                0
Grade, %G                .0               .0               .0             -1.4
===============  ==============  ==============  ==============  ==============

      -----------------------------------------------------------------------
Sq 11 |  Phase 1  |  Phase 2  |  Phase 3  |  Phase 4  |  Phase 5  |  Phase 6  |
LG/** -----------------------------------------------------------------------
      |   +       |           |           |           |           |           |
  .   |   +       |           |           |           |           |           |
 /|\  |   +       |           |           |           |           |           |
  |   |   v       |    ^      |           |           |           |           |
  |   |       ^   |++++       |           |           |           |           |
North |       +   |           |           |           |           |           |
  |   |       +   |++++       |           |           |           |           |
      |       +   |    v      |           |           |           |           |
      -----------------------------------------------------------------------
C= 92"| G=  70.0" | G=  16.0" | G=   0.0" | G=   0.0" | G=   0.0" | G=   0.0" |
      | Y+R= 3.0" | Y+R= 3.0" | Y+R= 0.0" | Y+R= 0.0" | Y+R= 0.0" | Y+R= 0.0" |
      -----------------------------------------------------------------------
```

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VOLKAN COSKUN THESIS                                                03/26/06
INT 1102 - AHIRKAPI-B - PM PEAK                                     22:22:49
EXISTING
```

SIGNAL2000/TEAPAC[Ver 2.60.07] - HCM Volume Adjust & Satflow Worksheet

Volume Adjustment	SB RT	SB TH	SB LT	WB RT	WB TH	WB LT	NB RT	NB TH	NB LT	EB RT	EB TH	EB LT
Volume, V	0	1409	0	0	0	0	0	906	0	162	0	81
Pk-hr fact, PHF	.88	.88	.88	.00	.00	.00	.93	.93	.93	.92	.92	.92
Adj mv flow, vp	0	1601	0	0	0	0	0	974	0	176	0	88
Lane group, LG		TH						TH			RT+TH+LT	
Adj LG flow, v		1601						974			264	
Prop LT, PLT		.000						.000			.333	
Prop RT, PRT		.000						.000			.667	

Saturation Flow Rate	SB RT	SB TH	SB LT	WB RT	WB TH	WB LT	NB RT	NB TH	NB LT	EB RT	EB TH	EB LT
Base satflo, so		1891						1891			1891	
Number lanes, N		2						2			1	
Lane width, fW		.928						.952			1.090	
Heavy veh, fHV		.979						.981			1.000	
Grade, fg		1.000						1.000			1.007	
Parking, fp		1.000						1.000			1.000	
Bus block, fbb		1.000						1.000			1.000	
Area type, fa		1.000						1.000			1.000	
Lane util, fLU		.950						.950			1.000	
Left-turn, fLT		1.000						1.000			.984	
Right-turn, fRT		1.000						1.000			.910	
PedBike LT, fLpb		1.000						1.000			1.000	
PedBike RT, fRpb		1.000						1.000			1.000	
Local adjustmnt		1.000						1.000			1.000	
Adj satflow, s		3267						3355			1858	

SIGNAL2000/TEAPAC[Ver 2.60.07] - HCM Capacity and LOS Worksheet

Capacity Analysis	SB RT	SB TH	SB LT	WB RT	WB TH	WB LT	NB RT	NB TH	NB LT	EB RT	EB TH	EB LT
Lane group, LG		TH						TH			RT+TH+LT	
Adj Flow, v		1601						974			264	
Satflow, s		3267						3355			1858	
Lost time, tL		3.6						3.6			3.6	
Effect green, g		69.4						69.4			15.4	
Grn ratio, g/C		.754						.754			.167	
LG capacity, c		2464						2531			311	
v/c ratio, X		.650						.385			.849	
Flow ratio, v/s		.490						.290			.142	
Crit lane group		*									*	
Sum crit v/s,Yc		0.632		Total lost, L				7.2				
Crit v/c, Xc		.686										

VOLKAN COSKUN THESIS 03/26/06
INT 1102 - AHIRKAPI-B - PM PEAK 22:22:49
EXISTING

SIGNAL2000/TEAPAC[Ver 2.60.07] - HCM Capacity and LOS Worksheet

Delay and LOS	SB RT	SB TH	SB LT	WB RT	WB TH	WB LT	NB RT	NB TH	NB LT	EB RT	EB TH	EB LT
Lane group, LG		TH						TH			RT+TH+LT	
Adj Flow, v		1601						974			264	
LG capacity, c		2464						2531			311	
v/c ratio, X		.650						.385			.849	
Grn ratio, g/C		.754						.754			.167	
Unif delay, d1		5.4						3.9			37.2	
Incr calib, k		.50						.50			.50	
Incr delay, d2		1.3						.4			24.0	
Queue Delay, d3		.0						.0			.0	
Unif delay, d1*		.0						.0			.0	
Prog factor, PF		1.88						1.88			1.00	
Contrl delay, d		11.6						7.8			61.2	
Lane group LOS		B+						A			E+	
Final Queue,Qbi		0						0			0	
Appr delay, dA		11.6						7.8			61.2	
Approach LOS		B+						A			E+	
Appr flow, vA		1601						974			264	

Intersection: Delay 14.9 LOS B+

VOLKAN COSKUN THESIS 03/26/06
INT 1102 - AHIRKAPI-B - PM PEAK 22:22:49
EXISTING

SIGNAL2000/TEAPAC[Ver 2.60.07] - HCM Back of Queue Worksheet

Queues in Worst Lanes	SB RT	SB TH	SB LT	WB RT	WB TH	WB LT	NB RT	NB TH	NB LT	EB RT	EB TH	EB LT
Lane group, LG		TH						TH			RT+TH+LT	
Init queue, QbL		0						0			0	
Ln flow, vL		843						513			264	
Ln satflow, sL		1719						1766			1858	
Ln capacity, cL		1297						1332			311	
Flow ratio, yL		.490						.290			.142	
v/c ratio, XL		.650						.385			.849	
Effect green, g		69.4						69.4			15.4	
Grn ratio, g/C		.754						.754			.167	
Upstr filter, I		1.00						1.00			1.00	
Grn arrivals, P		.52						.50			.17	
Platn ratio, Rp		.69						.67			1.00	
Prog factr, PF2		1.50						1.78			1.00	
Queue (1st), Q1		15.5						8.1			6.5	
Queue factr, kB		1.39						1.42			.51	
Queue (2nd), Q2		2.5						.9			2.1	
Avg queue, Q		18.0						9.0			8.7	
90% factor, fB		1.51						1.58			1.59	
90% queue, Qp		27.3						14.2			13.8	
Avg spacing, Lh		25.3						25.3			25.0	
Avail storg, La		0						0			0	
Avg distance		456						226			217	
Avg ratio, RQ		.00						.00			.00	
90% distance		690						359			344	
90% ratio, RQp		.00						.00			.00	

```
VOLKAN COSKUN THESIS                                                   03/26/06
INT 1102 - AHIRKAPI-B - PM PEAK                                        22:22:49
EXISTING


SIGNAL2000/TEAPAC[Ver 2.60.07] - Capacity Analysis Summary

Intersection Averages for Int # 102 -
      Degree of Saturation (v/c) 0.58  Vehicle Delay  14.9  Level of Service B+

      -------------------------
Sq 11 |  Phase 1   |  Phase 2  |
LG/** -------------------------
      |    +       |           |
  .   |    +       |           |
 /|\  |    +       |           |
  |   |    v       |     ^     |
  |   |        ^   |++++       |
North |        +   |           |
  |   |        +   |++++       |
      |        +   |    v      |
      -------------------------
      | G/C=0.761  | G/C=0.174 |
      | G=  70.0"  | G=  16.0" |
      | Y+R= 3.0"  | Y+R= 3.0" |
      | OFF= 0.0%  | OFF=79.3% |
      -------------------------
      C= 92 sec   G= 86.0 sec = 93.5%  Y= 6.0 sec =  6.5%  Ped= 0.0 sec =  0.0%

--------------------------------------------------------------------------------
| Lane   |Width/|     g/C     | Service Rate|  Adj |       |  HCM   | L | Queue |
|  Group | Lanes| Reqd   Used | @C (vph) @E |Volume|  v/c  | Delay  | S |Model 1|
--------------------------------------------------------------------------------

SB Approach                                                       11.6    B+
================================================================================
|   TH   | 20/2 |0.532 |0.754 | 2425 | 2464 | 1601 |0.650 |   11.6 | B+| 690 ft|
--------------------------------------------------------------------------------

NB Approach                                                        7.8    A
================================================================================
|   TH   | 21/2 |0.361 |0.754 | 2493 | 2531 |  974 |0.385 |    7.8 | A | 359 ft|
--------------------------------------------------------------------------------

EB Approach                                                       61.2    E+
================================================================================
|RT+TH+LT| 15/1 |0.251 |0.167 |   74 |  299 |  264 |0.849 |   61.2 | E+| 344 ft|
--------------------------------------------------------------------------------
```

```
VOLKAN COSKUN THESIS                                          03/26/06
INT 1162A - UNVERDI - OFF-PEAK                                22:52:51
EXISTING


SIGNAL2000/TEAPAC[Ver 2.60.07] - HCM Input Worksheet

Intersection # 162 -                              Area Location Type: NONCBD

          |     |     |     ||    |                      Key:  VOLUMES -- >
          |  26 | 428 | 179 ||    |                             |   WIDTHS
          | 0.0 |34.5 | 0.0 ||    |                             v      LANES
          |   0 |   3 |   0 ||    ---------------
          |     |     |     ||  \    0  23.0  1                .
---------    /     |     \       ---------------               /|\
                               --  564  24.0  2                 |
==============                   ---------------                |
    174  0.0  0  /         +      /  278   0.0  0              North
--------------                   ===============                |
    725  25.3  2  --
--------------             \    |    /   ---------
      3  16.0  1  \    ||     |     |     |
----------------       ||  261 | 361 | 143 |     Phasing:  SEQUENCE    77
                  |    ||  0.0 |34.5 | 0.0 |               PERMSV  N N N N
                  |    ||    0 |   3 |   0 |               OVERLP  Y Y Y Y
                  |    ||      |     |     |               LEADLAG   LD LD


                          SB                WB                NB                EB
                   RT    TH    LT    RT    TH    LT    RT    TH    LT    RT    TH    LT
=============== ============= ============= ============= =============
Heavy veh, %HV    15.4   2.6   3.4    .0   9.2   4.0   2.8   4.2  13.8    .0   7.5   4.0
Pk-hr fact, PHF    .95   .95   .95   .96   .96   .96   .93   .93   .93   .91   .91   .91
Pretimed or Act      P     P     P     P     P     P     P     P     P     P     P     P
Strtup lost, l1    2.3   2.3   2.3   2.3   2.3   2.3   2.3   2.3   2.3   2.3   2.3   2.3
Ext eff grn, e     1.7   1.7   1.7   1.7   1.7   1.7   1.7   1.7   1.7   1.7   1.7   1.7
Arrival typ, AT      3     3     3     3     3     3     3     3     3     3     3     3
--------------- ------------- ------------- ------------- -------------
Ped vol, vped              0                 0                 0                 0
Bike vol, vbic             0                 0                 0                 0
Parking locatns           NO                NO                NO                NO
Park mnvrs, Nm             0                 0                 0                 0
Bus stops, NB              0                 0                 0                 0
Grade, %G                 .0                .0                .0                .0
=============== ============= ============= ============= =============

      ---------------------------------------------------------------------
Sq 77 |  Phase 1  |  Phase 2  |  Phase 3  |  Phase 4  |  Phase 5  |  Phase 6  |
**/** ---------------------------------------------------------------------
      | * * * ^   |       ^   |       ^   |       ^   |           |           |
  .   | * * * ****|       ****|       ****|       ****|           |           |
 /|\  |<* * *>    |           |      <****|           |           |           |
  |   |   v       |           |       ****|   ^       |           |           |
  |   |           |       ^   |       v   |****       |           |           |
North |           |    <* * *>|           |****>      |           |           |
  |   |****       |**** * * * |****       |****       |           |           |
      |   v       |   v * * * |   v       |   v       |           |           |
      ---------------------------------------------------------------------
C= 90"| G=  12.0" | G=  17.0" | G=  21.0" | G=  28.0" | G=   0.0" | G=   0.0" |
      | Y+R= 3.0" | Y+R= 3.0" | Y+R= 3.0" | Y+R= 3.0" | Y+R= 0.0" | Y+R= 0.0" |
      ---------------------------------------------------------------------
```

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VOLKAN COSKUN THESIS                                                   03/26/06
INT 1162A - UNVERDI - OFF-PEAK                                         22:52:51
EXISTING


SIGNAL2000/TEAPAC[Ver 2.60.07] - HCM Volume Adjust & Satflow Worksheet

Volume                    SB              WB              NB              EB
Adjustment           RT   TH   LT    RT   TH   LT    RT   TH   LT    RT   TH   LT
===============  ==============  ==============  ==============  ==============
Volume, V            26  428  179     0  564  278   143  361  261     0  725  174
Pk-hr fact, PHF     .95  .95  .95   .96  .96  .96   .93  .93  .93   .91  .91  .91
Adj mv flow, vp      27  451  188     0  588  290   154  388  281     0  797  191
---------------  --------------  --------------  --------------  --------------
Lane group, LG      RT+TH+LT            TH+LT         RT+TH+LT            TH+LT
Adj LG flow, v         666               878             823               988
Prop LT, PLT          .282              .330            .341              .193
Prop RT, PRT          .041              .000            .187              .000
---------------  --------------  --------------  --------------  --------------

Saturation                SB              WB              NB              EB
Flow Rate            RT   TH   LT    RT   TH   LT    RT   TH   LT    RT   TH   LT
===============  ==============  ==============  ==============  ==============
Base satflo, so       1891              1891            1891              1891
Number lanes, N          3                 2               3                 2
Lane width, fW        .983             1.000            .983             1.022
Heavy veh, fHV        .968              .930            .933              .936
Grade, fg            1.000             1.000           1.000             1.000
Parking, fp          1.000             1.000           1.000             1.000
Bus block, fbb       1.000             1.000           1.000             1.000
Area type, fa        1.000             1.000           1.000             1.000
Lane util, fLU        .910              .950            .910              .950
Left-turn, fLT        .986              .984            .983              .990
Right-turn, fRT       .994             1.000            .972             1.000
PedBike LT,fLpb      1.000             1.000           1.000             1.000
PedBike RT,fRpb      1.000             1.000           1.000             1.000
Local adjustmnt      1.000             1.000           1.000             1.000
Adj satflow, s        4814              3288            4525              3403
===============  ==============  ==============  ==============  ==============


SIGNAL2000/TEAPAC[Ver 2.60.07] - HCM Capacity and LOS Worksheet

Capacity                  SB              WB              NB              EB
Analysis             RT   TH   LT    RT   TH   LT    RT   TH   LT    RT   TH   LT
===============  ==============  ==============  ==============  ==============
Lane group, LG      RT+TH+LT            TH+LT         RT+TH+LT            TH+LT
Adj Flow, v            666               878             823               988
Satflow, s            4814              3288            4525              3403
Lost time, tL          3.6               3.6             3.6               3.6
Effect green, g       11.4              20.4            16.4              27.4
Grn ratio, g/C        .127              .227            .182              .304
LG capacity, c         610               745             824              1036
v/c ratio, X         1.092             1.179            .999              .954
Flow ratio, v/s       .138              .267            .182              .290
Crit lane group          *                 *               *                 *
---------------  --------------  --------------  --------------  --------------
Sum crit v/s,Yc      0.878       Total lost, L          14.4
Crit v/c, Xc         1.045
===============  ==============  ==============  ==============  ==============
```

VOLKAN COSKUN THESIS 03/26/06
INT 1162A - UNVERDI - OFF-PEAK 22:52:51
EXISTING

SIGNAL2000/TEAPAC[Ver 2.60.07] - HCM Capacity and LOS Worksheet

Delay and LOS	SB RT	SB TH	SB LT	WB RT	WB TH	WB LT	NB RT	NB TH	NB LT	EB RT	EB TH	EB LT
Lane group, LG		RT+TH+LT			TH+LT			RT+TH+LT			TH+LT	
Adj Flow, v		666			878			823			988	
LG capacity, c		610			745			824			1036	
v/c ratio, X		1.092			1.179			.999			.954	
Grn ratio, g/C		.127			.227			.182			.304	
Unif delay, d1		39.3			34.8			36.8			30.7	
Incr calib, k		.50			.50			.50			.50	
Incr delay, d2		64.0			94.0			31.1			18.8	
Queue Delay, d3		.0			.0			.0			.0	
Unif delay, d1*		.0			.0			.0			.0	
Prog factor, PF		1.00			1.00			1.00			1.00	
Contrl delay, d		103.3			128.8			67.9			49.5	
Lane group LOS		F			F			E			D	
Final Queue,Qbi		14			33			0			0	
Appr delay, dA		103.3			128.8			67.9			49.5	
Approach LOS		F			F			E			D	
Appr flow, vA		666			878			823			988	

Intersection: Delay 85.4 LOS F

VOLKAN COSKUN THESIS 03/26/06
INT 1162A - UNVERDI - OFF-PEAK 22:52:51
EXISTING

SIGNAL2000/TEAPAC[Ver 2.60.07] - HCM Back of Queue Worksheet

Queues in Worst Lanes	SB RT TH LT	WB RT TH LT	NB RT TH LT	EB RT TH LT
Lane group, LG	RT+TH+LT	TH+LT	RT+TH+LT	TH+LT
Init queue, QbL	0	0	0	0
Ln flow, vL	244	462	301	520
Ln satflow, sL	1763	1731	1657	1791
Ln capacity, cL	223	392	302	545
Flow ratio, yL	.138	.267	.182	.290
v/c ratio, XL	1.092	1.179	.999	.954
Effect green, g	11.4	20.4	16.4	27.4
Grn ratio, g/C	.127	.227	.182	.304
Upstr filter, I	1.00	1.00	1.00	1.00
Grn arrivals, P	.13	.23	.18	.30
Platn ratio, Rp	1.00	1.00	1.00	1.00
Prog factr, PF2	1.00	1.00	1.00	1.00
Queue (1st), Q1	6.1	11.6	7.5	12.7
Queue factr, kB	.40	.59	.49	.75
Queue (2nd), Q2	5.0	11.7	4.3	5.6
Avg queue, Q	11.1	23.2	11.8	18.3
90% factor, fB	1.55	1.50	1.55	1.51
90% queue, Qp	17.3	35.0	18.3	27.7
Avg spacing, Lh	25.5	26.1	26.1	26.0
Avail storg, La	0	0	0	0
Avg distance	283	607	308	476
Avg ratio, RQ	.00	.00	.00	.00
90% distance	440	913	477	721
90% ratio, RQp	.00	.00	.00	.00

```
VOLKAN COSKUN THESIS                                                03/26/06
INT 1162A - UNVERDI - OFF-PEAK                                      22:52:51
EXISTING


SIGNAL2000/TEAPAC[Ver 2.60.07] - Capacity Analysis Summary

Intersection Averages for Int # 162 -
      Degree of Saturation (v/c) 1.05  Vehicle Delay  85.4  Level of Service F

      -------------------------------------------------
Sq 77 |  Phase 1  |  Phase 2  |  Phase 3  |  Phase 4  |
**/** -------------------------------------------------
      | * * * ^   |       ^   |       ^   |       ^   |
  .   | * * * ****|       ****|       ****|       ****|
 /|\  |<* * *>    |           |      <****|           |
  |   |   v       |           |       ****|   ^       |
  |   |           |       ^   |       v   |****       |
North |           |    <* * *>|           |****>      |
  |   |****       |**** * * * |****       |****       |
      |   v       |   v * * * |   v       |   v       |
      -------------------------------------------------
      | G/C=0.133 | G/C=0.189 | G/C=0.233 | G/C=0.311 |
      | G=  12.0" | G=  17.0" | G=  21.0" | G=  28.0" |
      | Y+R= 3.0" | Y+R= 3.0" | Y+R= 3.0" | Y+R= 3.0" |
      | OFF= 0.0% | OFF=16.7% | OFF=38.9% | OFF=65.6% |
      -------------------------------------------------
      C= 90 sec   G= 78.0 sec = 86.7%  Y=12.0 sec = 13.3%  Ped= 0.0 sec =  0.0%

-------------------------------------------------------------------------------
| Lane   |Width/|     g/C     | Service Rate| Adj  |       |  HCM  | L | Queue |
|  Group | Lanes| Reqd   Used | @C (vph) @E |Volume|  v/c  | Delay | S |Model 1|
-------------------------------------------------------------------------------

SB Approach                                                 103.3   F
===============================================================================
|RT+TH+LT| 35/3 |0.217 |0.127 |   55 |  610 |  666 |1.092 | 103.3 |*F | 440 ft|
-------------------------------------------------------------------------------

NB Approach                                                  67.9   E
===============================================================================
|RT+TH+LT| 35/3 |0.250 |0.182 |  397 |  824 |  823 |0.999 |  67.9 |*E | 477 ft|
-------------------------------------------------------------------------------

WB Approach                                                 128.8   F
===============================================================================
|   TH+LT| 24/2 |0.326 |0.227 |  457 |  745 |  878 |1.179 | 128.8 |*F | 913 ft|
-------------------------------------------------------------------------------

EB Approach                                                  49.5   D
===============================================================================
|   TH+LT| 25/2 |0.343 |0.304 |  823 | 1036 |  988 |0.954 |  49.5 |*D | 721 ft|
-------------------------------------------------------------------------------
```

```
VOLKAN COSKUN THESIS                                              03/26/06
INT. 1163 - YAYLA - OFF-PEAK                                      22:57:00
EXISTING


SIGNAL2000/TEAPAC[Ver 2.60.07] - HCM Input Worksheet

Intersection # 163 -                                 Area Location Type: NONCBD

               |      |      |      ||      |                Key:  VOLUMES -- >
               |  123 |  263 |  185 ||      |                        |   WIDTHS
               |  0.0 | 16.0 |  0.0 ||      |                        v       LANES
               |    0 |    1 |    0 ||      ----------------
               |      |      |      ||    \   83   0.0  0                .
-------------     /      |      \          ----------------              /|\
                                         --  709  26.0  2                  |
=================                          ----------------                |
        0   0.0  0  /         +         /     0   0.0  0               North
-----------------                          ================                |
      901  23.0  2  --
-----------------                \      |      /    -----------
       41  12.0  1  \      ||      |      |      |
------------------         ||  120 |  163 |   27 |     Phasing:  SEQUENCE     71
                   |       ||  0.0 | 16.0 |  0.0 |               PERMSV  N N N N
                   |       ||    0 |    1 |    0 |               OVERLP  N N N Y
                   |       ||      |      |      |               LEADLAG    LG LD


                         SB                 WB                 NB                 EB
                   RT    TH    LT    RT    TH    LT    RT    TH    LT    RT    TH    LT
=============== ============== ============== ============== ==============
Heavy veh, %HV     6.5   6.1  18.4  15.7  11.6    .0   3.7  10.4   6.7   2.4   9.1    .0
Pk-hr fact, PHF    .96   .96   .96   .95   .95   .95   .83   .83   .83   .92   .92   .92
Pretimed or Act      P     P     P     P     P     P     P     P     P     P     P     P
Strtup lost, l1    2.3   2.3   2.3   2.3   2.3   2.3   2.3   2.3   2.3   2.3   2.3   2.3
Ext eff grn, e     2.7   2.7   2.7   1.7   1.7   1.7   1.7   1.7   1.7   1.7   1.7   1.7
Arrival typ, AT      3     3     3     3     3     3     3     3     3     3     3     3
                --------------  --------------  --------------  --------------
Ped vol, vped            0                  0                  0                  0
Bike vol, vbic           0                  0                  0                  0
Parking locatns         NO                 NO                 NO                 NO
Park mnvrs, Nm           0                  0                  0                  0
Bus stops, NB            0                  0                  0                  0
Grade, %G               .0                 .0                 .0                 .0
=============== ============== ============== ============== ==============

      --------------------------------------------------------------------------------------------
Sq 71 |  Phase 1   |  Phase 2   |  Phase 3   |  Phase 4   |  Phase 5   |  Phase 6   |
LG/** --------------------------------------------------------------------------------------------
      |            | * * *      |       ^    |            |            |            |
  .   |            | * * *      |      ++++  |            |            |            |
 /|\  |            |<* * *>     |     <++++  |            |            |            |
  |   |            |   v        |            |            |            |            |
  |   |       ^    |            |            |            |            |            |
North |    <* * *> |            |****>       |            |            |            |
  |   |++++ * * *  |            |++++        |            |            |            |
      |    v * * * |            |   v        |            |            |            |
      --------------------------------------------------------------------------------------------
C= 88"| G=  24.0"  | G=  14.0"  | G=  40.0"  | G=   0.0"  | G=   0.0"  | G=   0.0"  |
      | Y+R= 3.0"  | Y+R= 4.0"  | Y+R= 3.0"  | Y+R= 0.0"  | Y+R= 0.0"  | Y+R= 0.0"  |
      --------------------------------------------------------------------------------------------
```

VOLKAN COSKUN THESIS 03/26/06
INT. 1163 - YAYLA - OFF-PEAK 22:57:00
EXISTING

SIGNAL2000/TEAPAC[Ver 2.60.07] - HCM Volume Adjust & Satflow Worksheet

Volume Adjustment	SB RT	SB TH	SB LT	WB RT	WB TH	WB LT	NB RT	NB TH	NB LT	EB RT	EB TH	EB LT
Volume, V	123	263	185	83	709	0	27	163	120	41	901	0
Pk-hr fact, PHF	.96	.96	.96	.95	.95	.95	.83	.83	.83	.92	.92	.92
Adj mv flow, vp	128	274	193	87	746	0	33	196	145	45	979	0
Lane group, LG		RT+TH+LT			RT+TH			RT+TH+LT		RT	TH	
Adj LG flow, v		595			833			374		45	979	
Prop LT, PLT		.324			.000			.388		.000	.000	
Prop RT, PRT		.215			.104			.088		1.000	.000	

Saturation Flow Rate	SB RT	SB TH	SB LT	WB RT	WB TH	WB LT	NB RT	NB TH	NB LT	EB RT	EB TH	EB LT
Base satflo, so		1891			1891			1891		1891	1891	
Number lanes, N		1			2			1		1	2	
Lane width, fW		1.133			1.033			1.133		1.000	.983	
Heavy veh, fHV		.908			.893			.923		.977	.917	
Grade, fg		1.000			1.000			1.000		1.000	1.00	
Parking, fp		1.000			1.000			1.000		1.000	1.00	
Bus block, fbb		1.000			1.000			1.000		1.000	1.00	
Area type, fa		1.000			1.000			1.000		1.000	1.00	
Lane util, fLU		1.000			.950			1.000		1.000	.950	
Left-turn, fLT		.984			1.000			.981		1.000	1.00	
Right-turn, fRT		.971			.984			.988		.850	1.00	
PedBike LT,fLpb		1.000			1.000			1.000		1.000	1.00	
PedBike RT,fRpb		1.000			1.000			1.000		1.000	1.00	
Local adjustmnt		1.000			1.000			1.000		1.000	1.00	
Adj satflow, s		1859			3262			1917		1570	3238	

SIGNAL2000/TEAPAC[Ver 2.60.07] - HCM Capacity and LOS Worksheet

Capacity Analysis	SB RT	SB TH	SB LT	WB RT	WB TH	WB LT	NB RT	NB TH	NB LT	EB RT	EB TH	EB LT
Lane group, LG		RT+TH+LT			RT+TH			RT+TH+LT		RT	TH	
Adj Flow, v		595			833			374		45	979	
Satflow, s		1859			3262			1917		1570	3238	
Lost time, tL		3.6			3.6			3.6		3.6	3.6	
Effect green, g		14.4			39.4			23.4		66.4	39.4	
Grn ratio, g/C		.164			.448			.266		.755	.448	
LG capacity, c		304			1461			510		1184	1450	
v/c ratio, X		1.957			.570			.733		.038	.675	
Flow ratio, v/s		.320			.255			.195		.029	.302	
Crit lane group		*						*			*	

Sum crit v/s,Yc	0.818	Total lost, L	10.8
Crit v/c, Xc	.932		

VOLKAN COSKUN THESIS 03/26/06
INT. 1163 - YAYLA - OFF-PEAK 22:57:00
EXISTING

SIGNAL2000/TEAPAC[Ver 2.60.07] - HCM Capacity and LOS Worksheet

Delay and LOS	SB RT	SB TH	SB LT	WB RT	WB TH	WB LT	NB RT	NB TH	NB LT	EB RT	EB TH	EB LT
Lane group, LG		RT+TH+LT			RT+TH			RT+TH+LT		RT	TH	
Adj Flow, v		595			833			374		45	979	
LG capacity, c		304			1461			510		1184	1450	
v/c ratio, X		1.957			.570			.733		.038	.675	
Grn ratio, g/C		.164			.448			.266		.755	.448	
Unif delay, d1		36.8			18.0			29.5		2.7	19.2	
Incr calib, k		.50			.50			.50		.50	.50	
Incr delay, d2		442.5			1.6			9.0		.1	2.5	
Queue Delay, d3		.0			.0			.0		.0	.0	
Unif delay, d1*		.0			.0			.0		.0	.0	
Prog factor, PF		1.00			1.00			1.00		1.00	1.00	
Contrl delay, d		479.3			19.6			38.5		2.8	21.8	
Lane group LOS		F			B			D+		A	C+	
Final Queue,Qbi		73			0			0		0	0	
Appr delay, dA		479.3			19.6			38.5			20.9	
Approach LOS		F			B			D+			C+	
Appr flow, vA		595			833			374			1024	
Intersection:	Delay		119.4	LOS		F						

VOLKAN COSKUN THESIS 03/26/06
INT. 1163 - YAYLA - OFF-PEAK 22:57:00
EXISTING

SIGNAL2000/TEAPAC[Ver 2.60.07] - HCM Back of Queue Worksheet

Queues in Worst Lanes	SB RT	SB TH	SB LT	WB RT	WB TH	WB LT	NB RT	NB TH	NB LT	EB RT	EB TH	EB LT
Lane group, LG		RT+TH+LT			RT+TH			RT+TH+LT		RT	TH	
Init queue, QbL		0			0			0		0	0	
Ln flow, vL		595			438			374		45	515	
Ln satflow, sL		1859			1717			1917		1570	1704	
Ln capacity, cL		304			769			510		1184	763	
Flow ratio, yL		.320			.255			.195		.029	.302	
v/c ratio, XL		1.957			.570			.733		.038	.675	
Effect green, g		14.4			39.4			23.4		66.4	39.4	
Grn ratio, g/C		.164			.448			.266		.755	.448	
Upstr filter, I		1.00			1.00			1.00		1.00	1.00	
Grn arrivals, P		.16			.45			.27		.75	.45	
Pltn ratio, Rp		1.00			1.00			1.00		1.00	1.00	
Prog factr, PF2		1.00			1.00			1.00		1.00	1.00	
Queue (1st), Q1		14.5			7.9			8.3		.3	10.0	
Queue factr, kB		.49			.94			.70		1.27	.93	
Queue (2nd), Q2		37.3			1.2			1.7		.0	1.8	
Avg queue, Q		51.9			9.2			10.1		.3	11.8	
90% factor, fB		1.50			1.58			1.57		1.97	1.55	
90% queue, Qp		77.8			14.5			15.8		.6	18.3	
Avg spacing, Lh		26.5			26.8			26.3		25.4	26.4	
Avail storg, La		0			0			0		0	0	
Avg distance		1377			245			265		8	311	
Avg ratio, RQ		.00			.00			.00		.00	.00	
90% distance		2065			388			415		16	481	
90% ratio, RQp		.00			.00			.00		.00	.00	

```
VOLKAN COSKUN THESIS                                                   03/26/06
INT. 1163 - YAYLA - OFF-PEAK                                           22:57:00
EXISTING


SIGNAL2000/TEAPAC[Ver 2.60.07] - Capacity Analysis Summary

Intersection Averages for Int # 163 -
      Degree of Saturation (v/c) 0.91  Vehicle Delay 119.4  Level of Service F

      -----------------------------------
Sq 71 |  Phase 1   |  Phase 2   |  Phase 3   |
LG/** -----------------------------------
      |           | * * *      |       ^    |
  .   |           | * * *      |       ++++|
 /|\  |           |<* * *>     |     <++++|
  |   |           |   v        |            |
  |   |       ^   |            |            |
North |    <* * *>|            |****>       |
  |   |++++ * * * |            |++++        |
      |   v * * * |            |   v        |
      -----------------------------------
      | G/C=0.273 | G/C=0.159 | G/C=0.455 |
      | G=  24.0" | G=  14.0" | G=  40.0" |
      | Y+R= 3.0" | Y+R= 4.0" | Y+R= 3.0" |
      | OFF= 0.0% | OFF=30.7% | OFF=51.1% |
      -----------------------------------
      C= 88 sec   G= 78.0 sec = 88.6%  Y=10.0 sec = 11.4%  Ped= 0.0 sec =  0.0%

-------------------------------------------------------------------------------
| Lane    |Width/|     g/C     | Service Rate| Adj |       |  HCM  | L | Queue |
|  Group  | Lanes| Reqd   Used | @C (vph) @E |Volume|  v/c | Delay | S |Model 1|
-------------------------------------------------------------------------------

SB Approach                                                   479.3   F
===============================================================================
|RT+TH+LT| 16/1 |0.387 |0.164 |    94 |  294 |  595 |1.957 | 479.3 |*F |2065 ft|
-------------------------------------------------------------------------------

NB Approach                                                    38.5   D+
===============================================================================
|RT+TH+LT| 16/1 |0.284 |0.266 |   332 |  510 |  374 |0.733 |  38.5 |*D+| 415 ft|
-------------------------------------------------------------------------------

WB Approach                                                    19.6   B
===============================================================================
|RT+TH   | 26/2 |0.313 |0.448 | 1361 | 1461 |  833 |0.570 |  19.6 | B | 388 ft|
-------------------------------------------------------------------------------

EB Approach                                                    20.9   C+
===============================================================================
|   RT   | 12/1 |0.146 |0.755 | 1176 | 1184 |   45 |0.038 |   2.8 | A |  16 ft|
|   TH   | 23/2 |0.352 |0.448 | 1350 | 1450 |  979 |0.675 |  21.8 |*C+| 481 ft|
-------------------------------------------------------------------------------
```

```
VOLKAN COSKUN THESIS                                                03/26/06
INT. 1164 - KOCASINAN GIRISI - OFF-PEAK                             23:00:26
EXISTING


SIGNAL2000/TEAPAC[Ver 2.60.07] - HCM Input Worksheet

Intersection # 164 -                                Area Location Type: NONCBD

             |       |       |      ||       |                Key:  VOLUMES -- >
             |  127  |     0 |  343 ||       |                      |   WIDTHS
             |  0.0  | 14.0  |  0.0 ||       |                      v       LANES
             |    0  |     1 |    0 ||       --------------------
             |       |       |      ||     \   298   8.2  1
-------------     /      |       \           --------------------       /|\
                                         --   848  25.0  2                |
===================                         --------------------          |
      142   0.0  0  /          +         /     0   0.0  0              North
-------------------                         ====================          |
      988  23.0  2  --
-------------------            \       |       /   -------------
        0   0.0  0  \      ||       |       |       |
--------------------       ||    0  |    0  |    0  |     Phasing:  SEQUENCE      13
                    |      ||  0.0  |  0.0  |  0.0  |               PERMSV  N N N N
                    |      ||    0  |    0  |    0  |               OVERLP  Y Y Y Y
                    |      ||       |       |       |               LEADLAG   LD LD


                              SB                  WB                  NB                  EB
                    RT    TH    LT     RT    TH    LT     RT    TH    LT     RT    TH    LT
================  ==============   ==============   ==============   ==============
Heavy veh, %HV     4.7    .0  11.1   11.7   5.7    .0     .0    .0    .0     .0   4.3   4.9
Pk-hr fact, PHF    .94   .94   .94    .97   .97   .97    .90   .90   .90    .88   .88   .88
Pretimed or Act      P     P     P      P     P     P      P     P     P      P     P     P
Strtup lost, l1    2.3   2.3   2.3    2.3   2.3   2.3    2.3   2.3   2.3    2.3   2.3   2.3
Ext eff grn, e     1.7   1.7   2.7    1.7   1.7   1.7    1.7   1.7   1.7    1.7   1.7   1.7
Arrival typ, AT      3     3     3      3     3     3      3     3     3      3     3     3
----------------  --------------   --------------   --------------   --------------
Ped vol, vped            0                  0                  0                  0
Bike vol, vbic           0                  0                  0                  0
Parking locatns         NO                 NO                 NO                 NO
Park mnvrs, Nm           0                  0                  0                  0
Bus stops, NB            0                  0                  0                  0
Grade, %G               .0                 .0                 .0                 .0
================  ==============   ==============   ==============   ==============


      ----------------------------------------------------------------------------
Sq 13 |  Phase 1   |  Phase 2   |  Phase 3   |  Phase 4   |  Phase 5   |  Phase 6   |
**/** ----------------------------------------------------------------------------
      | +    + ^   | *          | +       ^  |            |            |            |
  .   | +    + ++++| *          | +      ++++|            |            |            |
 /|\  |<+    +>    |<*          |<+     <****|            |            |            |
  |   |            |    ^       |            |            |            |            |
  |   |            |****        |            |            |            |            |
North |            |****>       |++++>       |            |            |            |
  |   |            |            |            |            |            |            |
      |            |            |            |            |            |            |
      ----------------------------------------------------------------------------
C= 90"| G= 18.0"   | G= 11.0"   | G= 51.0"   | G=  0.0"   | G=  0.0"   | G=  0.0"   |
      | Y+R= 4.0"  | Y+R= 3.0"  | Y+R= 3.0"  | Y+R= 0.0"  | Y+R= 0.0"  | Y+R= 0.0"  |
      ----------------------------------------------------------------------------
```

VOLKAN COSKUN THESIS 03/26/06
INT. 1164 - KOCASINAN GIRISI - OFF-PEAK 23:00:26
EXISTING

SIGNAL2000/TEAPAC[Ver 2.60.07] - HCM Volume Adjust & Satflow Worksheet

Volume Adjustment	SB RT	SB TH	SB LT	WB RT	WB TH	WB LT	NB RT	NB TH	NB LT	EB RT	EB TH	EB LT
Volume, V	0	0	343	298	848	0	0	0	0	0	988	142
Pk-hr fact, PHF	.94	.94	.94	.97	.97	.97	.00	.00	.00	.88	.88	.88
Adj mv flow, vp	0	0	365	307	874	0	0	0	0	0	1123	161
Lane group, LG		TH+LT		RT	TH						TH+LT	
Adj LG flow, v		365		307	874						1284	
Prop LT, PLT		1.000		.000	.000						.125	
Prop RT, PRT		.000		1.000	.000						.000	

Saturation Flow Rate	SB RT	SB TH	SB LT	WB RT	WB TH	WB LT	NB RT	NB TH	NB LT	EB RT	EB TH	EB LT
Base satflo, so		1891		1891	1891						1891	
Number lanes, N		1		1	2						2	
Lane width, fW		1.067		.873	1.02						.983	
Heavy veh, fHV		.900		.895	.946						.958	
Grade, fg		1.000		1.000	1.00						1.000	
Parking, fp		1.000		1.000	1.00						1.000	
Bus block, fbb		1.000		1.000	1.00						1.000	
Area type, fa		1.000		1.000	1.00						1.000	
Lane util, fLU		1.000		1.000	.950						.950	
Left-turn, fLT		.952		1.000	1.00						.994	
Right-turn, fRT		1.000		.850	1.00						1.000	
PedBike LT,fLpb		1.000		1.000	1.00						1.000	
PedBike RT,fRpb		1.000		1.000	1.00						1.000	
Local adjustmnt		1.000		1.000	1.00						1.000	
Adj satflow, s		1729		1257	3456						3364	

SIGNAL2000/TEAPAC[Ver 2.60.07] - HCM Capacity and LOS Worksheet

Capacity Analysis	SB RT	SB TH	SB LT	WB RT	WB TH	WB LT	NB RT	NB TH	NB LT	EB RT	EB TH	EB LT
Lane group, LG		TH+LT		RT	TH						TH+LT	
Adj Flow, v		365		307	874						1284	
Satflow, s		1729		1257	3456						3364	
Lost time, tL		4.6		4.6	3.6						3.6	
Effect green, g		17.4		71.4	50.4						64.4	
Grn ratio, g/C		.193		.793	.560						.716	
LG capacity, c		334		997	1935						2407	
v/c ratio, X		1.093		.308	.452						.533	
Flow ratio, v/s		.211		.244	.253						.382	
Crit lane group		*									*	

Sum crit v/s,Yc	0.593	Total lost, L	8.2
Crit v/c, Xc	.652		

```
VOLKAN COSKUN THESIS                                                03/26/06
INT. 1164 - KOCASINAN GIRISI - OFF-PEAK                             23:00:26
EXISTING


SIGNAL2000/TEAPAC[Ver 2.60.07] - HCM Capacity and LOS Worksheet


Delay                    SB              WB              NB              EB
and LOS             RT   TH   LT    RT   TH   LT    RT   TH   LT    RT   TH   LT
--------------- -------------- -------------- -------------- --------------
Lane group, LG        TH+LT         RT   TH                               TH+LT
Adj Flow, v            365         307  874                               1284
LG capacity, c         334         997 1935                               2407
v/c ratio, X         1.093        .308 .452                               .533
Grn ratio, g/C        .193        .793 .560                               .716
Unif delay, d1        36.3         2.5 11.7                                5.9
Incr calib, k          .50         .50  .50                                .50
Incr delay, d2        76.4          .8   .8                                 .9
Queue Delay, d3         .0          .0   .0                                 .0
Unif delay, d1*         .0          .0   .0                                 .0
Prog factor, PF       1.00        1.00 1.00                               1.00
Contrl delay, d      112.7         3.3 12.4                                6.7
Lane group LOS           F           A   B+                                  A
Final Queue,Qbi          8           0    0                                  0
--------------- -------------- -------------- -------------- --------------
Appr delay, dA       112.7             10.1                                6.7
Approach LOS             F               B+                                  A
Appr flow, vA          365             1181                               1284
--------------- -------------- -------------- -------------- --------------
Intersection:   Delay     21.8 LOS          C+
--------------- -------------- -------------- -------------- --------------
```

VOLKAN COSKUN THESIS 03/26/06
INT. 1164 - KOCASINAN GIRISI - OFF-PEAK 23:00:26
EXISTING

SIGNAL2000/TEAPAC[Ver 2.60.07] - HCM Back of Queue Worksheet

Queues in Worst Lanes	SB RT	SB TH	SB LT	WB RT	WB TH	WB LT	NB RT	NB TH	NB LT	EB RT	EB TH	EB LT
Lane group, LG		TH+LT		RT	TH						TH+LT	
Init queue, QbL		0		0	0						0	
Ln flow, vL		365		307	460						676	
Ln satflow, sL		1729		1257	1819						1770	
Ln capacity, cL		334		997	1018						1267	
Flow ratio, yL		.211		.244	.253						.382	
v/c ratio, XL		1.093		.308	.452						.533	
Effect green, g		17.4		71.4	50.4						64.4	
Grn ratio, g/C		.193		.793	.560						.716	
Upstr filter, I		1.00		1.00	1.00						1.00	
Grn arrivals, P		.19		.79	.56						.72	
Pltn ratio, Rp		1.00		1.00	1.00						1.00	
Prog factr, PF2		1.00		1.00	1.00						1.00	
Queue (1st), Q1		9.1		2.1	6.8						7.8	
Queue factr, kB		.53		1.14	1.16						1.35	
Queue (2nd), Q2		7.2		.5	.9						1.5	
Avg queue, Q		16.3		2.6	7.7						9.3	
90% factor, fB		1.52		1.80	1.61						1.58	
90% queue, Qp		24.8		4.7	12.4						14.6	
Avg spacing, Lh		26.7		26.8	25.9						25.7	
Avail storg, La		0		49	0						0	
Avg distance		436		70	199						238	
Avg ratio, RQ		.00		1.42	.00						.00	
90% distance		662		125	320						376	
90% ratio, RQp		.00		2.55	.00						.00	

```
VOLKAN COSKUN THESIS                                                    03/26/06
INT. 1164 - KOCASINAN GIRISI - OFF-PEAK                                 23:00:26
EXISTING


SIGNAL2000/TEAPAC[Ver 2.60.07] - Capacity Analysis Summary

Intersection Averages for Int # 164 -
      Degree of Saturation (v/c) 0.56  Vehicle Delay  21.8  Level of Service C+

      -------------------------------------
Sq 13 |  Phase 1   |  Phase 2   |  Phase 3   |
**/** -------------------------------------
      | +   + ^    | *          | +      ^   |
  .   | +   + ++++| *          | +      ++++|
 /|\  |<+   +>     |<*         |<+     <****|
  |   |            |    ^      |            |
  |   |            |****       |            |
North |            |****>      |++++>       |
  |   |            |           |            |
      |            |           |            |
      -------------------------------------
      | G/C=0.200 | G/C=0.122 | G/C=0.567 |
      | G=  18.0" | G=  11.0" | G=  51.0" |
      | Y+R= 4.0" | Y+R= 3.0" | Y+R= 3.0" |
      | OFF=60.0% | OFF=84.4% | OFF= 0.0% |
      -------------------------------------
      C= 90 sec   G= 80.0 sec = 88.9%  Y=10.0 sec = 11.1%  Ped= 0.0 sec =  0.0%

--------------------------------------------------------------------------------
| Lane   |Width/|     g/C     | Service Rate|  Adj |       |  HCM  | L | Queue |
|  Group | Lanes| Reqd   Used | @C (vph) @E |Volume|  v/c  | Delay | S |Model 1|
--------------------------------------------------------------------------------

SB Approach                                                   112.7   F
================================================================================
|   TH+LT| 14/1 |0.304 |0.193 |   130 |   327 |   365 |1.093 | 112.7 | F | 662 ft|
--------------------------------------------------------------------------------

WB Approach                                                    10.1   B+
================================================================================
|   RT   |  8/1 |0.345 |0.793 |   987 |   997 |   307 |0.308 |   3.3 | A | 125 ft|
|   TH   | 25/2 |0.313 |0.560 |  1892 |  1935 |   874 |0.452 |  12.4 |*B+| 320 ft|
--------------------------------------------------------------------------------

EB Approach                                                     6.7   A
================================================================================
|   TH+LT| 23/2 |0.419 |0.716 |  2407 |  2407 |  1284 |0.533 |   6.7 |*A | 376 ft|
--------------------------------------------------------------------------------
```

```
VOLKAN COSKUN THESIS                                               03/26/06
INT. 1165 - SIRINEVLER - OFF-PEAK                                  23:03:41
EXISTING


SIGNAL2000/TEAPAC[Ver 2.60.07] - HCM Input Worksheet

Intersection # 165 -                                 Area Location Type: NONCBD

          |     |     |     ||     |                 Key:  VOLUMES -- >
          |  62 |   0 | 309 ||     |                       |   WIDTHS
          | 0.0 |29.5 | 0.0 ||     |                       v       LANES
          |   0 |   2 |   0 ||     |  ---------------
          |     |     |     ||     \   240   0.0  0
----------    /     |     \            ---------------             .
                                   --   770  23.7  2              /|\
===============                         ---------------              |
                                                                     |
      0   0.0  0  /       +       /      0   0.0  0               North
---------------                         ===============              |
    809  23.7  2  --
---------------          \       |       /     -----------
      0   0.0  0  \    ||     |     |     |
----------------       ||   0 |   0 |   0 |     Phasing:  SEQUENCE     -1
                |      || 0.0 | 0.0 | 0.0 |               PERMSV  N N N N
                |      ||   0 |   0 |   0 |               OVERLP   Y Y Y Y
                |      ||     |     |     |               LEADLAG   LD LD


                         SB                WB                NB                EB
                   RT    TH    LT    RT    TH    LT    RT    TH    LT    RT    TH    LT
===============  ==============  ==============  ==============  ==============
Heavy veh, %HV     1.6    .0   1.9   3.8   3.1    .0    .0    .0    .0    .0   3.0    .0
Pk-hr fact, PHF    .78   .90   .91   .90   .91   .90   .90   .90   .90   .90   .90   .90
Pretimed or Act      P     P     P     P     P     P     P     P     P     P     P     P
Strtup lost, l1    2.3   2.3   2.3   2.3   2.3   2.3   2.3   2.3   2.3   2.3   2.3   2.3
Ext eff grn, e     1.7   1.7   2.7   1.7   1.7   1.7   1.7   1.7   1.7   1.7   1.7   1.7
Arrival typ, AT      3     3     3     3     3     3     3     3     3     3     3     3
---------------  --------------  --------------  --------------  --------------
Ped vol, vped            0                 0                 0                 0
Bike vol, vbic           0                 0                 0                 0
Parking locatns         NO                NO                NO                NO
Park mnvrs, Nm           0                 0                 0                 0
Bus stops, NB            0                 0                 0                 0
Grade, %G             -5.0               5.0                .0              -7.0
===============  ==============  ==============  ==============  ==============

      ---------------------------------------------------------------------
Sq -1 |  Phase 1  |  Phase 2  |  Phase 3  |  Phase 4  |  Phase 5  |  Phase 6  |
**/** ---------------------------------------------------------------------
      | +      ^  | +         | +   + ^   |           |           |           |
  .   | +     ++++| +         | +   + ++++|           |           |           |
 /|\  |<+    <++++|<+         |<+   +>    |           |           |           |
  |   |           |           |           |           |           |           |
  |   |           |           |           |           |           |           |
North |++++>      |++++>      |           |           |           |           |
  |   |           |           |           |           |           |           |
      |           |           |           |           |           |           |
      ---------------------------------------------------------------------
C= 90"| G= 53.0"  | G= 10.0"  | G= 17.0"  | G=  0.0"  | G=  0.0"  | G=  0.0"  |
      | Y+R= 3.0" | Y+R= 3.0" | Y+R= 4.0" | Y+R= 0.0" | Y+R= 0.0" | Y+R= 0.0" |
      ---------------------------------------------------------------------
```

VOLKAN COSKUN THESIS 03/26/06
INT. 1165 - SIRINEVLER - OFF-PEAK 23:03:41
EXISTING

SIGNAL2000/TEAPAC[Ver 2.60.07] - HCM Volume Adjust & Satflow Worksheet

Volume Adjustment	SB RT	SB TH	SB LT	WB RT	WB TH	WB LT	NB RT	NB TH	NB LT	EB RT	EB TH	EB LT
Volume, V	0	0	309	240	770	0	0	0	0	0	809	0
Pk-hr fact, PHF	.78	.90	.91	.90	.91	.90	.00	.00	.00	.90	.90	.90
Adj mv flow, vp	0	0	340	267	846	0	0	0	0	0	899	0
Lane group, LG		TH+LT			RT+TH						TH	
Adj LG flow, v		340			1113						899	
Prop LT, PLT		1.000			.000						.000	
Prop RT, PRT		.000			.240						.000	

Saturation Flow Rate	SB RT	SB TH	SB LT	WB RT	WB TH	WB LT	NB RT	NB TH	NB LT	EB RT	EB TH	EB LT
Base satflo, so		1891			1891						1891	
Number lanes, N		2			2						2	
Lane width, fW		1.092			.995						.995	
Heavy veh, fHV		.981			.968						.971	
Grade, fg		1.025			.975						1.030	
Parking, fp		1.000			1.000						1.000	
Bus block, fbb		1.000			1.000						1.000	
Area type, fa		1.000			1.000						1.000	
Lane util, fLU		.950			.950						.950	
Left-turn, fLT		.952			1.000						1.000	
Right-turn, fRT		1.000			.964						1.000	
PedBike LT,fLpb		1.000			1.000						1.000	
PedBike RT,fRpb		1.000			1.000						1.000	
Local adjustmnt		1.000			1.000						1.000	
Adj satflow, s		3757			3254						3575	

SIGNAL2000/TEAPAC[Ver 2.60.07] - HCM Capacity and LOS Worksheet

Capacity Analysis	SB RT	SB TH	SB LT	WB RT	WB TH	WB LT	NB RT	NB TH	NB LT	EB RT	EB TH	EB LT
Lane group, LG		TH+LT			RT+TH						TH	
Adj Flow, v		340			1113						899	
Satflow, s		3757			3254						3575	
Lost time, tL		4.6			3.6						3.6	
Effect green, g		16.4			52.4						65.4	
Grn ratio, g/C		.182			.582						.727	
LG capacity, c		685			1894						2598	
v/c ratio, X		.496			.588						.346	
Flow ratio, v/s		.090			.342						.251	
Crit lane group		*									*	
Sum crit v/s,Yc		0.342		Total lost, L				8.2				
Crit v/c, Xc		.376										

VOLKAN COSKUN THESIS 03/26/06
INT. 1165 - SIRINEVLER - OFF-PEAK 23:03:41
EXISTING

SIGNAL2000/TEAPAC[Ver 2.60.07] - HCM Capacity and LOS Worksheet

Delay and LOS	SB RT	SB TH	SB LT	WB RT	WB TH	WB LT	NB RT	NB TH	NB LT	EB RT	EB TH	EB LT
Lane group, LG		TH+LT			RT+TH						TH	
Adj Flow, v		340			1113						899	
LG capacity, c		685			1894						2598	
v/c ratio, X		.496			.588						.346	
Grn ratio, g/C		.182			.582						.727	
Unif delay, d1		33.1			11.9						4.5	
Incr calib, k		.50			.50						.50	
Incr delay, d2		2.6			1.3						.4	
Queue Delay, d3		.0			.0						.0	
Unif delay, d1*		.0			.0						.0	
Prog factor, PF		1.00			1.00						1.00	
Contrl delay, d		35.6			13.3						4.9	
Lane group LOS		D+			B+						A	
Final Queue,Qbi		0			0						0	
Appr delay, dA		35.6			13.3						4.9	
Approach LOS		D+			B+						A	
Appr flow, vA		340			1113						899	

Intersection: Delay 13.3 LOS B+

VOLKAN COSKUN THESIS 03/26/06
INT. 1165 - SIRINEVLER - OFF-PEAK 23:03:41
EXISTING

SIGNAL2000/TEAPAC[Ver 2.60.07] - HCM Back of Queue Worksheet

Queues in Worst Lanes	SB RT	SB TH	SB LT	WB RT	WB TH	WB LT	NB RT	NB TH	NB LT	EB RT	EB TH	EB LT
Lane group, LG		TH+LT			RT+TH						TH	
Init queue, QbL		0			0						0	
Ln flow, vL		179			586						473	
Ln satflow, sL		1978			1713						1882	
Ln capacity, cL		361			997						1367	
Flow ratio, yL		.090			.342						.251	
v/c ratio, XL		.496			.588						.346	
Effect green, g		16.4			52.4						65.4	
Grn ratio, g/C		.182			.582						.727	
Upstr filter, I		1.00			1.00						1.00	
Grn arrivals, P		.18			.58						.73	
Platn ratio, Rp		1.00			1.00						1.00	
Prog factr, PF2		1.00			1.00						1.00	
Queue (1st), Q1		4.0			9.3						4.3	
Queue factr, kB		.56			1.14						1.42	
Queue (2nd), Q2		.5			1.6						.7	
Avg queue, Q		4.6			10.9						5.1	
90% factor, fB		1.70			1.56						1.68	
90% queue, Qp		7.8			16.9						8.5	
Avg spacing, Lh		25.3			25.5						25.5	
Avail storg, La		0			0						0	
Avg distance		115			277						129	
Avg ratio, RQ		.00			.00						.00	
90% distance		196			432						217	
90% ratio, RQp		.00			.00						.00	

```
VOLKAN COSKUN THESIS                                                       03/26/06
INT. 1165 - SIRINEVLER - OFF-PEAK                                          23:03:41
EXISTING


SIGNAL2000/TEAPAC[Ver 2.60.07] - Capacity Analysis Summary

Intersection Averages for Int # 165 -
      Degree of Saturation (v/c) 0.48  Vehicle Delay  13.3  Level of Service B+

      ------------------------------------
Sq -1 |  Phase 1   |  Phase 2   |  Phase 3   |
**/** ------------------------------------
      | +      ^   | +          | +    + ^   |
  .   | +      ++++| +          | +    + ++++|
 /|\  |<+    <++++|<+          |<+    +>     |
  |   |            |            |            |
  |   |            |            |            |
North |++++>       |++++>       |            |
  |   |            |            |            |
      |            |            |            |
      ------------------------------------
      | G/C=0.589  | G/C=0.111  | G/C=0.189  |
      | G=  53.0"  | G=  10.0"  | G=  17.0"  |
      | Y+R= 3.0"  | Y+R= 3.0"  | Y+R= 4.0"  |
      | OFF= 0.0%  | OFF=62.2%  | OFF=76.7%  |
      ------------------------------------
      C= 90 sec   G= 80.0 sec = 88.9%  Y=10.0 sec = 11.1%  Ped= 0.0 sec =  0.0%

-------------------------------------------------------------------------------
| Lane   |Width/|     g/C     | Service Rate| Adj |       |  HCM  | L | Queue |
|  Group | Lanes| Reqd   Used | @C (vph) @E |Volume|  v/c | Delay | S |Model 1|
-------------------------------------------------------------------------------

SB Approach                                                       35.6   D+
===============================================================================
|   TH+LT|  30/2 |0.188 |0.182 |  313 |  685 |  340 |0.496 |  35.6 | D+| 196 ft|
-------------------------------------------------------------------------------

WB Approach                                                       13.3   B+
===============================================================================
|RT+TH   | 24/2 |0.387 |0.582 | 1859 | 1894 | 1113 |0.588 |  13.3 | B+| 432 ft|
-------------------------------------------------------------------------------

EB Approach                                                        4.9   A
===============================================================================
|   TH   | 24/2 |0.311 |0.727 | 2598 | 2598 |  899 |0.346 |   4.9 | A | 217 ft|
-------------------------------------------------------------------------------
```

```
VOLKAN COSKUN THESIS                                                    03/26/06
INT. 1426A - UEFA ANITI - OFF-PEAK                                      23:06:45
EXISTING


SIGNAL2000/TEAPAC[Ver 2.60.07] - HCM Input Worksheet

Intersection #  26 -                                   Area Location Type: NONCBD

           |      |      |      ||      |                   Key:  VOLUMES -- >
           |   97 |   91 |   34 ||      |                          |  WIDTHS
           |  0.0 | 11.8 |  0.0 ||      |                          v      LANES
           |    0 |    1 |    0 ||       ------------------
           |      |      |      ||    \   212   0.0  0
-----------    /     |     \           ------------------          /|\
                                      --  1060  21.3  2              |
----------------                           ------------------        |
      0   0.0  0  /         +        /    65   0.0  0             North
----------------                           ==================        |
    886  22.6  2  --
----------------            \      |      /     ------------
    243   0.0  0  \     ||      |      |      |
-----------------       ||    0 |    0 |    0 |     Phasing:  SEQUENCE     12
                  |     ||  0.0 |  0.0 |  0.0 |               PERMSV  N N N N
                  |     ||    0 |    0 |    0 |               OVERLP  Y Y Y Y
                  |     ||      |      |      |               LEADLAG    LD LD


                         SB                WB                NB                EB
                   RT    TH    LT    RT    TH    LT    RT    TH    LT    RT    TH    LT
-------------    -----------------  -----------------  -----------------  -----------------
Heavy veh, %HV    4.1   4.4   2.9   4.3   4.0   6.2   2.0   2.0   2.0   2.1   4.6   2.0
Pk-hr fact, PHF   .83   .83   .83   .86   .86   .86   .86   .86   .86   .77   .77   .77
Pretimed or Act     P     P     P     P     P     P     P     P     P     P     P     P
Strtup lost, l1   2.3   2.3   2.3   2.3   2.3   2.3   2.3   2.3   2.3   2.3   2.3   2.3
Ext eff grn, e    2.7   2.7   2.7   1.7   1.7   1.7   1.7   1.7   1.7   1.7   1.7   1.7
Arrival typ, AT     3     3     3     3     3     3     3     3     3     3     3     3
-------------    -----------------  -----------------  -----------------  -----------------
Ped vol, vped            0                 0                 0                 0
Bike vol, vbic           0                 0                 0                 0
Parking locatns         NO                NO                NO                NO
Park mnvrs, Nm           0                 0                 0                 0
Bus stops, NB            0                 0                 0                 0
Grade, %G               .0                .0                .0                .0
-------------    -----------------  -----------------  -----------------  -----------------

     -------------------------------------------------------------------------------
Sq 12 |  Phase 1   |  Phase 2   |  Phase 3   |  Phase 4   |  Phase 5   |  Phase 6   |
**/** -------------------------------------------------------------------------------
      | * * *      |        ^   |        ^   |            |            |            |
  .   | * * *      |     ++++|  |     ****|  |            |            |            |
 /|\  |<* * *>     |    <++++|  |    <****|  |            |            |            |
  |   |    v       |     ****|  |            |            |            |            |
  |   |            |     v      |            |            |            |            |
North |            |            |++++>       |            |            |            |
  |   |            |            |++++        |            |            |            |
      |            |            |   v        |            |            |            |
     -------------------------------------------------------------------------------
C= 90"| G=  17.0"  | G=   6.0"  | G=  58.0"  | G=   0.0"  | G=   0.0"  | G=   0.0"  |
      | Y+R= 4.0"  | Y+R= 2.0"  | Y+R= 3.0"  | Y+R= 0.0"  | Y+R= 0.0"  | Y+R= 0.0"  |
     -------------------------------------------------------------------------------
```

VOLKAN COSKUN THESIS 03/26/06
INT. 1426A - UEFA ANITI - OFF-PEAK 23:06:45
EXISTING

SIGNAL2000/TEAPAC[Ver 2.60.07] - HCM Volume Adjust & Satflow Worksheet

Volume Adjustment	SB RT	SB TH	SB LT	WB RT	WB TH	WB LT	NB RT	NB TH	NB LT	EB RT	EB TH	EB LT
Volume, V	97	91	34	212	1060	65	0	0	0	243	886	0
Pk-hr fact, PHF	.83	.83	.83	.86	.86	.86	.00	.00	.00	.77	.77	.77
Adj mv flow, vp	117	110	41	247	1233	76	0	0	0	316	1151	0
Lane group, LG		RT+TH+LT			RT+TH+LT						RT+TH	
Adj LG flow, v		268			1556						1467	
Prop LT, PLT		.153			.049						.000	
Prop RT, PRT		.437			.159						.215	

Saturation Flow Rate	SB RT	SB TH	SB LT	WB RT	WB TH	WB LT	NB RT	NB TH	NB LT	EB RT	EB TH	EB LT
Base satflo, so		1891			1891						1891	
Number lanes, N		1			2						2	
Lane width, fW		.993			.955						.977	
Heavy veh, fHV		.961			.960						.961	
Grade, fg		1.000			1.000						1.000	
Parking, fp		1.000			1.000						1.000	
Bus block, fbb		1.000			1.000						1.000	
Area type, fa		1.000			1.000						1.000	
Lane util, fLU		1.000			.950						.950	
Left-turn, fLT		.992			.998						1.000	
Right-turn, fRT		.941			.976						.968	
PedBike LT, fLpb		1.000			1.000						1.000	
PedBike RT, fRpb		1.000			1.000						1.000	
Local adjustmnt		1.000			1.000						1.000	
Adj satflow, s		1686			3208						3263	

SIGNAL2000/TEAPAC[Ver 2.60.07] - HCM Capacity and LOS Worksheet

Capacity Analysis	SB RT	SB TH	SB LT	WB RT	WB TH	WB LT	NB RT	NB TH	NB LT	EB RT	EB TH	EB LT
Lane group, LG		RT+TH+LT			RT+TH+LT						RT+TH	
Adj Flow, v		268			1556						1467	
Satflow, s		1686			3208						3263	
Lost time, tL		3.6			3.6						3.6	
Effect green, g		17.4			65.4						57.4	
Grn ratio, g/C		.193			.727						.638	
LG capacity, c		326			2331						2081	
v/c ratio, X		.822			.668						.705	
Flow ratio, v/s		.159			.485						.450	
Crit lane group		*			*							

Sum crit v/s,Yc 0.644 Total lost, L 7.2
Crit v/c, Xc .700

VOLKAN COSKUN THESIS 03/26/06
INT. 1426A - UEFA AMITI - OFF-PEAK 23:06:45
EXISTING

SIGNAL2000/TEAPAC[Ver 2.60.07] - HCM Capacity and LOS Worksheet

Delay and LOS	SB RT	SB TH	SB LT	WB RT	WB TH	WB LT	NB RT	NB TH	NB LT	EB RT	EB TH	EB LT
Lane group, LG		RT+TH+LT			RT+TH+LT						RT+TH	
Adj Flow, v		268			1556						1467	
LG capacity, c		326			2331						2081	
v/c ratio, X		.822			.668						.705	
Grn ratio, g/C		.193			.727						.638	
Unif delay, d1		34.8			6.5						10.7	
Incr calib, k		.50			.50						.50	
Incr delay, d2		20.3			1.5						2.0	
Queue Delay, d3		.0			.0						.0	
Unif delay, d1*		.0			.0						.0	
Prog factor, PF		1.00			1.00						1.00	
Contrl delay, d		55.2			8.1						12.8	
Lane group LOS		E+			A						B+	
Final Queue,Qbi		0			0						0	
Appr delay, dA		55.2			8.1						12.8	
Approach LOS		E+			A						B+	
Appr flow, vA		268			1556						1467	
Intersection:	Delay		14.0	LOS		B+						

VOLKAN COSKUN THESIS 03/26/06
INT. 1426A - UEFA ANITI - OFF-PEAK 23:06:45
EXISTING

SIGNAL2000/TEAPAC[Ver 2.60.07] - HCM Back of Queue Worksheet

Queues in Worst Lanes	SB RT	SB TH	SB LT	WB RT	WB TH	WB LT	NB RT	NB TH	NB LT	EB RT	EB TH	EB LT
Lane group, LG		RT+TH+LT			RT+TH+LT						RT+TH	
Init queue, QbL		0			0						0	
Ln flow, vL		268			819						772	
Ln satflow, sL		1686			1688						1717	
Ln capacity, cL		326			1227						1095	
Flow ratio, yL		.159			.485						.450	
v/c ratio, XL		.822			.668						.705	
Effect green, g		17.4			65.4						57.4	
Grn ratio, g/C		.193			.727						.638	
Upstr filter, I		1.00			1.00						1.00	
Grn arrivals, P		.19			.73						.64	
Platn ratio, Rp		1.00			1.00						1.00	
Prog factr, PF2		1.00			1.00						1.00	
Queue (1st), Q1		6.4			10.9						12.7	
Queue factr, kB		.52			1.32						1.22	
Queue (2nd), Q2		1.9			2.5						2.7	
Avg queue, Q		8.3			13.4						15.4	
90% factor, fB		1.59			1.53						1.52	
90% queue, Qp		13.3			20.5						23.5	
Avg spacing, Lh		25.6			25.6						25.6	
Avail storg, La		0			0						0	
Avg distance		213			343						395	
Avg ratio, RQ		.00			.00						.00	
90% distance		340			526						602	
90% ratio, RQp		.00			.00						.00	

```
VOLKAN COSKUN THESIS                                                    03/26/06
INT. 1426A - UEFA ANITI - OFF-PEAK                                      23:06:45
EXISTING


SIGNAL2000/TEAPAC[Ver 2.60.07] - Capacity Analysis Summary

Intersection Averages for Int #  26 -
      Degree of Saturation (v/c) 0.70  Vehicle Delay  14.0  Level of Service B+

      -------------------------------------
Sq 12 |  Phase 1   |  Phase 2   |  Phase 3   |
**/** -------------------------------------
      | * * *      |        ^   |        ^   |
  .   | * * *      |        ++++|       ****|
 /|\  |<* * *>     |      <++++|      <****|
  |   |    v       |        ****|            |
  |   |            |        v   |            |
North |            |            |++++>       |
  |   |            |            |++++        |
      |            |            |   v        |
      -------------------------------------
      | G/C=0.189  | G/C=0.067  | G/C=0.644  |
      | G=  17.0"  | G=   6.0"  | G=  58.0"  |
      | Y+R= 4.0"  | Y+R= 2.0"  | Y+R= 3.0"  |
      | OFF= 0.0%  | OFF=23.3%  | OFF=32.2%  |
      -------------------------------------
      C= 90 sec   G= 81.0 sec = 90.0%  Y= 9.0 sec = 10.0%  Ped= 0.0 sec =  0.0%

--------------------------------------------------------------------------------
| Lane    |Width/|      g/C      | Service Rate| Adj |       | HCM  | L | Queue |
|  Group  | Lanes| Reqd   Used   | @D (vph) @E |Volume|  v/c | Delay | S |Model 1|
--------------------------------------------------------------------------------

SB Approach                                                      55.2    E+
================================================================================
|RT+TH+LT| 12/1 |0.194 |0.193 |  268 |  318 |  268 |0.822 |  55.2 |*E+| 340 ft|
--------------------------------------------------------------------------------

WB Approach                                                       8.1    A
================================================================================
|RT+TH+LT| 21/2 |0.471 |0.727 | 2331 | 2331 | 1556 |0.668 |   8.1 |*A | 526 ft|
--------------------------------------------------------------------------------

EB Approach                                                      12.8    B+
================================================================================
|RT+TH   | 23/2 |0.439 |0.638 | 2081 | 2081 | 1467 |0.705 |  12.8 | B+| 602 ft|
--------------------------------------------------------------------------------
```

```
VOLKAN COSKUN THESIS                                                    03/26/06
INT. 1115 - SILIVRIKAPI - OFF-PEAK                                      23:16:14
CYCLE LENGTH 51 - NEW COUNTS


SIGNAL2000/TEAPAC[Ver 2.60.07] - HCM Input Worksheet

Intersection # 115 - 1115 SILIVRIKAPI                  Area Location Type: NONCBD

              |      |      |      ||      |                 Key:  VOLUMES -- >
              |   50 |  848 |    0 ||      |                       |   WIDTHS
              |  0.0 | 21.3 |  0.0 ||      |                       v      LANES
              |    0 |    2 |    0 ||       --------------------
              |      |      |      ||    \   143   0.0  0
-------------    /      |     \           --------------------       .
                                        --   113  21.4  2            /|\
===================                       --------------------        |
       35   0.0  0  /         +        /   125   0.0  0                |
-------------------                       ===================       North
        0   8.2  1  --                                                 |
-------------------            \     |     /   -------------
       33   0.0  0  \     ||      |      |      |
--------------------      ||    0 |  710 |    0 |     Phasing:  SEQUENCE      17
                    |     ||  0.0 | 22.3 |  0.0 |               PERMSV   N N N N
                    |     ||    0 |    2 |    0 |               OVERLP   Y Y Y Y
                    |     ||      |      |      |               LEADLAG    LD LD


                           SB                 WB                 NB                 EB
                    RT     TH    LT    RT     TH    LT    RT     TH    LT    RT     TH    LT
===============   ==============    ==============   ==============    ==============
Heavy veh, %HV     4.0   4.7   .0    1.4    .0   .0     .0   5.8   .0    6.1    .0   .0
Pk-hr fact, PHF    .89   .89  .89    .89   .89  .89    .91   .91  .91    .94   .94  .94
Pretimed or Act      P     P    P      P     P    P      P     P    P      P     P    P
Strtup lost, l1    2.3   2.3  2.3    2.3   2.3  2.3    2.3   2.3  2.3    2.3   2.3  2.3
Ext eff grn, e     2.7   2.7  2.7     .7    .7   .7    2.7   2.7  2.7    2.2   2.2  2.2
Arrival typ, AT      3     3    3      3     3    3      3     3    3      3     3    3
---------------   --------------    --------------   --------------    --------------
Ped vol, vped             20                 20                 20                 20
Bike vol, vbic             0                  0                  0                  0
Parking locatns           NO                 NO                 NO                 NO
Park mnvrs, Nm             0                  0                  0                  0
Bus stops, NB              0                  0                  0                  0
Grade, %G               -4.7                 .7                2.1                 .0
===============   ==============    ==============   ==============    ==============

            -----------------------------------------------------------------------------------
Sq 17 |  Phase 1  |  Phase 2  |  Phase 3  |  Phase 4  |  Phase 5  |  Phase 6  |
**/** -----------------------------------------------------------------------------------
      | * *       |      ^    |           |           |           |           |
  .   | * *       |      ****|           |           |           |           |
 /|\  |<* *       |     <****|           |           |           |           |
  |   |   v       |      ****|   ^       |           |           |           |
  |   |       ^   |      v   |****       |           |           |           |
North |       +   |           |           |           |           |           |
  |   |       +   |           |****       |           |           |           |
      |       +   |n          |n  v       |           |           |           |
            -----------------------------------------------------------------------------------
C= 51"| G=  26.5" | G=  10.0" | G=   5.0" | G=   0.0" | G=   0.0" | G=   0.0" |
      | Y+R= 4.0" | Y+R= 2.0" | Y+R= 3.5" | Y+R= 0.0" | Y+R= 0.0" | Y+R= 0.0" |
            -----------------------------------------------------------------------------------
```

VOLKAN COSKUN THESIS 03/26/06
INT. 1115 - SILIVRIKAPI - OFF-PEAK 23:16:14
CYCLE LENGTH 51 - NEW COUNTS

SIGNAL2000/TEAPAC[Ver 2.60.07] - HCM Volume Adjust & Satflow Worksheet

Volume Adjustment	SB RT	SB TH	SB LT	WB RT	WB TH	WB LT	NB RT	NB TH	NB LT	EB RT	EB TH	EB LT
Volume, V	50	848	0	143	113	125	0	710	0	33	0	35
Pk-hr fact, PHF	.89	.89	.89	.89	.89	.89	.91	.91	.91	.94	.94	.94
Adj mv flow, vp	56	953	0	161	127	140	0	780	0	35	0	37
Lane group, LG		RT+TH			RT+TH+LT			TH			RT+TH+LT	
Adj LG flow, v		1009			428			780			72	
Prop LT, PLT		.000			.327			.000			.514	
Prop RT, PRT		.056			.376			.000			.486	

Saturation Flow Rate	SB RT	SB TH	SB LT	WB RT	WB TH	WB LT	NB RT	NB TH	NB LT	EB RT	EB TH	EB LT
Base satflo, so		1891			1891			1891			1891	
Number lanes, N		2			2			2			1	
Lane width, fW		.955			.957			.972			.873	
Heavy veh, fHV		.955			.995			.945			.971	
Grade, fg		1.023			.997			.989			1.000	
Parking, fp		1.000			1.000			1.000			1.000	
Bus block, fbb		1.000			1.000			1.000			1.000	
Area type, fa		1.000			1.000			1.000			1.000	
Lane util, fLU		.950			.950			.950			1.000	
Left-turn, fLT		1.000			.984			1.000			.975	
Right-turn, fRT		.992			.944			1.000			.934	
PedBike LT, fLpb		1.000			1.000			1.000			1.000	
PedBike RT, fRpb		.999			.988			1.000			.970	
Local adjustmnt		1.000			1.000			1.000			1.000	
Adj satflow, s		3325			3127			3265			1418	

SIGNAL2000/TEAPAC[Ver 2.60.07] - HCM Ped-Bike LT Effects Worksheet

Input/Calculation	SB	WB	NB	EB
Effective ped green time, gp	.0	5.0	.0	10.0
Conflicting ped volume, Vped	0	20	0	20
Ped flow rate, Vpedg	.000	204.000	.000	102.000
Avg. ped occupancy, OCCpedg	.000	.102	.000	.051
Opposing queue clear time, gq	.000	.000	.000	.000
Opposing queue g ratio, gq/gp	.000	.000	.000	.000
Ped occ after queue, OCCpedu	.000	.102	.000	.051
Opposing flow rate, Vo	0	0	0	0
Relevant occupancy, OCCr	.000	.102	.000	.051
# receiving lanes, Nrec	0	2	0	2
# turning lanes, Nturn	0	1	0	1
Adjustment factor, ApbT	.000	.939	.000	.969
Proportion left turns, PLT	.000	.327	.000	.514
Prop LT in prot phase, PLTA	.000	1.000	.000	1.000
Ped-bike adjust factor, fLpb	.000	1.000	.000	1.000

VOLKAN COSKUN THESIS 03/26/06
INT. 1115 - SILIVRIKAPI - OFF-PEAK 23:16:14
CYCLE LENGTH 51 - NEW COUNTS

SIGNAL2000/TEAPAC[Ver 2.60.07] - HCM Ped-Bike RT Effects Worksheet

Input/Calculation	SB	WB	NB	EB
Effective ped green time, gp	26.5	10.0	.0	5.0
Conflicting ped volume, Vped	20	20	0	20
Conflicting bike volume, Vbic	0	0	0	0
Ped flow rate, Vpedg	38.491	102.000	.000	204.000
Avg ped occupancy, OCCpedg	.019	.051	.000	.102
Effective bike green time, g	26.9	8.4	.0	4.9
Bike flow rate, Vbicg	.000	.000	.000	.000
Avg bike occupancy, OCCbicg	.000	.000	.000	.000
Relevant occupancy, OCCr	.019	.051	.000	.102
# receiving lanes, Nrec	2	2	0	2
# turning lanes, Nturn	1	1	0	1
Adjustment factor, ApbT	.988	.969	.000	.939
Proportion right turns, PR	.056	.376	.000	.486
Prop RT in prot phase, PRA	.000	.000	.000	.000
Ped-bike adjust factor, fRpb	.999	.988	.000	.970

SIGNAL2000/TEAPAC[Ver 2.60.07] - HCM Capacity and LOS Worksheet

Capacity Analysis	SB RT	SB TH	SB LT	WB RT	WB TH	WB LT	NB RT	NB TH	NB LT	EB RT	EB TH	EB LT
Lane group, LG		RT+TH			RT+TH+LT			TH			RT+TH+LT	
Adj Flow, v		1009			428			780			72	
Satflow, s		3325			3127			3265			1418	
Lost time, tL		3.6			3.6			3.6			3.6	
Effect green, g		26.9			8.4			26.9			4.9	
Grn ratio, g/C		.527			.165			.527			.096	
LG capacity, c		1754			515			1722			136	
v/c ratio, X		.575			.831			.453			.529	
Flow ratio, v/s		.303			.137			.239			.051	
Crit lane group		*			*						*	
Sum crit v/s,Yc		0.491		Total lost, L				10.8				
Crit v/c, Xc		.623										

VOLKAN COSKUN THESIS 03/26/06
INT. 1115 - SILIVRIKAPI - OFF-PEAK 23:16:14
CYCLE LENGTH 51 - NEW COUNTS

SIGNAL2000/TEAPAC[Ver 2.60.07] - HCM Capacity and LOS Worksheet

Delay and LOS	SB	WB	NB	EB
	RT TH LT	RT TH LT	RT TH LT	RT TH LT
Lane group, LG	RT+TH	RT+TH+LT	TH	RT+TH+LT
Adj Flow, v	1009	428	780	72
LG capacity, c	1754	515	1722	136
v/c ratio, X	.575	.831	.453	.529
Grn ratio, g/C	.527	.165	.527	.096
Unif delay, d1	8.2	20.6	7.5	22.0
Incr calib, k	.50	.50	.50	.50
Incr delay, d2	1.4	14.4	.9	14.0
Queue Delay, d3	.0	.0	.0	.0
Unif delay, d1*	.0	.0	.0	.0
Prog factor, PF	1.00	1.00	1.00	1.00
Contrl delay, d	9.6	35.1	8.3	35.9
Lane group LOS	A	D+	A	D+
Final Queue,Qbi	0	0	0	0
Appr delay, dA	9.6	35.1	8.3	35.9
Approach LOS	A	D+	A	D+
Appr flow, vA	1009	428	780	72
Intersection:	Delay 14.7	LOS B+		

VOLKAN COSKUN THESIS 03/26/06
INT. 1115 - SILIVRIKAPI - OFF-PEAK 23:16:14
CYCLE LENGTH 51 - NEW COUNTS

SIGNAL2000/TEAPAC[Ver 2.60.07] - HCM Back of Queue Worksheet

Queues in Worst Lanes	SB RT	SB TH	SB LT	WB RT	WB TH	WB LT	NB RT	NB TH	NB LT	EB RT	EB TH	EB LT
Lane group, LG		RT+TH			RT+TH+LT			TH			RT+TH+LT	
Init queue, QbL		0			0			0			0	
Ln flow, vL		531			225			411			72	
Ln satflow, sL		1750			1646			1718			1418	
Ln capacity, cL		923			271			906			136	
Flow ratio, yL		.303			.137			.239			.051	
v/c ratio, XL		.575			.831			.453			.529	
Effect green, g		26.9			8.4			26.9			4.9	
Grn ratio, g/C		.527			.165			.527			.096	
Upstr filter, I		1.00			1.00			1.00			1.00	
Grn arrivals, P		.53			.16			.53			.10	
Pltn ratio, Rp		1.00			1.00			1.00			1.00	
Prog factr, PF2		1.00			1.00			1.00			1.00	
Queue (1st), Q1		5.1			3.1			3.6			1.0	
Queue factr, kB		.73			.31			.72			.19	
Queue (2nd), Q2		1.0			1.2			.6			.2	
Avg queue, Q		6.1			4.3			4.2			1.2	
90% factor, fB		1.65			1.71			1.72			1.89	
90% queue, Qp		10.0			7.4			7.2			2.2	
Avg spacing, Lh		20.9			20.1			21.2			20.6	
Avail storg, La		0			0			0			0	
Avg distance		127			87			89			24	
Avg ratio, RQ		.00			.00			.00			.00	
90% distance		209			149			152			46	
90% ratio, RQp		.00			.00			.00			.00	

```
VOLKAN COSKUN THESIS                                                03/26/06
INT. 1115 - SILIVRIKAPI - OFF-PEAK                                  23:16:14
CYCLE LENGTH 51 - NEW COUNTS


SIGNAL2000/TEAPAC[Ver 2.60.07] - Capacity Analysis Summary

Intersection Averages for Int # 115 - 1115 SILIVRIKAPI
      Degree of Saturation (v/c) 0.58  Vehicle Delay  14.7  Level of Service B+

      -------------------------------------
Sq 17 |  Phase 1   |  Phase 2   |  Phase 3   |
**/** -------------------------------------
      | * *        |        ^   |            |
  .   | * *        |        ****|            |
 /|\  |<* *        |       <****|            |
  |   |   v        |        ****|    ^       |
  |   |       ^    |        v   |****        |
North |       +    |            |            |
  |   |       +    |            |****        |
      |       +    |m           |m  v        |
      -------------------------------------
      | G/C=0.520  | G/C=0.196  | G/C=0.098  |
      | G=   26.5" | G=   10.0" | G=    5.0" |
      | Y+R= 4.0"  | Y+R= 2.0"  | Y+R= 3.5"  |
      | OFF= 0.0%  | OFF=59.8%  | OFF=83.3%  |
      -------------------------------------
      C= 51 sec    G= 41.5 sec = 81.4%   Y= 9.5 sec = 18.6%   Ped= 0.0 sec =  0.0%

-------------------------------------------------------------------------------
| Lane    |Width/|      g/C      | Service Rate| Adj |       |  HCM  | L | Queue |
|  Group  | Lanes| Reqd   Used  | @C (vph) @E |Volume|  v/c  | Delay | S |Model 1|
-------------------------------------------------------------------------------

SB Approach                                                      9.6    A
===============================================================================
|RT+TH    | 21/2 |0.319 |0.527 | 1754 | 1754 | 1009 |0.575 |    9.6 |*A | 209 ft|
-------------------------------------------------------------------------------

NB Approach                                                      8.3    A
===============================================================================
|   TH    | 22/2 |0.260 |0.527 | 1722 | 1722 |  780 |0.453 |    8.3 | A | 152 ft|
-------------------------------------------------------------------------------

WB Approach                                                     35.1    D+
===============================================================================
|RT+TH+LT| 21/2 |0.165 |0.165 |  428 |  515 |  428 |0.831 |   35.1 |*D+| 149 ft|
-------------------------------------------------------------------------------

EB Approach                                                     35.9    D+
===============================================================================
|RT+TH+LT|  8/1 |0.098 |0.096 |   70 |  125 |   72 |0.529 |   35.9 |*D+|  46 ft|
-------------------------------------------------------------------------------
```

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VOLKAN COSKUN THESIS                                              03/26/06
INT. 1115 - SILIVRIKAPI - OFF-PEAK                                23:19:03
CYCLE LENGTH 82 - NEW COUNTS


SIGNAL2000/TEAPAC[Ver 2.60.07] - HCM Input Worksheet

Intersection # 115 - 1115 SILIVRIKAPI           Area Location Type: NONCBD

             |      |      |      ||      |                Key:  VOLUMES -- >
             |   58 |  794 |    0 ||      |                      |   WIDTHS
             |  0.0 | 21.3 |  0.0 ||      |                      v      LANES
             |    0 |    2 |    0 ||       --------------------
             |      |      |      ||     \  136   0.0  0
-------------    /     |      \          --------------------      . 
                                     --  98  21.4  2              /|\
===================                      --------------------      |
       34   0.0  0  /        +        /  127   0.0  0              |
-------------------                      ===================     North
        0   8.2  1  --                                             |
-------------------          \       |       /   -------------
       28   0.0  0  \    ||      |       |       |
--------------------     ||    0 |  728 |     0 |   Phasing:  SEQUENCE     17
                    |    ||  0.0 | 22.3 |   0.0 |             PERMSV   N N N N
                    |    ||    0 |    2 |     0 |             OVERLP   N N N N
                    |    ||      |       |       |             LEADLAG    LD LD


                          SB                WB                NB                EB
                    RT    TH    LT    RT    TH    LT    RT    TH    LT    RT    TH    LT
===============  ==============  ==============  ==============  ==============
Heavy veh, %HV     .0   3.5    .0   1.5   2.0    .0    .0   4.9    .0   7.1    .0    .0
Pk-hr fact, PHF   .97   .97   .97   .96   .96   .96   .99   .99   .99   .97   .97   .97
Pretimed or Act     P     P     P     P     P     P     P     P     P     P     P     P
Strtup lost, l1   2.3   2.3   2.3   2.3   2.3   2.3   2.3   2.3   2.3   2.3   2.3   2.3
Ext eff grn, e    2.7   2.7   2.7    .7    .7    .7   2.7   2.7   2.7   2.2   2.2   2.2
Arrival typ, AT     3     3     3     3     3     3     3     3     3     3     3     3
---------------  --------------  --------------  --------------  --------------
Ped vol, vped            20                20                20                20
Bike vol, vbic            0                 0                 0                 0
Parking locatns          NO                NO                NO                NO
Park mnvrs, Nm            0                 0                 0                 0
Bus stops, NB             0                 0                 0                 0
Grade, %G              -4.7                .7               2.1                .0
===============  ==============  ==============  ==============  ==============


      ------------------------------------------------------------------------------
Sq 17 |  Phase 1   |  Phase 2   |  Phase 3   |  Phase 4   |  Phase 5   |  Phase 6   |
**/** ------------------------------------------------------------------------------
      | * *        |       ^    |            |            |            |            |
   .  | * *        |       ****|            |            |            |            |
 /|\  |<* *        |      <****|            |            |            |            |
  |   |   v        |       ****|    ^       |            |            |            |
  |   |       ^    |       v    |****        |            |            |            |
North |       +    |            |            |            |            |            |
  |   |       +    |            |****        |            |            |            |
      |       +    |m           |m   v       |            |            |            |
      ------------------------------------------------------------------------------
C= 82"| G=  47.5"  | G=  18.0"  | G=   7.0"  | G=   0.0"  | G=   0.0"  | G=   0.0"  |
      | Y+R= 4.0"  | Y+R= 2.0"  | Y+R= 3.5"  | Y+R= 0.0"  | Y+R= 0.0"  | Y+R= 0.0"  |
      ------------------------------------------------------------------------------
```

VOLKAN COSKUN THESIS 03/26/06
INT. 1115 - SILIVRIKAPI - OFF-PEAK 23:19:03
CYCLE LENGTH 82 - NEW COUNTS

SIGNAL2000/TEAPAC[Ver 2.60.07] - HCM Volume Adjust & Satflow Worksheet

Volume Adjustment	SB RT	SB TH	SB LT	WB RT	WB TH	WB LT	NB RT	NB TH	NB LT	EB RT	EB TH	EB LT
Volume, V	58	794	0	136	98	127	0	728	0	28	0	34
Pk-hr fact, PHF	.97	.97	.97	.96	.96	.96	.99	.99	.99	.97	.97	.97
Adj mv flow, vp	60	819	0	142	102	132	0	735	0	29	0	35
Lane group, LG		RT+TH			RT+TH+LT			TH			RT+TH+LT	
Adj LG flow, v		879			376			735			64	
Prop LT, PLT		.000			.351			.000			.547	
Prop RT, PRT		.068			.378			.000			.453	

Saturation Flow Rate	SB RT	SB TH	SB LT	WB RT	WB TH	WB LT	NB RT	NB TH	NB LT	EB RT	EB TH	EB LT
Base satflo, so		1891			1891			1891			1891	
Number lanes, N		2			2			2			1	
Lane width, fW		.955			.957			.972			.873	
Heavy veh, fHV		.968			.989			.953			.969	
Grade, fg		1.023			.997			.989			1.000	
Parking, fp		1.000			1.000			1.000			1.000	
Bus block, fbb		1.000			1.000			1.000			1.000	
Area type, fa		1.000			1.000			1.000			1.000	
Lane util, fLU		.950			.950			.950			1.000	
Left-turn, fLT		1.000			.983			1.000			.973	
Right-turn, fRT		.990			.943			1.000			.939	
PedBike LT, fLpb		1.000			1.000			1.000			1.000	
PedBike RT, fRpb		.999			.990			1.000			.968	
Local adjustmnt		1.000			1.000			1.000			1.000	
Adj satflow, s		3364			3108			3293			1416	

SIGNAL2000/TEAPAC[Ver 2.60.07] - HCM Ped-Bike LT Effects Worksheet

Input/Calculation	SB	WB	NB	EB
Effective ped green time, gp	.0	7.0	.0	18.0
Conflicting ped volume, Vped	0	20	0	20
Ped flow rate, Vpedg	.000	234.286	.000	91.111
Avg. ped occupancy, OCCpedg	.000	.117	.000	.046
Opposing queue clear time, gq	.000	.000	.000	.000
Opposing queue g ratio, gq/gp	.000	.000	.000	.000
Ped occ after queue, OCCpedu	.000	.117	.000	.046
Opposing flow rate, Vo	0	0	0	0
Relevant occupancy, OCCr	.000	.117	.000	.046
# receiving lanes, Nrec	0	2	0	2
# turning lanes, Nturn	0	1	0	1
Adjustment factor, ApbT	.000	.930	.000	.973
Proportion left turns, PLT	.000	.351	.000	.547
Prop LT in prot phase, PLTA	.000	1.000	.000	1.000
Ped-bike adjust factor, fLpb	.000	1.000	.000	1.000

VOLKAN COSKUN THESIS 03/26/06
INT. 1115 - SILIVRIKAPI - OFF-PEAK 23:19:03
CYCLE LENGTH 82 - NEW COUNTS

SIGNAL2000/TEAPAC[Ver 2.60.07] - HCM Ped-Bike RT Effects Worksheet

Input/Calculation	SB	WB	NB	EB
Effective ped green time, gp	47.5	18.0	.0	7.0
Conflicting ped volume, Vped	20	20	0	20
Conflicting bike volume, Vbic	0	0	0	0
Ped flow rate, Vpedg	34.526	91.111	.000	234.286
Avg ped occupancy, OCCpedg	.017	.046	.000	.117
Effective bike green time, g	47.9	16.4	.0	6.9
Bike flow rate, Vbicg	.000	.000	.000	.000
Avg bike occupancy, OCCbicg	.000	.000	.000	.000
Relevant occupancy, OCCr	.017	.046	.000	.117
# receiving lanes, Nrec	2	2	0	2
# turning lanes, Nturn	1	1	0	1
Adjustment factor, ApbT	.990	.973	.000	.930
Proportion right turns, PR	.068	.378	.000	.453
Prop RT in prot phase, PRA	.000	.000	.000	.000
Ped-bike adjust factor, fRpb	.999	.990	.000	.968

SIGNAL2000/TEAPAC[Ver 2.60.07] - HCM Capacity and LOS Worksheet

Capacity	SB			WB			NB			EB		
Analysis	RT	TH	LT	RT	TH	LT	RT	TH	LT	RT	TH	LT
Lane group, LG	RT+TH			RT+TH+LT			TH			RT+TH+LT		
Adj Flow, v	879			376			735			64		
Satflow, s	3364			3108			3293			1416		
Lost time, tL	3.6			3.6			3.6			3.6		
Effect green, g	47.9			16.4			47.9			6.9		
Grn ratio, g/C	.584			.200			.584			.084		
LG capacity, c	1965			622			1924			119		
v/c ratio, X	.447			.605			.382			.538		
Flow ratio, v/s	.261			.121			.223			.045		
Crit lane group	*			*						*		
Sum crit v/s,Yc	0.427			Total lost, L			10.8					
Crit v/c, Xc	.492											

VOLKAN COSKUN THESIS 03/26/06
INT. 1115 - SILIVRIKAPI - OFF-PEAK 23:19:03
CYCLE LENGTH 82 - NEW COUNTS

SIGNAL2000/TEAPAC[Ver 2.60.07] - HCM Capacity and LOS Worksheet

Delay and LOS	SB RT	SB TH	SB LT	WB RT	WB TH	WB LT	NB RT	NB TH	NB LT	EB RT	EB TH	EB LT
Lane group, LG		RT+TH			RT+TH+LT			TH			RT+TH+LT	
Adj Flow, v		879			376			735			64	
LG capacity, c		1965			622			1924			119	
v/c ratio, X		.447			.605			.382			.538	
Grn ratio, g/C		.584			.200			.584			.084	
Unif delay, d1		9.6			29.8			9.1			36.0	
Incr calib, k		.50			.50			.50			.50	
Incr delay, d2		.7			4.3			.6			16.3	
Queue Delay, d3		.0			.0			.0			.0	
Unif delay, d1*		.0			.0			.0			.0	
Prog factor, PF		1.00			1.00			1.00			1.00	
Contrl delay, d		10.3			34.2			9.7			52.3	
Lane group LOS		B+			C			A			D	
Final Queue,Qbi		0			0			0			0	
Appr delay, dA		10.3			34.2			9.7			52.3	
Approach LOS		B+			C			A			D	
Appr flow, vA		879			376			735			64	

Intersection: Delay 15.8 LOS B

VOLKAN COSKUN THESIS 03/26/06
INT. 1115 - SILIVRIKAPI - OFF-PEAK 23:19:03
CYCLE LENGTH 82 - NEW COUNTS

SIGNAL2000/TEAPAC[Ver 2.60.07] - HCM Back of Queue Worksheet

Queues in Worst Lanes	SB RT	SB TH	SB LT	WB RT	WB TH	WB LT	NB RT	NB TH	NB LT	EB RT	EB TH	EB LT
Lane group, LG		RT+TH			RT+TH+LT			TH			RT+TH+LT	
Init queue, QbL		0			0			0			0	
Ln flow, vL		463			198			387			64	
Ln satflow, sL		1770			1636			1733			1416	
Ln capacity, cL		1034			327			1013			119	
Flow ratio, yL		.261			.121			.223			.045	
v/c ratio, XL		.447			.605			.382			.538	
Effect green, g		47.9			16.4			47.9			6.9	
Grn ratio, g/C		.584			.200			.584			.084	
Upstr filter, I		1.00			1.00			1.00			1.00	
Grn arrivals, P		.58			.20			.58			.08	
Platn ratio, Rp		1.00			1.00			1.00			1.00	
Prog factr, PF2		1.00			1.00			1.00			1.00	
Queue (1st), Q1		5.9			4.1			4.7			1.4	
Queue factr, kB		1.10			.49			1.08			.24	
Queue (2nd), Q2		.9			.7			.7			.3	
Avg queue, Q		6.8			4.8			5.4			1.7	
90% factor, fB		1.63			1.69			1.67			1.86	
90% queue, Qp		11.1			8.1			9.0			3.1	
Avg spacing, Lh		20.7			20.2			21.0			20.6	
Avail storg, La		0			0			0			0	
Avg distance		141			97			113			34	
Avg ratio, RQ		.00			.00			.00			.00	
90% distance		229			165			189			64	
90% ratio, RQp		.00			.00			.00			.00	

```
VOLKAN COSKUN THESIS                                                    03/26/06
INT. 1115 - SILIVRIKAPI - OFF-PEAK                                      23:19:03
CYCLE LENGTH 82 - NEW COUNTS


SIGNAL2000/TEAPAC[Ver 2.60.07] - Capacity Analysis Summary

Intersection Averages for Int # 115 - 1115 SILIVRIKAPI
      Degree of Saturation (v/c) 0.46  Vehicle Delay  15.8   Level of Service B

      ------------------------------------
Sq 17 |  Phase 1   |  Phase 2   |  Phase 3   |
**/** ------------------------------------
      | * *        |        ^   |            |
  .   | * *        |        ****|            |
 /|\  |<* *        |      <*****|            |
  |   |   v        |        ****|    ^       |
  |   |        ^   |        v   |****        |
North |        +   |            |            |
  |   |        +   |            |****        |
      |        +   |            |    v       |
      ------------------------------------
      | G/C=0.579  | G/C=0.220  | G/C=0.085  |
      | G=  47.5"  | G=  18.0"  | G=   7.0"  |
      | Y+R= 4.0"  | Y+R= 2.0"  | Y+R= 3.5"  |
      | OFF= 0.0%  | OFF=62.8%  | OFF=87.2%  |
      ------------------------------------
      C= 82 sec   G= 72.5 sec = 88.4%  Y= 9.5 sec = 11.6%  Ped= 0.0 sec =  0.0%

--------------------------------------------------------------------------------
| Lane    |Width/|     g/C     | Service Rate| Adj |       |  HCM  | L | Queue |
|  Group  | Lanes| Reqd   Used | @C (vph) @E |Volume|  v/c | Delay | S |Model 1|
--------------------------------------------------------------------------------

SB Approach                                                  10.3    B+
================================================================================
|RT+TH    | 21/2 |0.309 |0.584 | 1947 | 1965 |  879 |0.447 |  10.3 |*B+| 229 ft|
--------------------------------------------------------------------------------

NB Approach                                                   9.7    A
================================================================================
|   TH    | 22/2 |0.278 |0.584 | 1904 | 1924 |  735 |0.382 |   9.7 | A | 189 ft|
--------------------------------------------------------------------------------

WB Approach                                                  34.2    C
================================================================================
|RT+TH+LT| 21/2 |0.195 |0.200 |  397 |  622 |  376 |0.605 |  34.2 |*C | 165 ft|
--------------------------------------------------------------------------------

EB Approach                                                  52.3    D
================================================================================
|RT+TH+LT|  8/1 |0.147 |0.084 |    4 |   97 |   64 |0.538 |  52.3 |*D |  64 ft|
--------------------------------------------------------------------------------
```

```
VOLKAN COSKUN THESIS                                                  03/26/06
INT. 1115 - SILIVRIKAPI - OFF-PEAK                                    23:10:06
EXISTING


SIGNAL2000/TEAPAC[Ver 2.60.07] - HCM Input Worksheet

Intersection # 115 - 1115 SILIVRIKAPI               Area Location Type: NONCBD

           |    |    |    ||    |                    Key:  VOLUMES --> 
           |  50 |  874 |    0 ||    |                         |   WIDTHS
           | 0.0 | 21.3 |  0.0 ||    |                         v        LANES
           |    0 |     2 |    0 ||    ----------------
           |    |    |    ||    \   134   0.0  0                .
----------      /      |      \     ----------------           /|\
                              --   115  21.4  2                 |
--------------                     ----------------             |
     31   0.0  0  /         +      /  126   0.0  0            North
--------------                     ----------------             |
      0   8.2  1  --
--------------            \      |      /    ----------
     39   0.0  0  \    ||      |      |      |
---------------        ||    0 |  711 |    0 |    Phasing:  SEQUENCE     17
                |      ||  0.0 | 22.3 |  0.0 |              PERMSV  N N N N
                |      ||    0 |    2 |    0 |              OVERLP  Y Y Y Y
                |      ||      |      |      |              LEADLAG    LD LD


                          SB               WB               NB               EB
                    RT   TH   LT     RT   TH   LT     RT   TH   LT     RT   TH   LT
-----------------  --------------   --------------   --------------   --------------
Heavy veh, %HV     4.0  4.8   .0     .8   .9   .8     .0  4.8   .0    2.6   .0  6.5
Pk-hr fact, PHF    .89  .89  .89    .94  .94  .94    .87  .87  .87    .83  .83  .83
Pretimed or Act      P    P    P      P    P    P      P    P    P      P    P    P
Strtup lost, l1    2.3  2.3  2.3    2.3  2.3  2.3    2.3  2.3  2.3    2.3  2.3  2.3
Ext eff grn, e     3.0  3.0  3.0     .7   .7   .7    3.0  3.0  3.0    1.7  1.7  1.7
Arrival typ, AT      3    3    3      3    3    3      3    3    3      3    3    3
-----------------  --------------   --------------   --------------   --------------
Ped vol, vped            20               20               20               20
Bike vol, vbic            0                0                0                0
Parking locatns          NO               NO               NO               NO
Park mnvrs, Nm            0                0                0                0
Bus stops, NB             0                0                0                0
Grade, %G              -4.7               .7              2.1               .0
-----------------  --------------   --------------   --------------   --------------

      ---------------------------------------------------------------------------
Sq 17 |  Phase 1  |  Phase 2  |  Phase 3  |  Phase 4  |  Phase 5  |  Phase 6  |
**/** ---------------------------------------------------------------------------
      | * *       |      ^    |           |           |           |           |
  .   | * *       |      ****|           |           |           |           |
 /|\  |<* *       |     <****|           |           |           |           |
  |   |   v       |      ****|    ^      |           |           |           |
  |   |        ^  |      v   |****       |           |           |           |
North |        +  |          |           |           |           |           |
  |   |        +  |          |****       |           |           |           |
      |        +  |          |    v      |           |           |           |
      ---------------------------------------------------------------------------
C= 80"| G=  40.5" | G=  17.5" | G=  12.0" | G=   0.0" | G=   0.0" | G=   0.0" |
      | Y+R= 4.5" | Y+R= 2.0" | Y+R= 3.0" | Y+R= 0.0" | Y+R= 0.0" | Y+R= 0.0" |
      ---------------------------------------------------------------------------
```

VOLKAN COSKUN THESIS 03/26/06
INT. 1115 - SILIVRIKAPI - OFF-PEAK 23:10:06
EXISTING

SIGNAL2000/TEAPAC[Ver 2.60.07] - HCM Volume Adjust & Satflow Worksheet

Volume Adjustment	SB RT	SB TH	SB LT	WB RT	WB TH	WB LT	NB RT	NB TH	NB LT	EB RT	EB TH	EB LT
Volume, V	50	874	0	134	115	126	0	711	0	39	0	31
Pk-hr fact, PHF	.89	.89	.89	.94	.94	.94	.87	.87	.87	.83	.83	.83
Adj mv flow, vp	56	982	0	143	122	134	0	817	0	47	0	37
Lane group, LG		RT+TH			RT+TH+LT			TH			RT+TH+LT	
Adj LG flow, v		1038			399			817			84	
Prop LT, PLT		.000			.336			.000			.440	
Prop RT, PRT		.054			.358			.000			.560	

Saturation Flow Rate	SB RT	SB TH	SB LT	WB RT	WB TH	WB LT	NB RT	NB TH	NB LT	EB RT	EB TH	EB LT
Base satflo, so		1891			1891			1891			1891	
Number lanes, N		2			2			2			1	
Lane width, fW		.955			.957			.972			.873	
Heavy veh, fHV		.955			.992			.954			.959	
Grade, fg		1.023			.997			.989			1.000	
Parking, fp		1.000			1.000			1.000			1.000	
Bus block, fbb		1.000			1.000			1.000			1.000	
Area type, fa		1.000			1.000			1.000			1.000	
Lane util, fLU		.950			.950			.950			1.000	
Left-turn, fLT		1.000			.983			1.000			.978	
Right-turn, fRT		.992			.946			1.000			.924	
PedBike LT, fLpb		1.000			1.000			1.000			1.000	
PedBike RT, fRpb		.999			.990			1.000			.978	
Local adjustmnt		1.000			1.000			1.000			1.000	
Adj satflow, s		3323			3130			3296			1400	

SIGNAL2000/TEAPAC[Ver 2.60.07] - HCM Ped-Bike LT Effects Worksheet

Input/Calculation	SB	WB	NB	EB
Effective ped green time, gp	.0	12.0	.0	17.5
Conflicting ped volume, Vped	0	20	0	20
Ped flow rate, Vpedg	.000	133.333	.000	91.429
Avg. ped occupancy, OCCpedg	.000	.067	.000	.046
Opposing queue clear time, gq	.000	.000	.000	.000
Opposing queue g ratio, gq/gp	.000	.000	.000	.000
Ped occ after queue, OCCpedu	.000	.067	.000	.046
Opposing flow rate, Vo	0	0	0	0
Relevant occupancy, OCCr	.000	.067	.000	.046
# receiving lanes, Nrec	0	2	0	2
# turning lanes, Nturn	0	1	0	1
Adjustment factor, ApbT	.000	.960	.000	.973
Proportion left turns, PLT	.000	.336	.000	.440
Prop LT in prot phase, PLTA	.000	1.000	.000	1.000
Ped-bike adjust factor, fLpb	.000	1.000	.000	1.000

VOLKAN COSKUN THESIS 03/26/06
INT. 1115 - SILIVRIKAPI - OFF-PEAK 23:10:06
EXISTING

SIGNAL2000/TEAPAC[Ver 2.60.07] - HCM Ped-Bike RT Effects Worksheet

Input/Calculation	SB	WB	NB	EB
Effective ped green time, gp	40.5	17.5	.0	12.0
Conflicting ped volume, Vped	20	20	0	20
Conflicting bike volume, Vbic	0	0	0	0
Ped flow rate, Vpedg	39.506	91.429	.000	133.333
Avg ped occupancy, OCCpedg	.020	.046	.000	.067
Effective bike green time, g	41.2	15.9	.0	11.4
Bike flow rate, Vbicg	.000	.000	.000	.000
Avg bike occupancy, OCCbicg	.000	.000	.000	.000
Relevant occupancy, OCCr	.020	.046	.000	.067
# receiving lanes, Nrec	2	2	0	2
# turning lanes, Nturn	1	1	0	1
Adjustment factor, ApbT	.988	.973	.000	.960
Proportion right turns, PR	.054	.358	.000	.560
Prop RT in prot phase, PRA	.000	.000	.000	.000
Ped-bike adjust factor, fRpb	.999	.990	.000	.978

SIGNAL2000/TEAPAC[Ver 2.60.07] - HCM Capacity and LOS Worksheet

Capacity	SB			WB			NB			EB		
Analysis	RT	TH	LT	RT	TH	LT	RT	TH	LT	RT	TH	LT
Lane group, LG		RT+TH			RT+TH+LT			TH			RT+TH+LT	
Adj Flow, v		1038			399			817			84	
Satflow, s		3323			3130			3296			1400	
Lost time, tL		3.8			3.6			3.8			3.6	
Effect green, g		41.2			15.9			41.2			11.4	
Grn ratio, g/C		.515			.199			.515			.142	
LG capacity, c		1711			622			1698			199	
v/c ratio, X		.607			.641			.481			.422	
Flow ratio, v/s		.312			.127			.248			.060	
Crit lane group		*			*						*	

Sum crit v/s,Yc	0.500	Total lost, L	11.0
Crit v/c, Xc	.580		

VOLKAN COSKUN THESIS 03/26/06
INT. 1115 - SILIVRIKAPI - OFF-PEAK 23:10:06
EXISTING

SIGNAL2000/TEAPAC[Ver 2.60.07] - HCM Capacity and LOS Worksheet

Delay and LOS	SB RT	SB TH	SB LT	WB RT	WB TH	WB LT	NB RT	NB TH	NB LT	EB RT	EB TH	EB LT
Lane group, LG		RT+TH			RT+TH+LT			TH			RT+TH+LT	
Adj Flow, v		1038			399			817			84	
LG capacity, c		1711			622			1698			199	
v/c ratio, X		.607			.641			.481			.422	
Grn ratio, g/C		.515			.199			.515			.142	
Unif delay, d1		13.7			29.4			12.5			31.3	
Incr calib, k		.50			.50			.50			.50	
Incr delay, d2		1.6			5.0			1.0			6.4	
Queue Delay, d3		.0			.0			.0			.0	
Unif delay, d1*		.0			.0			.0			.0	
Prog factor, PF		1.00			1.00			1.00			1.00	
Contrl delay, d		15.3			34.5			13.5			37.7	
Lane group LOS		B			C			B+			D+	
Final Queue,Qbi		0			0			0			0	
Appr delay, dA		15.3			34.5			13.5			37.7	
Approach LOS		B			C			B+			D+	
Appr flow, vA		1038			399			817			84	

Intersection: Delay 18.7 LOS B

VOLKAN COSKUN THESIS 03/26/06
INT. 1115 - SILIVRIKAPI - OFF-PEAK 23:10:06
EXISTING

SIGNAL2000/TEAPAC[Ver 2.60.07] - HCM Back of Queue Worksheet

Queues in Worst Lanes	SB (RT TH LT)	WB (RT TH LT)	NB (RT TH LT)	EB (RT TH LT)
Lane group, LG	RT+TH	RT+TH+LT	TH	RT+TH+LT
Init queue, QbL	0	0	0	0
Ln flow, vL	546	210	430	84
Ln satflow, sL	1749	1647	1735	1400
Ln capacity, cL	901	327	894	199
Flow ratio, yL	.312	.127	.248	.060
v/c ratio, XL	.607	.641	.481	.422
Effect green, g	41.2	15.9	41.2	11.4
Grn ratio, g/C	.515	.199	.515	.142
Upstr filter, I	1.00	1.00	1.00	1.00
Grn arrivals, P	.51	.20	.51	.14
Platn ratio, Rp	1.00	1.00	1.00	1.00
Prog factr, PF2	1.00	1.00	1.00	1.00
Queue (1st), Q1	8.6	4.3	6.2	1.7
Queue factr, kB	.98	.48	.97	.34
Queue (2nd), Q2	1.5	.8	.9	.2
Avg queue, Q	10.0	5.1	7.0	1.9
90% factor, fB	1.57	1.68	1.62	1.84
90% queue, Qp	15.7	8.6	11.4	3.6
Avg spacing, Lh	25.7	25.1	25.7	25.6
Avail storg, La	0	0	0	0
Avg distance	258	128	181	50
Avg ratio, RQ	.00	.00	.00	.00
90% distance	404	215	294	92
90% ratio, RQp	.00	.00	.00	.00

```
VOLKAN COSKUN THESIS                                                    03/26/06
INT. 1115 - SILIVRIKAPI - OFF-PEAK                                      23:10:06
EXISTING


SIGNAL2000/TEAPAC[Ver 2.60.07] - Capacity Analysis Summary

Intersection Averages for Int # 115 - 1115 SILIVRIKAPI
      Degree of Saturation (v/c) 0.56  Vehicle Delay  18.7   Level of Service B

      -------------------------------------
Sq 17 |  Phase 1  |  Phase 2  |  Phase 3  |
**/** -------------------------------------
      | * *       |       ^   |           |
  .   | * *       |       ****|           |
 /|\  |<* *       |      <****|           |
  |   |   v       |       ****|   ^       |
  |   |       ^   |       v   |****       |
North |       +   |           |           |
  |   |       +   |           |****       |
      |       +   |           |   v       |
      -------------------------------------
      | G/C=0.506 | G/C=0.219 | G/C=0.150 |
      | G=  40.5" | G=  17.5" | G=  12.0" |
      | Y+R= 4.5" | Y+R= 2.0" | Y+R= 3.0" |
      | OFF=99.4% | OFF=56.3% | OFF=80.6% |
      -------------------------------------
      C= 80 sec   G= 70.0 sec = 87.5%  Y= 9.5 sec = 11.9%  Ped= 0.0 sec =  0.0%

--------------------------------------------------------------------------------
| Lane   |Width/|     g/C     | Service Rate| Adj |       |  HCM  | L | Queue |
|  Group | Lanes| Reqd   Used | @C (vph) @E |Volume|  v/c | Delay | S |Model 1|
--------------------------------------------------------------------------------

SB Approach                                                     15.3   B
================================================================================
|RT+TH   | 21/2 |0.350 |0.515 | 1665 | 1711 | 1038 |0.607 |  15.3 |*B | 404 ft|
--------------------------------------------------------------------------------

NB Approach                                                     13.5   B+
================================================================================
|   TH   | 22/2 |0.295 |0.515 | 1651 | 1698 |  817 |0.481 |  13.5 | B+| 294 ft|
--------------------------------------------------------------------------------

WB Approach                                                     34.5   C
================================================================================
|RT+TH+LT| 21/2 |0.195 |0.199 |  411 |  622 |  399 |0.641 |  34.5 |*C | 215 ft|
--------------------------------------------------------------------------------

EB Approach                                                     37.7   D+
================================================================================
|RT+TH+LT|  8/1 |0.158 |0.142 |   64 |  184 |   84 |0.422 |  37.7 |*D+|  92 ft|
--------------------------------------------------------------------------------
```

```
VOLKAN COSKUN THESIS                                                 05/17/06
INT 2204 - DOLMABAHCE - PM PEAK                                      12:59:14
EXISTING


SIGNAL2000/TEAPAC[Ver 2.60.07] - HCM Input Worksheet

Intersection # 204 -                                   Area Location Type:    CBD

          |    |    | 2102 ||    |                    Key:  VOLUMES -- >
          |  0 |  0 |      ||    |                          |  WIDTHS
          | 0.0| 0.0| 28.2 ||    |                          v      LANES
          |  0 |  0 |    3 ||    -----------------
          |    |    |      ||  \    0   0.0   0              .
---------      /    |    \        -----------------          /|\
                                --   910  21.0   2            |
--------------                    -----------------           |
      0   0.0   0  /       +       /    0   0.0   0          North
--------------                    =================           |
    1976  35.5  3  --
--------------             \     |     /    ----------
      0   0.0   0  \    ||    |    |    |
------------------      ||   0 |   0 |   0 |     Phasing:  SEQUENCE     11
               |        || 0.0 | 0.0 | 0.0 |               PERMSV   N N N N
               |        ||   0 |   0 |   0 |               OVERLP   Y Y Y Y
               |        ||     |     |     |               LEADLAG    LD LD

                          SB              WB              NB              EB
                     RT   TH   LT    RT   TH   LT    RT   TH   LT    RT   TH   LT
---------------    --------------  --------------  --------------  --------------
Heavy veh, %HV      6.1   .0  3.6    .0  6.4   .0    .0   .0   .0    .0  5.6   .0
Pk-hr fact, PHF     .90  .90  .90   .96  .96  .96   .90  .90  .90   .82  .82  .82
Pretimed or Act       P    P    P     P    P    P     P    P    P     P    P    P
Strtup lost, l1     2.3  2.3  2.3   2.3  2.3  2.3   2.3  2.3  2.3   2.3  2.3  2.3
Ext eff grn, e      2.7  2.7  2.7   2.7  2.7  2.7   2.7  2.7  2.7   2.7  2.7  2.7
Arrival typ, AT       3    3    3     3    3    3     3    3    3     3    3    3
---------------    --------------  --------------  --------------  --------------
Ped vol, vped              0               0               0               0
Bike vol, vbic             0               0               0               0
Parking locatns           NO              NO              NO              NO
Park mnvrs, Nm             0               0               0               0
Bus stops, NB              0               0               0               0
Grade, %G              -10.0              .0              .0              .0
---------------    --------------  --------------  --------------  --------------

        -------------------------------------------------------------------------
Sq 11 |  Phase 1  |  Phase 2  |  Phase 3  |  Phase 4  |  Phase 5  |  Phase 6  |
**/** -------------------------------------------------------------------------
      |     +     |           |           |           |           |           |
  .   |     +     |           |           |           |           |           |
 /|\  |     +>    |     <++++|           |           |           |           |
  |   |           |           |           |           |           |           |
  |   |           |           |           |           |           |           |
North |           |++++>      |           |           |           |           |
  |   |           |           |           |           |           |           |
      |           |           |           |           |           |           |
        -------------------------------------------------------------------------
C=114"| G=  58.0" | G=  48.0" | G=   0.0" | G=   0.0" | G=   0.0" | G=   0.0" |
      | Y+R= 4.0" | Y+R= 4.0" | Y+R= 0.0" | Y+R= 0.0" | Y+R= 0.0" | Y+R= 0.0" |
        -------------------------------------------------------------------------
```

VOLKAN COSKUN THESIS 05/17/06
INT 2204 - DOLMABAHCE - PM PEAK 12:59:14
EXISTING

SIGNAL2000/TEAPAC[Ver 2.60.07] - HCM Volume Adjust & Satflow Worksheet

Volume		SB			WB			NB			EB	
Adjustment	RT	TH	LT	RT	TH	LT	RT	TH	LT	RT	TH	LT
Volume, V	0	0	2102	0	910	0	0	0	0	0	1976	0
Pk-hr fact, PHF	.90	.90	.90	.96	.96	.96	.00	.00	.00	.82	.82	.82
Adj mv flow, vp	0	0	2336	0	948	0	0	0	0	0	2410	0
Lane group, LG			LT		TH						TH	
Adj LG flow, v			2336		948						2410	
Prop LT, PLT			1.000		.000						.000	
Prop RT, PRT			.000		.000						.000	

Saturation		SB			WB			NB			EB	
Flow Rate	RT	TH	LT	RT	TH	LT	RT	TH	LT	RT	TH	LT
Base satflo, so			1891		1891						1891	
Number lanes, N			3		2						3	
Lane width, fW			.913		.950						.994	
Heavy veh, fHV			.965		.940						.947	
Grade, fg			1.030		1.000						1.000	
Parking, fp			1.000		1.000						1.000	
Bus block, fbb			1.000		1.000						1.000	
Area type, fa			.900		.900						.900	
Lane util, fLU			.970		.950						.910	
Left-turn, fLT			.950		1.000						1.000	
Right-turn, fRT			1.000		1.000						1.000	
PedBike LT,fLpb			1.000		1.000						1.000	
PedBike RT,fRpb			1.000		1.000						1.000	
Local adjustmnt			1.000		1.000						1.000	
Adj satflow, s			4271		2888						4377	

SIGNAL2000/TEAPAC[Ver 2.60.07] - HCM Capacity and LOS Worksheet

Capacity		SB			WB			NB			EB	
Analysis	RT	TH	LT	RT	TH	LT	RT	TH	LT	RT	TH	LT
Lane group, LG			LT		TH						TH	
Adj Flow, v			2336		948						2410	
Satflow, s			4271		2888						4377	
Lost time, tL			3.6		3.6						3.6	
Effect green, g			58.4		48.4						48.4	
Grn ratio, g/C			.512		.425						.425	
LG capacity, c			2188		1226						1858	
v/c ratio, X			1.068		.773						1.297	
Flow ratio, v/s			.547		.328						.551	
Crit lane group			*								*	

Sum crit v/s,Yc	1.098	Total lost, L	7.2
Crit v/c, Xc	1.172		

VOLKAN COSKUN THESIS 05/17/06
INT 2204 - DOLMABAHCE - PM PEAK 12:59:14
EXISTING

SIGNAL2000/TEAPAC[Ver 2.60.07] - HCM Capacity and LOS Worksheet

Delay and LOS	SB RT	SB TH	SB LT	WB RT	WB TH	WB LT	NB RT	NB TH	NB LT	EB RT	EB TH	EB LT
Lane group, LG			LT		TH						TH	
Adj Flow, v			2336		948						2410	
LG capacity, c			2188		1226						1858	
v/c ratio, X			1.068		.773						1.297	
Grn ratio, g/C			.512		.425						.425	
Unif delay, d1			27.8		28.1						32.8	
Incr calib, k			.50		.50						.50	
Incr delay, d2			40.3		4.8						137.8	
Queue Delay, d3			54.3		.0						.0	
Unif delay, d1*			.0		.0						.0	
Prog factor, PF			1.00		1.00						1.00	
Contrl delay, d			122.4		32.9						170.6	
Lane group LOS			F		C						F	
Final Queue,Qbi			70		0						138	
Appr delay, dA		122.4			32.9						170.6	
Approach LOS		F			C						F	
Appr flow, vA		2336			948						2410	
Intersection:	Delay		127.9	LOS		F						

SIGNAL2000/TEAPAC[Ver 2.60.07] - HCM Initial Queue Delay Worksheet

Durat, T 0.25 h / Cycle, C 114 s	SB RT	SB TH	SB LT	WB RT	WB TH	WB LT	NB RT	NB TH	NB LT	EB RT	EB TH	EB LT
Lane group, LG			LT		TH						TH	
Init queue, Qb			33		0						0	
Grn ratio, g/C			.512		.425						.425	
v/c ratio, X			1.07		.77						1.30	
Adj capacity, c			2188		1226						1858	
Durtn unmet, t			.25		.00						.00	
Case number, i			5		1						2	
Delay param, u			1.00		.00						.00	
Queue delay, d3			54.3		.0						.0	
Unif delay, d1*			27.8		.0						.0	
Last depart, Tc			.28		.00						.00	
Final queue,Qbi			70		0						138	

VOLKAN COSKUN THESIS 05/17/06
INT 2204 - DOLMABAHCE - DM PEAK 12:59:14
EXISTING

SIGNAL2000/TEAPAC[Ver 2.60.07] - HCM Back of Queue Worksheet

Queues in Worst Lanes	SB RT	SB TH	SB LT	WB RT	WB TH	WB LT	NB RT	NB TH	NB LT	EB RT	EB TH	EB LT
Lane group, LG			LT		TH						TH	
Init queue, QbL			11		0						0	
Ln flow, vL			848		499						883	
Ln satflow, sL			1468		1520						1603	
Ln capacity, cL			752		645						681	
Flow ratio, yL			.578		.328						.551	
v/c ratio, XL			1.128		.773						1.297	
Effect green, g			58.4		48.4						48.4	
Grn ratio, g/C			.512		.425						.425	
Upstr filter, I			1.00		1.00						1.00	
Grn arrivals, P			.51		.42						.42	
Platn ratio, Rp			1.00		1.00						1.00	
Prog factr, PF2			1.00		1.00						1.00	
Queue (1st), Q1			26.9		13.5						28.0	
Queue factr, kB			1.10		.99						1.03	
Queue (2nd), Q2			23.0		2.9						29.2	
Avg queue, Q			49.9		16.5						57.1	
90% factor, fB			1.50		1.52						1.50	
90% queue, Qp			74.9		25.0						85.7	
Avg spacing, Lh			25.5		26.0						25.8	
Avail storg, La			0		0						0	
Avg distance			1275		427						1476	
Avg ratio, RQ			.00		.00						.00	
90% distance			1912		649						2214	
90% ratio, RQp			.00		.00						.00	

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VOLKAN COSKUN THESIS                                                05/17/06
INT 2204 - DOLMABAHCE - PM PEAK                                     12:59:14
EXISTING


SIGNAL2000/TEAPAC[Ver 2.60.07] - Evaluation of Intersection Performance

Intersection # 204 -

        ------------------------
Sq 11 |  Phase 1  |  Phase 2  |
**/** ------------------------
        |     +     |           |
   .    |     +     |           |
 /|\    |     +>    |      <++++|
  |     |           |           |
  |     |           |           |
North   |           |++++>      |
  |     |           |           |
        |           |           |
        ------------------------
        | G/C=0.509 | G/C=0.421 |
        | G=  58.0" | G=  48.0" |
        | Y+R= 4.0" | Y+R= 4.0" |
        | OFF= 0.0% | OFF=54.4% |
        ------------------------
        C=114 sec   G=106.0 sec = 93.0%  Y= 8.0 sec =  7.0%  Ped= 0.0 sec =  0.0%

MVMT TOTALS    SB Approach     WB Approach     NB Approach     EB Approach    Int
Param:Units    RT   TH   LT    RT   TH   LT    RT   TH   LT    RT   TH   LT  Total
-----------  --------------- --------------- --------------- --------------- -----
AdjVol: vph     0     0 2336     0   948    0     0     0    0     0 2410    0  5694
Wid/Ln:ft/#   0/0   0/0 28/3   0/0 21/2   0/0   0/0   0/0  0/0   0/0 36/3   0/0
g/C Rqd@C:%     0     0   62     0    41    0     0     0    0     0   57    0
g/C Used: %     0     0   51     0    42    0     0     0    0     0   42    0
SV @E:  vph     0     0 2116     0  1226    0     0     0    0     0 1858    0  5200
-----------  --------------- --------------- --------------- --------------- -----
Svc Lvl:LOS                F          C                                  F        F
Deg Sat:v/c  0.00  0.00 1.07  0.00  0.77 0.00  0.00  0.00 0.00  0.00 1.30 0.00  1.12
HCM Del:s/v    0.0   0.0122.4   0.0  32.9   0.0   0.0   0.0   0.0   0.0170.6   0.0 127.9
Tot Del:min     0     0 1191     0   130    0     0     0    0     0 1713    0  3034
# Stops:veh     0     0  584     0   203    0     0     0    0     0  602    0  1389
-----------  --------------- --------------- --------------- --------------- -----
Queue 1:veh     0     0   75     0    25    0     0     0    0     0   86    0    86
Queue 1: ft     0     0 1912     0   649    0     0     0    0     0 2214    0  2214
-----------  --------------- --------------- --------------- --------------- -----
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VOLKAN COSKUN THESIS 05/17/06
INT 2204 - DOLMABAHCE - PM PEAK 12:59:14
EXISTING

SIGNAL2000/TEAPAC[Ver 2.60.07] - Evaluation of Intersection Performance

APPR TOTALS Param:Units	SB Approach	WB Approach	NB Approach	EB Approach	Int Total
AdjVol: vph	2336	948	0	2410	5694
Svc Lvl:LOS	F	C		F	F
Deg Sat:v/c	1.07	0.77	0.00	1.30	1.12
HCM Del:s/v	122.4	32.9	0.0	170.6	127.9
Tot Del:min	1191	130	0	1713	3034
# Stops:veh	584	203	0	602	1389
Queue 1:veh	75	25	0	86	86
Queue 1: ft	1912	649	0	2214	2214

APPENDIX C: OUTPUTS OF THE SYNCHRO HCM ANALYSIS

1109 – Sarayburnu Intersection – AM Peak, Existing

HCM Signalized Intersection Capacity Analysis
3: Int 09.04.2006

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Ideal Flow (vphpl)	1891	1891	1891	1891	1891	1891
Lane Width	3.0	3.6	3.6	3.0	3.3	3.6
Grade (%)	0%			4%	-8%	
Total Lost time (s)	3.6			3.6	3.6	
Lane Util. Factor	0.95			0.95	0.97	
Frt	0.96			1.00	0.99	
Flt Protected	1.00			1.00	0.96	
Satd. Flow (prot)	3018			3222	2943	
Flt Permitted	1.00			1.00	0.96	
Satd. Flow (perm)	3018			3222	2943	
Volume (vph)	418	169	0	1503	108	8
Peak-hour factor, PHF	0.92	0.92	0.90	0.90	0.73	0.73
Adj. Flow (vph)	454	184	0	1670	148	11
RTOR Reduction (vph)	55	0	0	0	7	0
Lane Group Flow (vph)	583	0	0	1670	152	0
Heavy Vehicles (%)	4%	12%	0%	2%	18%	25%
Turn Type						
Protected Phases	2			2	1	
Permitted Phases						
Actuated Green, G (s)	52.0			52.0	16.0	
Effective Green, g (s)	52.4			52.4	15.4	
Actuated g/C Ratio	0.70			0.70	0.21	
Clearance Time (s)	4.0			4.0	3.0	
Lane Grp Cap (vph)	2109			2251	604	
v/s Ratio Prot	0.19			c0.52	c0.05	
v/s Ratio Perm						
v/c Ratio	0.28			0.74	0.25	
Uniform Delay, d1	4.2			7.1	25.0	
Progression Factor	1.00			1.00	1.00	
Incremental Delay, d2	0.3			2.3	1.0	
Delay (s)	4.5			9.3	26.0	
Level of Service	A			A	C	
Approach Delay (s)	4.5			9.3	26.0	
Approach LOS	A			A	C	

Intersection Summary			
HCM Average Control Delay	9.2	HCM Level of Service	A
HCM Volume to Capacity ratio	0.63		
Actuated Cycle Length (s)	75.0	Sum of lost time (s)	7.2
Intersection Capacity Utilization	51.8%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Baseline Synchro 6 Report
ISBAK INC. Page 1

1109 – Sarayburnu Intersection – AM Peak, Optimum

HCM Signalized Intersection Capacity Analysis
3: Int 09.04.2006

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Ideal Flow (vphpl)	1891	1891	1891	1891	1891	1891
Lane Width	3.0	3.6	3.6	3.0	3.3	3.6
Grade (%)	0%			4%	-8%	
Total Lost time (s)	3.6			3.6	3.6	
Lane Util. Factor	0.95			0.95	0.97	
Frt	0.96			1.00	0.99	
Flt Protected	1.00			1.00	0.96	
Satd. Flow (prot)	3018			3222	2943	
Flt Permitted	1.00			1.00	0.96	
Satd. Flow (perm)	3018			3222	2943	
Volume (vph)	418	169	0	1503	108	8
Peak-hour factor, PHF	0.92	0.92	0.90	0.90	0.73	0.73
Adj. Flow (vph)	454	184	0	1670	148	11
RTOR Reduction (vph)	48	0	0	0	8	0
Lane Group Flow (vph)	590	0	0	1670	151	0
Heavy Vehicles (%)	4%	12%	0%	2%	18%	25%
Turn Type						
Protected Phases	2			2	1	
Permitted Phases						
Actuated Green, G (s)	55.0			55.0	13.0	
Effective Green, g (s)	55.4			55.4	12.4	
Actuated g/C Ratio	0.74			0.74	0.17	
Clearance Time (s)	4.0			4.0	3.0	
Lane Grp Cap (vph)	2229			2380	487	
v/s Ratio Prot	0.20			c0.52	c0.05	
v/s Ratio Perm						
v/c Ratio	0.26			0.70	0.31	
Uniform Delay, d1	3.2			5.3	27.5	
Progression Factor	1.00			1.00	1.00	
Incremental Delay, d2	0.3			1.8	1.7	
Delay (s)	3.5			7.1	29.2	
Level of Service	A			A	C	
Approach Delay (s)	3.5			7.1	29.2	
Approach LOS	A			A	C	

Intersection Summary			
HCM Average Control Delay	7.6	HCM Level of Service	A
HCM Volume to Capacity ratio	0.63		
Actuated Cycle Length (s)	75.0	Sum of lost time (s)	7.2
Intersection Capacity Utilization	51.8%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

1109 – Sarayburnu Intersection – PM Peak, Existing

HCM Signalized Intersection Capacity Analysis

3: Int 09.04.2006

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Ideal Flow (vphpl)	1891	1891	1891	1891	1891	1891
Lane Width	3.0	3.6	3.6	3.0	3.3	3.6
Grade (%)	0%			4%	-8%	
Total Lost time (s)	3.6			3.6	3.6	
Lane Util. Factor	0.95			0.95	0.97	
Frt	0.99			1.00	0.99	
Flt Protected	1.00			1.00	0.96	
Satd. Flow (prot)	3271			3254	3433	
Flt Permitted	1.00			1.00	0.96	
Satd. Flow (perm)	3271			3254	3433	
Volume (vph)	1473	134	0	859	216	21
Peak-hour factor, PHF	0.87	0.87	0.96	0.96	0.85	0.85
Adj. Flow (vph)	1693	154	0	895	254	25
RTOR Reduction (vph)	8	0	0	0	9	0
Lane Group Flow (vph)	1839	0	0	895	270	0
Heavy Vehicles (%)	1%	4%	0%	1%	1%	5%
Turn Type						
Protected Phases	2			2	1	
Permitted Phases						
Actuated Green, G (s)	60.0			60.0	16.0	
Effective Green, g (s)	60.4			60.4	15.4	
Actuated g/C Ratio	0.73			0.73	0.19	
Clearance Time (s)	4.0			4.0	3.0	
Lane Grp Cap (vph)	2380			2368	637	
v/s Ratio Prot	c0.56			0.28	c0.08	
v/s Ratio Perm						
v/c Ratio	0.77			0.38	0.42	
Uniform Delay, d1	7.0			4.2	29.9	
Progression Factor	1.00			1.00	1.00	
Incremental Delay, d2	2.5			0.5	2.1	
Delay (s)	9.5			4.7	31.9	
Level of Service	A			A	C	
Approach Delay (s)	9.5			4.7	31.9	
Approach LOS	A			A	C	

Intersection Summary			
HCM Average Control Delay	10.2	HCM Level of Service	B
HCM Volume to Capacity ratio	0.70		
Actuated Cycle Length (s)	83.0	Sum of lost time (s)	7.2
Intersection Capacity Utilization	58.7%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

1109 – Sarayburnu Intersection – PM Peak, Optimum

HCM Signalized Intersection Capacity Analysis
3: Int 09.04.2006

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Ideal Flow (vphpl)	1891	1891	1891	1891	1891	1891
Lane Width	3.0	3.6	3.6	3.0	3.3	3.6
Grade (%)	0%			4%	-8%	
Total Lost time (s)	3.6			3.6	3.6	
Lane Util. Factor	0.95			0.95	0.97	
Frt	0.99			1.00	0.99	
Flt Protected	1.00			1.00	0.96	
Satd. Flow (prot)	3271			3254	3433	
Flt Permitted	1.00			1.00	0.96	
Satd. Flow (perm)	3271			3254	3433	
Volume (vph)	1473	134	0	859	216	21
Peak-hour factor, PHF	0.87	0.87	0.96	0.96	0.85	0.85
Adj. Flow (vph)	1693	154	0	895	254	25
RTOR Reduction (vph)	8	0	0	0	9	0
Lane Group Flow (vph)	1839	0	0	895	270	0
Heavy Vehicles (%)	1%	4%	0%	1%	1%	5%
Turn Type						
Protected Phases	2			2	1	
Permitted Phases						
Actuated Green, G (s)	63.0			63.0	12.0	
Effective Green, g (s)	63.4			63.4	11.4	
Actuated g/C Ratio	0.77			0.77	0.14	
Clearance Time (s)	4.0			4.0	3.0	
Lane Grp Cap (vph)	2529			2516	477	
v/s Ratio Prot	c0.56			0.28	c0.08	
v/s Ratio Perm						
v/c Ratio	0.73			0.36	0.57	
Uniform Delay, d1	4.8			2.9	33.0	
Progression Factor	1.00			1.00	1.00	
Incremental Delay, d2	1.9			0.4	4.8	
Delay (s)	6.7			3.3	37.8	
Level of Service	A			A	D	
Approach Delay (s)	6.7			3.3	37.8	
Approach LOS	A			A	D	

Intersection Summary			
HCM Average Control Delay	8.6	HCM Level of Service	A
HCM Volume to Capacity ratio	0.70		
Actuated Cycle Length (s)	82.0	Sum of lost time (s)	7.2
Intersection Capacity Utilization	58.7%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

1102 A – Ahırkapı Intersection – A, AM Peak, Existing

HCM Signalized Intersection Capacity Analysis
1102: Int

09.04.2006

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Ideal Flow (vphpl)	1891	1891	1891	1891	1891	1891
Lane Width	3.6	3.6	3.9	3.3	3.2	3.6
Total Lost time (s)			3.3	3.3	3.3	
Lane Util. Factor			1.00	1.00	0.95	
Frt			1.00	1.00	0.98	
Flt Protected			0.95	1.00	1.00	
Satd. Flow (prot)			1838	1792	3195	
Flt Permitted			0.95	1.00	1.00	
Satd. Flow (perm)			1838	1792	3195	
Volume (vph)	0	0	248	1375	366	44
Peak-hour factor, PHF	0.92	0.92	0.84	0.96	0.90	0.79
Adj. Flow (vph)	0	0	295	1432	407	56
RTOR Reduction (vph)	0	0	0	0	14	0
Lane Group Flow (vph)	0	0	295	1432	449	0
Heavy Vehicles (%)	0%	0%	1%	2%	6%	2%
Turn Type			Prot			
Protected Phases			1	1 2	2	
Permitted Phases						
Actuated Green, G (s)			25.0	77.0	46.0	
Effective Green, g (s)			24.7	77.0	45.7	
Actuated g/C Ratio			0.32	1.00	0.59	
Clearance Time (s)			3.0		4.0	
Lane Grp Cap (vph)			590	1792	1896	
v/s Ratio Prot			0.16	c0.80	0.14	
v/s Ratio Perm						
v/c Ratio			0.50	0.80	0.24	
Uniform Delay, d1			21.2	0.0	7.4	
Progression Factor			1.27	1.00	1.00	
Incremental Delay, d2			2.4	3.1	0.3	
Delay (s)			29.3	3.1	7.7	
Level of Service			C	A	A	
Approach Delay (s)	0.0			7.6	7.7	
Approach LOS	A			A	A	

Intersection Summary			
HCM Average Control Delay	7.6	HCM Level of Service	A
HCM Volume to Capacity ratio	0.80		
Actuated Cycle Length (s)	77.0	Sum of lost time (s)	0.0
Intersection Capacity Utilization	76.0%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Baseline
ISBAK INC.

Synchro 6 Report
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1102 B – Ahırkapı Intersection – B, AM Peak, Existing

HCM Signalized Intersection Capacity Analysis
3: Int 09.04.2006

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Ideal Flow (vphpl)	1891	1891	1891	1891	1891	1891
Lane Width	4.4	3.6	3.6	3.3	3.0	3.6
Grade (%)	-1%			0%	0%	
Total Lost time (s)	3.3			3.3	3.3	
Lane Util. Factor	1.00			0.95	0.95	
Frt	0.94			1.00	1.00	
Flt Protected	0.97			1.00	1.00	
Satd. Flow (prot)	1794			3405	3194	
Flt Permitted	0.97			1.00	1.00	
Satd. Flow (perm)	1794			3405	3194	
Volume (vph)	81	57	0	1542	367	0
Peak-hour factor, PHF	0.88	0.88	0.96	0.96	0.90	0.90
Adj. Flow (vph)	92	65	0	1606	408	0
RTOR Reduction (vph)	33	0	0	0	0	0
Lane Group Flow (vph)	124	0	0	1606	408	0
Heavy Vehicles (%)	0%	14%	0%	2%	5%	0%
Turn Type						
Protected Phases	2			1	1	
Permitted Phases						
Actuated Green, G (s)	12.0			59.0	59.0	
Effective Green, g (s)	11.7			58.7	58.7	
Actuated g/C Ratio	0.15			0.76	0.76	
Clearance Time (s)	3.0			3.0	3.0	
Lane Grp Cap (vph)	273			2596	2435	
v/s Ratio Prot	c0.07			c0.47	0.13	
v/s Ratio Perm						
v/c Ratio	0.45			0.62	0.17	
Uniform Delay, d1	29.7			4.1	2.5	
Progression Factor	1.00			1.00	1.00	
Incremental Delay, d2	5.4			1.1	0.1	
Delay (s)	35.1			5.2	2.6	
Level of Service	D			A	A	
Approach Delay (s)	35.1			5.2	2.6	
Approach LOS	D			A	A	

Intersection Summary			
HCM Average Control Delay	6.9	HCM Level of Service	A
HCM Volume to Capacity ratio	0.59		
Actuated Cycle Length (s)	77.0	Sum of lost time (s)	6.6
Intersection Capacity Utilization	76.0%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

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1102 A – Ahırkapı Intersection – A, PM Peak, Existing

HCM Signalized Intersection Capacity Analysis
1102: Int 09.04.2006

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Ideal Flow (vphpl)	1891	1891	1891	1891	1891	1891
Lane Width	3.6	3.6	3.9	3.3	3.2	3.6
Total Lost time (s)			3.3	3.3	3.3	
Lane Util. Factor			1.00	1.00	0.95	
Frt			1.00	1.00	0.99	
Flt Protected			0.95	1.00	1.00	
Satd. Flow (prot)			1802	1792	3351	
Flt Permitted			0.95	1.00	1.00	
Satd. Flow (perm)			1802	1792	3351	
Volume (vph)	0	0	115	872	1410	45
Peak-hour factor, PHF	0.92	0.92	0.81	0.93	0.88	0.80
Adj. Flow (vph)	0	0	142	938	1602	56
RTOR Reduction (vph)	0	0	0	0	3	0
Lane Group Flow (vph)	0	0	142	938	1655	0
Heavy Vehicles (%)	0%	0%	3%	2%	2%	0%
Turn Type			Prot			
Protected Phases			1	1 2	2	
Permitted Phases						
Actuated Green, G (s)			20.0	92.0	66.0	
Effective Green, g (s)			19.7	92.0	65.7	
Actuated g/C Ratio			0.21	1.00	0.71	
Clearance Time (s)			3.0		4.0	
Lane Grp Cap (vph)			386	1792	2393	
v/s Ratio Prot			0.08	c0.52	c0.49	
v/s Ratio Perm						
v/c Ratio			0.37	0.52	0.69	
Uniform Delay, d1			30.8	0.0	7.4	
Progression Factor			1.35	1.00	1.00	
Incremental Delay, d2			2.5	1.0	1.7	
Delay (s)			44.2	1.0	9.1	
Level of Service			D	A	A	
Approach Delay (s)	0.0			6.7	9.1	
Approach LOS	A			A	A	

Intersection Summary			
HCM Average Control Delay	8.2	HCM Level of Service	A
HCM Volume to Capacity ratio	0.65		
Actuated Cycle Length (s)	92.0	Sum of lost time (s)	3.3
Intersection Capacity Utilization	60.3%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

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ISBAK INC.

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1102 B – Ahırkapı Intersection – B, PM Peak, Existing

HCM Signalized Intersection Capacity Analysis
3: Int 09.04.2006

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Ideal Flow (vphpl)	1891	1891	1891	1891	1891	1891
Lane Width	4.4	3.6	3.6	3.3	3.0	3.6
Grade (%)	-1%			0%	0%	
Total Lost time (s)	3.3			3.3	3.3	
Lane Util. Factor	1.00			0.95	0.95	
Frt	0.92			1.00	1.00	
Flt Protected	0.98			1.00	1.00	
Satd. Flow (prot)	1864			3405	3288	
Flt Permitted	0.98			1.00	1.00	
Satd. Flow (perm)	1864			3405	3288	
Volume (vph)	81	162	0	906	1409	0
Peak-hour factor, PHF	0.71	0.93	0.93	0.93	0.88	0.88
Adj. Flow (vph)	114	174	0	974	1601	0
RTOR Reduction (vph)	54	0	0	0	0	0
Lane Group Flow (vph)	234	0	0	974	1601	0
Heavy Vehicles (%)	0%	0%	0%	2%	2%	0%
Turn Type						
Protected Phases	2			1	1	
Permitted Phases						
Actuated Green, G (s)	16.0			70.0	70.0	
Effective Green, g (s)	15.7			69.7	69.7	
Actuated g/C Ratio	0.17			0.76	0.76	
Clearance Time (s)	3.0			3.0	3.0	
Lane Grp Cap (vph)	318			2580	2491	
v/s Ratio Prot	c0.13			0.29	c0.49	
v/s Ratio Perm						
v/c Ratio	0.74			0.38	0.64	
Uniform Delay, d1	36.2			3.8	5.3	
Progression Factor	1.00			1.00	0.83	
Incremental Delay, d2	14.1			0.4	0.9	
Delay (s)	50.3			4.2	5.3	
Level of Service	D			A	A	
Approach Delay (s)	50.3			4.2	5.3	
Approach LOS	D			A	A	

Intersection Summary			
HCM Average Control Delay	9.4	HCM Level of Service	A
HCM Volume to Capacity ratio	0.66		
Actuated Cycle Length (s)	92.0	Sum of lost time (s)	6.6
Intersection Capacity Utilization	60.3%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

1102 A – Ahırkapı Intersection – A, PM Peak, Optimum

HCM Signalized Intersection Capacity Analysis
1102: Int 09.04.2006

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Ideal Flow (vphpl)	1891	1891	1891	1891	1891	1891
Lane Width	3.6	3.6	3.9	3.3	3.2	3.6
Total Lost time (s)			3.3	3.3	3.3	
Lane Util. Factor			1.00	1.00	0.95	
Frt			1.00	1.00	0.99	
Flt Protected			0.95	1.00	1.00	
Satd. Flow (prot)			1802	1792	3351	
Flt Permitted			0.95	1.00	1.00	
Satd. Flow (perm)			1802	1792	3351	
Volume (vph)	0	0	115	872	1410	45
Peak-hour factor, PHF	0.92	0.92	0.81	0.93	0.88	0.80
Adj. Flow (vph)	0	0	142	938	1602	56
RTOR Reduction (vph)	0	0	0	0	3	0
Lane Group Flow (vph)	0	0	142	938	1655	0
Heavy Vehicles (%)	0%	0%	3%	2%	2%	0%
Turn Type			Prot			
Protected Phases			1	1 2	2	
Permitted Phases						
Actuated Green, G (s)			16.0	71.0	48.0	
Effective Green, g (s)			15.7	71.0	48.7	
Actuated g/C Ratio			0.22	1.00	0.69	
Clearance Time (s)			3.0		4.0	
Lane Grp Cap (vph)			398	1792	2299	
v/s Ratio Prot			0.08	c0.52	c0.49	
v/s Ratio Perm						
v/c Ratio			0.36	0.52	0.72	
Uniform Delay, d1			23.4	0.0	6.9	
Progression Factor			1.35	1.00	1.00	
Incremental Delay, d2			2.3	1.0	2.0	
Delay (s)			33.8	1.0	8.9	
Level of Service			C	A	A	
Approach Delay (s)	0.0			5.3	8.9	
Approach LOS	A			A	A	

Intersection Summary			
HCM Average Control Delay	7.5	HCM Level of Service	A
HCM Volume to Capacity ratio	0.66		
Actuated Cycle Length (s)	71.0	Sum of lost time (s)	3.3
Intersection Capacity Utilization	60.3%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

1102 B – Ahırkapı Intersection – B, PM Peak, Optimum

HCM Signalized Intersection Capacity Analysis

3: Int 09.04.2006

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Ideal Flow (vphpl)	1891	1891	1891	1891	1891	1891
Lane Width	4.4	3.6	3.6	3.3	3.0	3.6
Grade (%)	-1%			0%	0%	
Total Lost time (s)	3.3			3.3	3.3	
Lane Util. Factor	1.00			0.95	0.95	
Frt	0.92			1.00	1.00	
Flt Protected	0.98			1.00	1.00	
Satd. Flow (prot)	1864			3405	3288	
Flt Permitted	0.98			1.00	1.00	
Satd. Flow (perm)	1864			3405	3288	
Volume (vph)	81	162	0	906	1409	0
Peak-hour factor, PHF	0.71	0.93	0.93	0.93	0.88	0.88
Adj. Flow (vph)	114	174	0	974	1601	0
RTOR Reduction (vph)	47	0	0	0	0	0
Lane Group Flow (vph)	241	0	0	974	1601	0
Heavy Vehicles (%)	0%	0%	0%	2%	2%	0%
Turn Type						
Protected Phases	2			1	1	
Permitted Phases						
Actuated Green, G (s)	13.0			52.0	52.0	
Effective Green, g (s)	12.7			51.7	51.7	
Actuated g/C Ratio	0.18			0.73	0.73	
Clearance Time (s)	3.0			3.0	3.0	
Lane Grp Cap (vph)	333			2479	2394	
v/s Ratio Prot	c0.13			0.29	c0.49	
v/s Ratio Perm						
v/c Ratio	0.72			0.39	0.67	
Uniform Delay, d1	27.5			3.7	5.1	
Progression Factor	1.00			1.00	1.11	
Incremental Delay, d2	12.9			0.5	1.0	
Delay (s)	40.4			4.1	6.7	
Level of Service	D			A	A	
Approach Delay (s)	40.4			4.1	6.7	
Approach LOS	D			A	A	

Intersection Summary			
HCM Average Control Delay	9.2	HCM Level of Service	A
HCM Volume to Capacity ratio	0.68		
Actuated Cycle Length (s)	71.0	Sum of lost time (s)	6.6
Intersection Capacity Utilization	60.3%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

1115 – Silivrikapı Intersection – Off-peak, Existing

HCM Signalized Intersection Capacity Analysis
1115: Int 26.03.2006

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1891	1891	1891	1891	1891	1891	1891	1891	1891	1891	1891	1891
Lane Width	3.6	2.5	3.6	3.6	3.2	3.6	3.6	3.3	3.6	3.6	3.2	3.6
Grade (%)		0%			1%			2%			-5%	
Total Lost time (s)		3.6			3.6			3.6			3.6	
Lane Util. Factor		1.00			0.95			0.95			0.95	
Frt		0.92			0.95			1.00			0.99	
Flt Protected		0.98			0.98			1.00			1.00	
Satd. Flow (prot)		1439			3148			3275			3326	
Flt Permitted		0.98			0.98			1.00			1.00	
Satd. Flow (perm)		1439			3148			3275			3326	
Volume (vph)	31	0	39	126	115	134	0	711	0	0	874	50
Peak-hour factor, PHF	0.83	0.83	0.83	0.94	0.94	0.94	0.87	0.87	0.87	0.89	0.89	0.89
Adj. Flow (vph)	37	0	47	134	122	143	0	817	0	0	982	56
RTOR Reduction (vph)	0	40	0	0	96	0	0	0	0	0	5	0
Lane Group Flow (vph)	0	44	0	0	303	0	0	817	0	0	1033	0
Heavy Vehicles (%)	6%	0%	3%	1%	1%	1%	0%	5%	0%	0%	5%	4%
Turn Type	Split			Split								
Protected Phases	3	3		2	2			1			1	
Permitted Phases												
Actuated Green, G (s)		12.0			17.5			41.0			41.0	
Effective Green, g (s)		11.4			15.9			41.9			41.9	
Actuated g/C Ratio		0.14			0.20			0.52			0.52	
Clearance Time (s)		3.0			2.0			4.5			4.5	
Lane Grp Cap (vph)		205			626			1715			1742	
v/s Ratio Prot		c0.03			c0.10			0.25			c0.31	
v/s Ratio Perm												
v/c Ratio		0.21			0.48			0.48			0.59	
Uniform Delay, d1		30.3			28.4			12.1			13.2	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		2.4			2.7			1.0			1.5	
Delay (s)		32.7			31.1			13.0			14.7	
Level of Service		C			C			B			B	
Approach Delay (s)		32.7			31.1			13.0			14.7	
Approach LOS		C			C			B			B	

Intersection Summary			
HCM Average Control Delay	17.5	HCM Level of Service	B
HCM Volume to Capacity ratio	0.51		
Actuated Cycle Length (s)	80.0	Sum of lost time (s)	10.8
Intersection Capacity Utilization	51.2%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

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1115 – Silivrikapı Intersection – Off-peak, Optimum C=51

HCM Signalized Intersection Capacity Analysis

1115: Int — 26.03.2006

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1891	1891	1891	1891	1891	1891	1891	1891	1891	1891	1891	1891
Lane Width	3.6	2.5	3.6	3.6	3.2	3.6	3.6	3.3	3.6	3.6	3.2	3.6
Grade (%)		0%			1%			2%			-5%	
Total Lost time (s)		3.6			3.6			3.6			3.6	
Lane Util. Factor		1.00			0.95			0.95			0.95	
Frt		0.93			0.94			1.00			0.99	
Flt Protected		0.97			0.98			1.00			1.00	
Satd. Flow (prot)		1469			3160			3244			3325	
Flt Permitted		0.97			0.98			1.00			1.00	
Satd. Flow (perm)		1469			3160			3244			3325	
Volume (vph)	35	0	33	125	113	143	0	710	0	0	848	50
Peak-hour factor, PHF	0.94	0.94	0.94	0.89	0.89	0.89	0.91	0.91	0.91	0.89	0.89	0.89
Adj. Flow (vph)	37	0	35	140	127	161	0	780	0	0	953	56
RTOR Reduction (vph)	0	32	0	0	134	0	0	0	0	0	9	0
Lane Group Flow (vph)	0	40	0	0	294	0	0	780	0	0	1000	0
Heavy Vehicles (%)	0%	0%	6%	0%	0%	1%	0%	6%	0%	0%	5%	4%
Turn Type	Split			Split								
Protected Phases	3	3		2	2			1			1	
Permitted Phases												
Actuated Green, G (s)		5.0			10.0			26.5			26.5	
Effective Green, g (s)		4.9			8.4			26.9			26.9	
Actuated g/C Ratio		0.10			0.16			0.53			0.53	
Clearance Time (s)		3.5			2.0			4.0			4.0	
Lane Grp Cap (vph)		141			520			1711			1754	
v/s Ratio Prot		c0.03			c0.09			0.24			c0.30	
v/s Ratio Perm												
v/c Ratio		0.29			0.56			0.46			0.57	
Uniform Delay, d1		21.4			19.6			7.5			8.1	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		5.0			4.4			0.9			1.4	
Delay (s)		26.5			24.0			8.4			9.5	
Level of Service		C			C			A			A	
Approach Delay (s)		26.5			24.0			8.4			9.5	
Approach LOS		C			C			A			A	

Intersection Summary			
HCM Average Control Delay	12.4	HCM Level of Service	B
HCM Volume to Capacity ratio	0.53		
Actuated Cycle Length (s)	51.0	Sum of lost time (s)	10.8
Intersection Capacity Utilization	50.5%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

1115 – Silivrikapı Intersection – Off-peak, Optimum C=82

HCM Signalized Intersection Capacity Analysis

1115: Int 26.03.2006

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1891	1891	1891	1891	1891	1891	1891	1891	1891	1891	1891	1891
Lane Width	3.6	2.5	3.6	3.6	3.2	3.6	3.6	3.3	3.6	3.6	3.2	3.6
Grade (%)		0%			1%			2%			-5%	
Total Lost time (s)		3.6			3.6			3.6			3.6	
Lane Util. Factor		1.00			0.95			0.95			0.95	
Frt		0.94			0.94			1.00			0.99	
Flt Protected		0.97			0.98			1.00			1.00	
Satd. Flow (prot)		1470			3126			3275			3358	
Flt Permitted		0.97			0.98			1.00			1.00	
Satd. Flow (perm)		1470			3126			3275			3358	
Volume (vph)	34	0	28	127	98	136	0	728	0	0	794	58
Peak-hour factor, PHF	0.97	0.97	0.97	0.96	0.96	0.96	0.99	0.99	0.99	0.97	0.97	0.97
Adj. Flow (vph)	35	0	29	132	102	142	0	735	0	0	819	60
RTOR Reduction (vph)	0	27	0	0	111	0	0	0	0	0	7	0
Lane Group Flow (vph)	0	37	0	0	265	0	0	735	0	0	872	0
Heavy Vehicles (%)	0%	0%	7%	0%	2%	2%	0%	5%	0%	0%	4%	0%
Turn Type	Split			Split								
Protected Phases	3	3		2	2			1			1	
Permitted Phases												
Actuated Green, G (s)		7.0			18.0			47.5			47.5	
Effective Green, g (s)		6.9			16.4			47.9			47.9	
Actuated g/C Ratio		0.08			0.20			0.58			0.58	
Clearance Time (s)		3.5			2.0			4.0			4.0	
Lane Grp Cap (vph)		124			625			1913			1962	
v/s Ratio Prot		c0.03			c0.08			0.22			c0.26	
v/s Ratio Perm												
v/c Ratio		0.30			0.42			0.38			0.44	
Uniform Delay, d1		35.3			28.7			9.1			9.6	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		6.2			2.1			0.6			0.7	
Delay (s)		41.4			30.8			9.7			10.3	
Level of Service		D			C			A			B	
Approach Delay (s)		41.4			30.8			9.7			10.3	
Approach LOS		D			C			A			B	

Intersection Summary			
HCM Average Control Delay	14.8	HCM Level of Service	B
HCM Volume to Capacity ratio	0.43		
Actuated Cycle Length (s)	82.0	Sum of lost time (s)	10.8
Intersection Capacity Utilization	48.3%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

1162 A – Unverdi Intersection – Off-peak

HCM Signalized Intersection Capacity Analysis
3: Int 27.03.2006

Movement	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Ideal Flow (vphpl)	1891	1891	1891	1891	1891	1891	1891	1891	1891	1891	1891	1891
Lane Width	3.6	3.5	3.6	3.6	3.5	3.6	3.6	3.8	4.8	3.6	3.6	4.8
Total Lost time (s)		3.6			3.6			3.6	3.6		3.6	
Lane Util. Factor		0.91			0.91			0.95	1.00		0.95	
Frt		0.97			0.99			1.00	0.85		1.00	
Flt Protected		0.98			0.99			0.99	1.00		0.98	
Satd. Flow (prot)		4623			4835			3392	1822		3293	
Flt Permitted		0.98			0.99			0.99	1.00		0.98	
Satd. Flow (perm)		4623			4835			3392	1822		3293	
Volume (vph)	261	361	143	179	428	26	174	725	3	278	564	0
Peak-hour factor, PHF	0.93	0.93	0.93	0.95	0.95	0.95	0.91	0.91	0.91	0.96	0.96	0.96
Adj. Flow (vph)	281	388	154	188	451	27	191	797	3	290	588	0
RTOR Reduction (vph)	0	42	0	0	5	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	781	0	0	661	0	0	988	3	0	878	0
Heavy Vehicles (%)	3%	4%	14%	3%	3%	15%	4%	8%	0%	4%	9%	0%
Turn Type	Split			Split			Split		Free	Split		Free
Protected Phases	2	2		1	1		4	4		3	3	
Permitted Phases									Free			Free
Actuated Green, G (s)		17.0			12.0			28.0	90.0		21.0	
Effective Green, g (s)		16.4			11.4			27.4	90.0		20.4	
Actuated g/C Ratio		0.18			0.13			0.30	1.00		0.23	
Clearance Time (s)		3.0			3.0			3.0			3.0	
Lane Grp Cap (vph)		842			612			1033	1822		746	
v/s Ratio Prot		c0.17			c0.14			c0.29			c0.27	
v/s Ratio Perm									0.00			
v/c Ratio		0.93			1.08			0.96	0.00		1.18	
Uniform Delay, d1		36.2			39.3			30.7	0.0		34.8	
Progression Factor		1.00			1.00			1.00	1.00		1.00	
Incremental Delay, d2		17.8			59.8			19.3	0.0		93.3	
Delay (s)		54.0			99.1			50.0	0.0		128.1	
Level of Service		D			F			D	A		F	
Approach Delay (s)		54.0			99.1			49.8			128.1	
Approach LOS		D			F			D			F	

Intersection Summary			
HCM Average Control Delay	81.1	HCM Level of Service	F
HCM Volume to Capacity ratio	1.03		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	14.4
Intersection Capacity Utilization	90.4%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

1163 – Yayla Intersection – Off-peak

HCM Signalized Intersection Capacity Analysis
1163: Int 26.03.2006

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1891	1891	1891	1891	1891	1891	1891	1891	1891	1891	1891	1891
Lane Width	3.6	3.5	3.6	3.6	3.9	3.6	3.6	4.8	3.6	3.6	4.8	3.6
Total Lost time (s)		3.6	3.6		3.6			3.6			3.6	
Lane Util. Factor		0.95	1.00		0.95			1.00			1.00	
Frt		1.00	0.85		0.98			0.99			0.97	
Flt Protected		1.00	1.00		1.00			0.98			0.98	
Satd. Flow (prot)		3260	1576		3251			1918			1863	
Flt Permitted		1.00	1.00		1.00			0.98			0.98	
Satd. Flow (perm)		3260	1576		3251			1918			1863	
Volume (vph)	0	901	41	0	709	83	120	163	27	185	263	123
Peak-hour factor, PHF	0.92	0.92	0.92	0.95	0.95	0.95	0.83	0.83	0.83	0.96	0.96	0.96
Adj. Flow (vph)	0	979	45	0	746	87	145	196	33	193	274	128
RTOR Reduction (vph)	0	0	11	0	10	0	0	4	0	0	11	0
Lane Group Flow (vph)	0	979	34	0	823	0	0	370	0	0	584	0
Heavy Vehicles (%)	0%	9%	2%	0%	12%	16%	7%	10%	4%	18%	6%	6%
Turn Type			pt+ov				Split			Split		
Protected Phases		3	3 1		3		1	1		2	2	
Permitted Phases												
Actuated Green, G (s)		40.0	67.0		40.0			24.0			14.0	
Effective Green, g (s)		39.4	66.4		39.4			23.4			14.4	
Actuated g/C Ratio		0.45	0.75		0.45			0.27			0.16	
Clearance Time (s)		3.0			3.0			3.0			4.0	
Lane Grp Cap (vph)		1460	1189		1456			510			305	
v/s Ratio Prot		c0.30	0.02		0.25			c0.19			c0.31	
v/s Ratio Perm												
v/c Ratio		0.67	0.03		0.57			0.73			1.92	
Uniform Delay, d1		19.2	2.7		18.0			29.4			36.8	
Progression Factor		1.00	1.00		1.00			1.00			1.00	
Incremental Delay, d2		2.5	0.0		1.6			8.7			423.8	
Delay (s)		21.6	2.8		19.6			38.1			460.6	
Level of Service		C	A		B			D			F	
Approach Delay (s)		20.8			19.6			38.1			460.6	
Approach LOS		C			B			D			F	

Intersection Summary			
HCM Average Control Delay	115.3	HCM Level of Service	F
HCM Volume to Capacity ratio	0.92		
Actuated Cycle Length (s)	88.0	Sum of lost time (s)	10.8
Intersection Capacity Utilization	70.5%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

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ISBAK INC.

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1164 – Kocasinan Girisi Intersection – Off-peak

HCM Signalized Intersection Capacity Analysis
1164: Int

26.03.2006

Movement	EBL	EBT	WBT	WBR	SEL	SER
Lane Configurations						
Ideal Flow (vphpl)	1891	1891	1891	1891	1891	1891
Lane Width	3.6	3.5	3.8	2.5	4.2	2.5
Total Lost time (s)		3.6	3.6	3.6	3.6	3.6
Lane Util. Factor		0.95	0.95	1.00	1.00	1.00
Frt		1.00	1.00	0.85	1.00	0.85
Flt Protected		0.99	1.00	1.00	0.95	1.00
Satd. Flow (prot)		3391	3465	1260	1726	1344
Flt Permitted		0.66	1.00	1.00	0.95	1.00
Satd. Flow (perm)		2252	3465	1260	1726	1344
Volume (vph)	142	988	848	298	343	127
Peak-hour factor, PHF	0.88	0.88	0.97	0.97	0.94	0.94
Adj. Flow (vph)	161	1123	874	307	365	135
RTOR Reduction (vph)	0	0	0	60	0	0
Lane Group Flow (vph)	0	1284	874	247	365	135
Heavy Vehicles (%)	5%	4%	6%	12%	11%	5%
Turn Type	Prot			pt+ov		Free
Protected Phases	2	2 3	3	3 1	1	
Permitted Phases						Free
Actuated Green, G (s)		62.0	51.0	72.0	18.0	90.0
Effective Green, g (s)		60.8	50.4	72.4	18.4	90.0
Actuated g/C Ratio		0.68	0.56	0.80	0.20	1.00
Clearance Time (s)			3.0		4.0	
Lane Grp Cap (vph)		1653	1940	1014	353	1344
v/s Ratio Prot		c0.09	0.25	0.20	c0.21	
v/s Ratio Perm		c0.43				0.10
v/c Ratio		0.78	0.45	0.24	1.03	0.10
Uniform Delay, d1		10.0	11.7	2.1	35.8	0.0
Progression Factor		1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2		3.7	0.8	0.6	57.0	0.1
Delay (s)		13.6	12.4	2.7	92.8	0.1
Level of Service		B	B	A	F	A
Approach Delay (s)		13.6	9.9		67.8	
Approach LOS		B	A		E	

Intersection Summary			
HCM Average Control Delay	21.3	HCM Level of Service	C
HCM Volume to Capacity ratio	0.84		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	10.8
Intersection Capacity Utilization	84.2%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

1165 – Sirinevler Intersection – Off-peak

HCM Signalized Intersection Capacity Analysis
1165: Int 26.03.2006

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Ideal Flow (vphpl)	1891	1891	1891	1891	1891	1891
Lane Width	3.6	3.6	3.6	3.6	4.4	4.4
Grade (%)		-7%	6%		-5%	
Total Lost time (s)		3.6	3.6	3.6	3.6	3.6
Lane Util. Factor		0.95	0.91	0.91	1.00	0.95
Frt		1.00	1.00	0.85	1.00	0.85
Flt Protected		1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)		3610	3258	1371	1966	1671
Flt Permitted		1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)		3610	3258	1371	1966	1671
Volume (vph)	0	809	770	221	309	62
Peak-hour factor, PHF	0.90	0.90	0.91	0.90	0.91	0.78
Adj. Flow (vph)	0	899	846	246	340	79
RTOR Reduction (vph)	0	0	0	45	0	71
Lane Group Flow (vph)	0	899	846	201	340	8
Heavy Vehicles (%)	0%	3%	3%	4%	2%	2%
Turn Type				pt+ov		custom
Protected Phases		1 2	1	1 3	3	
Permitted Phases						2
Actuated Green, G (s)		66.0	53.0	74.0	17.0	10.0
Effective Green, g (s)		65.4	52.4	73.4	17.4	9.4
Actuated g/C Ratio		0.73	0.58	0.82	0.19	0.10
Clearance Time (s)			3.0		4.0	3.0
Lane Grp Cap (vph)		2623	1897	1118	380	175
v/s Ratio Prot		c0.25	c0.26	0.15	c0.17	
v/s Ratio Perm						0.00
v/c Ratio		0.34	0.45	0.18	0.89	0.05
Uniform Delay, d1		4.5	10.6	1.8	35.4	36.3
Progression Factor		1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2		0.4	0.8	0.4	26.0	0.5
Delay (s)		4.8	11.4	2.1	61.4	36.8
Level of Service		A	B	A	E	D
Approach Delay (s)		4.8	9.3		56.8	
Approach LOS		A	A		E	

Intersection Summary			
HCM Average Control Delay	15.9	HCM Level of Service	B
HCM Volume to Capacity ratio	0.52		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	7.2
Intersection Capacity Utilization	48.9%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

1426 – UEFA Intersection – Off-peak

HCM Signalized Intersection Capacity Analysis
3: Int 26.03.2006

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1891	1891	1891	1891	1891	1891	1891	1891	1891	1891	1891	1891
Lane Width	3.6	3.5	3.6	3.6	3.5	3.6	3.6	3.6	3.6	3.6	3.6	3.6
Total Lost time (s)		3.6			3.6						3.6	
Lane Util. Factor		0.95			0.95						1.00	
Frt		0.97			0.98						0.94	
Flt Protected		1.00			1.00						0.99	
Satd. Flow (prot)		3295			3324						1701	
Flt Permitted		1.00			0.73						0.99	
Satd. Flow (perm)		3295			2424						1701	
Volume (vph)	0	886	243	65	1060	212	0	0	0	34	91	97
Peak-hour factor, PHF	0.77	0.77	0.77	0.86	0.86	0.86	0.90	0.90	0.90	0.83	0.83	0.83
Adj. Flow (vph)	0	1151	316	76	1233	247	0	0	0	41	110	117
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	1467	0	0	1556	0	0	0	0	0	268	0
Heavy Vehicles (%)	2%	5%	2%	6%	4%	4%	2%	2%	2%	3%	4%	4%
Turn Type				Prot						Split		
Protected Phases		3		2	2 3					1	1	
Permitted Phases												
Actuated Green, G (s)		58.0			64.0						18.0	
Effective Green, g (s)		57.4			61.8						17.4	
Actuated g/C Ratio		0.64			0.69						0.19	
Clearance Time (s)		3.0									3.0	
Lane Grp Cap (vph)		2101			1708						329	
v/s Ratio Prot		0.45			c0.04						c0.16	
v/s Ratio Perm					c0.58							
v/c Ratio		0.70			0.91						0.81	
Uniform Delay, d1		10.6			11.8						34.8	
Progression Factor		1.00			1.00						1.00	
Incremental Delay, d2		2.0			8.8						19.5	
Delay (s)		12.6			20.6						54.2	
Level of Service		B			C						D	
Approach Delay (s)		12.6			20.6			0.0			54.2	
Approach LOS		B			C			A			D	

Intersection Summary			
HCM Average Control Delay	19.8	HCM Level of Service	B
HCM Volume to Capacity ratio	0.89		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	10.8
Intersection Capacity Utilization	93.2%	ICU Level of Service	F
Analysis Period (min)	15		

c Critical Lane Group

2204 – Dolmabahce Intersection – PM Peak

HCM Signalized Intersection Capacity Analysis
3: Int 18.05.2006

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Ideal Flow (vphpl)	1891	1891	1891	1891	1891	1891
Lane Width	3.6	3.9	3.5	3.6	3.1	3.6
Grade (%)		0%	0%		-10%	
Total Lost time (s)		3.6	3.6		3.6	
Lane Util. Factor		0.91	0.95		0.94	
Frt		1.00	1.00		1.00	
Flt Protected		1.00	1.00		0.95	
Satd. Flow (prot)		4529	3017		4347	
Flt Permitted		1.00	1.00		0.95	
Satd. Flow (perm)		4529	3017		4347	
Volume (vph)	0	1976	910	0	2102	0
Peak-hour factor, PHF	0.82	0.82	0.96	0.96	0.90	0.90
Adj. Flow (vph)	0	2410	948	0	2336	0
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	0	2410	948	0	2336	0
Heavy Vehicles (%)	0%	6%	6%	0%	4%	0%
Turn Type						
Protected Phases		2	2		1	
Permitted Phases						
Actuated Green, G (s)		48.0	48.0		58.0	
Effective Green, g (s)		48.4	48.4		58.4	
Actuated g/C Ratio		0.42	0.42		0.51	
Clearance Time (s)		4.0	4.0		4.0	
Lane Grp Cap (vph)		1923	1281		2227	
v/s Ratio Prot		c0.53	0.31		c0.54	
v/s Ratio Perm						
v/c Ratio		1.25	0.74		1.05	
Uniform Delay, d1		32.8	27.5		27.8	
Progression Factor		1.00	1.00		1.00	
Incremental Delay, d2		118.4	3.9		33.4	
Delay (s)		151.2	31.4		61.2	
Level of Service		F	C		E	
Approach Delay (s)		151.2	31.4		61.2	
Approach LOS		F	C		E	

Intersection Summary			
HCM Average Control Delay	94.4	HCM Level of Service	F
HCM Volume to Capacity ratio	1.14		
Actuated Cycle Length (s)	114.0	Sum of lost time (s)	7.2
Intersection Capacity Utilization	93.9%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

APPENDIX D: OUTPUTS OF THE SYNCHRO PDM ANALYSIS

1109 – Sarayburnu Intersection – AM Peak, Existing

Lanes, Volumes, Timings
3: Int 09.04.2006

Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Ideal Flow (vphpl)	1891	1891	1891	1891	1891	1891
Lane Width (m)	3.0	3.6	3.6	3.0	3.3	3.6
Grade (%)	0%			4%	-8%	
Storage Length (m)		0.0	0.0		0.0	0.0
Storage Lanes		0	0		2	0
Total Lost Time (s)	3.6	3.6	3.6	3.6	3.6	3.6
Leading Detector (m)	15.0			15.0	15.0	
Trailing Detector (m)	0.0			0.0	0.0	
Turning Speed (k/h)		15	25		25	15
Satd. Flow (prot)	3019	0	0	3222	2946	0
Flt Permitted					0.956	
Satd. Flow (perm)	3019	0	0	3222	2946	0
Right Turn on Red		Yes				Yes
Satd. Flow (RTOR)	184				9	
Link Speed (k/h)	50			50	50	
Link Distance (m)	268.6			273.8	219.2	
Travel Time (s)	19.3			19.7	15.8	
Volume (vph)	418	169	0	1503	108	8
Confl. Peds. (#/hr)						
Confl. Bikes (#/hr)						
Peak Hour Factor	0.92	0.92	0.90	0.90	0.73	0.73
Growth Factor	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	4%	12%	0%	2%	18%	25%
Bus Blockages (#/hr)	0	0	0	0	0	0
Parking (#/hr)						
Mid-Block Traffic (%)	0%			0%	0%	
Lane Group Flow (vph)	638	0	0	1670	159	0
Turn Type						
Protected Phases	2			2	1	
Permitted Phases						
Detector Phases	2			2	1	
Minimum Initial (s)	4.0			4.0	4.0	
Minimum Split (s)	21.0			21.0	16.0	
Total Split (s)	56.0	0.0	0.0	56.0	19.0	0.0
Total Split (%)	74.7%	0.0%	0.0%	74.7%	25.3%	0.0%
Yellow Time (s)	3.0			3.0	2.0	
All-Red Time (s)	1.0			1.0	1.0	
Lead/Lag	Lag			Lag	Lead	
Lead-Lag Optimize?	Yes			Yes	Yes	
Recall Mode	Max			Max	Max	
Act Effct Green (s)	52.4			52.4	15.4	
Actuated g/C Ratio	0.70			0.70	0.21	
v/c Ratio	0.29			0.74	0.26	
Control Delay	3.3			9.7	24.9	
Queue Delay	0.0			0.0	0.0	
Total Delay	3.3			9.7	24.9	
LOS	A			A	C	
Approach Delay	3.3			9.7	24.9	
Approach LOS	A			A	C	
Queue Length 50th (m)	10.3			67.4	9.7	
Queue Length 95th (m)	16.0			92.7	14.0	
Internal Link Dist (m)	244.6			249.8	195.2	

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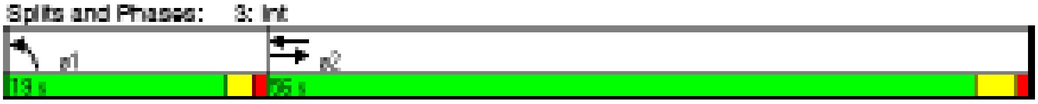
Lanes, Volumes, Timings
3: Int 09.04.2006

Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Turn Bay Length (m)						
Base Capacity (vph)	2166			2251	612	
Starvation Cap Reductn	0			0	0	
Spillback Cap Reductn	0			0	0	
Storage Cap Reductn	0			0	0	
Reduced v/c Ratio	0.29			0.74	0.26	

Intersection Summary

Area Type: Other
Cycle Length: 75
Actuated Cycle Length: 75
Offset: 0 (0%), Referenced to phase 2:EBW B and 6:, Start of Green
Natural Cycle: 60
Control Type: Pretimed
Maximum v/c Ratio: 0.74
Intersection Signal Delay: 9.0 Intersection LOS: A
Intersection Capacity Utilization 51.8% ICU Level of Service A
Analysis Period (min) 15

Splits and Phases: 3: Int



1109 – Sarayburnu Intersection – AM Peak, Optimum

Lanes, Volumes, Timings
3: Int 09.04.2006

Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Ideal Flow (vphpl)	1891	1891	1891	1891	1891	1891
Lane Width (m)	3.0	3.6	3.6	3.0	3.3	3.6
Grade (%)	0%			4%	-8%	
Storage Length (m)		0.0	0.0		0.0	0.0
Storage Lanes		0	0		2	0
Total Lost Time (s)	3.6	3.6	3.6	3.6	3.6	3.6
Leading Detector (m)	15.0			15.0	15.0	
Trailing Detector (m)	0.0			0.0	0.0	
Turning Speed (k/h)		15	25		25	15
Satd. Flow (prot)	3019	0	0	3222	2946	0
Flt Permitted					0.956	
Satd. Flow (perm)	3019	0	0	3222	2946	0
Right Turn on Red		Yes				Yes
Satd. Flow (RTOR)	184				9	
Link Speed (k/h)	50			50	50	
Link Distance (m)	268.6			273.8	219.2	
Travel Time (s)	19.3			19.7	15.8	
Volume (vph)	418	169	0	1503	108	8
Confl. Peds. (#/hr)						
Confl. Bikes (#/hr)						
Peak Hour Factor	0.92	0.92	0.90	0.90	0.73	0.73
Growth Factor	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	4%	12%	0%	2%	18%	25%
Bus Blockages (#/hr)	0	0	0	0	0	0
Parking (#/hr)						
Mid-Block Traffic (%)	0%			0%	0%	
Lane Group Flow (vph)	638	0	0	1670	159	0
Turn Type						
Protected Phases	2			2	1	
Permitted Phases						
Detector Phases	2			2	1	
Minimum Initial (s)	4.0			4.0	4.0	
Minimum Split (s)	21.0			21.0	16.0	
Total Split (s)	59.0	0.0	0.0	59.0	16.0	0.0
Total Split (%)	78.7%	0.0%	0.0%	78.7%	21.3%	0.0%
Yellow Time (s)	3.0			3.0	2.0	
All-Red Time (s)	1.0			1.0	1.0	
Lead/Lag	Lag			Lag	Lead	
Lead-Lag Optimize?	Yes			Yes	Yes	
Recall Mode	Max			Max	Max	
Act Effct Green (s)	55.4			55.4	12.4	
Actuated g/C Ratio	0.74			0.74	0.17	
v/c Ratio	0.28			0.70	0.32	
Control Delay	2.5			7.3	28.0	
Queue Delay	0.0			0.0	0.0	
Total Delay	2.5			7.3	28.0	
LOS	A			A	C	
Approach Delay	2.5			7.3	28.0	
Approach LOS	A			A	C	
Queue Length 50th (m)	8.5			55.1	10.2	
Queue Length 95th (m)	13.1			76.1	14.7	
Internal Link Dist (m)	244.6			249.8	195.2	

Baseline Synchro 6 Report
ISBAK INC. Page 1

Lanes, Volumes, Timings
3: Int 09.04.2006

Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Turn Bay Length (m)						
Base Capacity (vph)	2278			2380	495	
Starvation Cap Reductn	0			0	0	
Spillback Cap Reductn	0			0	0	
Storage Cap Reductn	0			0	0	
Reduced v/c Ratio	0.28			0.70	0.32	

Intersection Summary

Area Type: Other
Cycle Length: 75
Actuated Cycle Length: 75
Offset: 0 (0%), Referenced to phase 2:EBWB and 6:, Start of Green
Natural Cycle: 60
Control Type: Pretimed
Maximum v/c Ratio: 0.70
Intersection Signal Delay: 7.4 Intersection LOS: A
Intersection Capacity Utilization 51.8% ICU Level of Service A
Analysis Period (min) 15

Splits and Phases: 3: Int

1109 – Sarayburnu Intersection – PM Peak, Existing

Lanes, Volumes, Timings
3: Int 09.04.2006

Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Ideal Flow (vphpl)	1891	1891	1891	1891	1891	1891
Lane Width (m)	3.0	3.6	3.6	3.0	3.3	3.6
Grade (%)	0%			4%	-8%	
Storage Length (m)		0.0	0.0		0.0	0.0
Storage Lanes		0	0		2	0
Total Lost Time (s)	3.6	3.6	3.6	3.6	3.6	3.6
Leading Detector (m)	15.0			15.0	15.0	
Trailing Detector (m)	0.0			0.0	0.0	
Turning Speed (k/h)		15	25		25	15
Satd. Flow (prot)	3369	0	0	3254	3433	0
Flt Permitted					0.956	
Satd. Flow (perm)	3369	0	0	3254	3433	0
Right Turn on Red		Yes				Yes
Satd. Flow (RTOR)	30				11	
Link Speed (k/h)	50			50	50	
Link Distance (m)	268.6			273.8	219.2	
Travel Time (s)	19.3			19.7	15.8	
Volume (vph)	1473	134	0	859	216	21
Confl. Peds. (#/hr)						
Confl. Bikes (#/hr)						
Peak Hour Factor	0.87	0.87	0.96	0.96	0.85	0.85
Growth Factor	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	1%	4%	0%	1%	1%	5%
Bus Blockages (#/hr)	0	0	0	0	0	0
Parking (#/hr)						
Mid-Block Traffic (%)	0%			0%	0%	
Lane Group Flow (vph)	1847	0	0	895	279	0
Turn Type						
Protected Phases	2			2	1	
Permitted Phases						
Detector Phases	2			2	1	
Minimum Initial (s)	4.0			4.0	4.0	
Minimum Split (s)	64.0			64.0	19.0	
Total Split (s)	64.0	0.0	0.0	64.0	19.0	0.0
Total Split (%)	77.1%	0.0%	0.0%	77.1%	22.9%	0.0%
Yellow Time (s)	3.0			3.0	2.0	
All-Red Time (s)	1.0			1.0	1.0	
Lead/Lag	Lag			Lag	Lead	
Lead-Lag Optimize?	Yes			Yes	Yes	
Recall Mode	Max			Max	Max	
Act Effct Green (s)	60.4			60.4	15.4	
Actuated g/C Ratio	0.73			0.73	0.19	
v/c Ratio	0.77			0.38	0.43	
Control Delay	9.8			4.8	31.1	
Queue Delay	0.0			0.0	0.0	
Total Delay	9.8			4.8	31.1	
LOS	A			A	C	
Approach Delay	9.8			4.8	31.1	
Approach LOS	A			A	C	
Queue Length 50th (m)	80.7			24.0	20.5	
Queue Length 95th (m)	99.7			32.1	30.1	
Internal Link Dist (m)	244.6			249.8	195.2	

Lanes, Volumes, Timings
3: Int 09.04.2006

Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Turn Bay Length (m)						
Base Capacity (vph)	2387			2368	646	
Starvation Cap Reductn	0			0	0	
Spillback Cap Reductn	0			0	0	
Storage Cap Reductn	0			0	0	
Reduced v/c Ratio	0.77			0.38	0.43	

Intersection Summary

Area Type: Other
Cycle Length: 83
Actuated Cycle Length: 83
Offset: 0 (0%), Referenced to phase 2:EBW B and 6:, Start of Green
Natural Cycle: 85
Control Type: Pretimed
Maximum v/c Ratio: 0.77
Intersection Signal Delay: 10.3 Intersection LOS: B
Intersection Capacity Utilization 58.7% ICU Level of Service B
Analysis Period (min) 15

Splits and Phases: 3: Int

1109 – Sarayburnu Intersection – PM Peak, Optimum

Lanes, Volumes, Timings
3: Int 09.04.2006

Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Ideal Flow (vphpl)	1891	1891	1891	1891	1891	1891
Lane Width (m)	3.0	3.6	3.6	3.0	3.3	3.6
Grade (%)	0%			4%	-8%	
Storage Length (m)		0.0	0.0		0.0	0.0
Storage Lanes		0	0		2	0
Total Lost Time (s)	3.6	3.6	3.6	3.6	3.6	3.6
Leading Detector (m)	15.0			15.0	15.0	
Trailing Detector (m)	0.0			0.0	0.0	
Turning Speed (k/h)		15	25		25	15
Satd. Flow (prot)	3269	0	0	3254	3433	0
Flt Permitted					0.956	
Satd. Flow (perm)	3269	0	0	3254	3433	0
Right Turn on Red		Yes				Yes
Satd. Flow (RTOR)	36				11	
Link Speed (k/h)	50			50	50	
Link Distance (m)	268.6			273.8	219.2	
Travel Time (s)	19.3			19.7	15.8	
Volume (vph)	1473	134	0	859	216	21
Confl. Peds. (#/hr)						
Confl. Bikes (#/hr)						
Peak Hour Factor	0.87	0.87	0.96	0.96	0.85	0.85
Growth Factor	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	1%	4%	0%	1%	1%	5%
Bus Blockages (#/hr)	0	0	0	0	0	0
Parking (#/hr)						
Mid-Block Traffic (%)	0%			0%	0%	
Lane Group Flow (vph)	1847	0	0	895	279	0
Turn Type						
Protected Phases	2			2	1	
Permitted Phases						
Detector Phases	2			2	1	
Minimum Initial (s)	4.0			4.0	4.0	
Minimum Split (s)	25.0			25.0	15.0	
Total Split (s)	67.0	0.0	0.0	67.0	15.0	0.0
Total Split (%)	81.7%	0.0%	0.0%	81.7%	18.3%	0.0%
Yellow Time (s)	3.0			3.0	2.0	
All-Red Time (s)	1.0			1.0	1.0	
Lead/Lag	Lag			Lag	Lead	
Lead-Lag Optimize?	Yes			Yes	Yes	
Recall Mode	Max			Max	Max	
Act Effct Green (s)	63.4			63.4	11.4	
Actuated g/C Ratio	0.77			0.77	0.14	
v/c Ratio	0.73			0.36	0.57	
Control Delay	6.8			3.4	36.9	
Queue Delay	0.0			0.0	0.0	
Total Delay	6.8			3.4	36.9	
LOS	A			A	D	
Approach Delay	6.8			3.4	36.9	
Approach LOS	A			A	D	
Queue Length 50th (m)	60.8			18.2	21.4	
Queue Length 95th (m)	75.6			24.4	31.7	
Internal Link Dist (m)	244.6			249.8	195.2	

Lanes, Volumes, Timings
3: Int 09.04.2006

Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Turn Bay Length (m)						
Base Capacity (vph)	2536			2516	487	
Starvation Cap Reductn	0			0	0	
Spillback Cap Reductn	0			0	0	
Storage Cap Reductn	0			0	0	
Reduced v/c Ratio	0.73			0.36	0.57	

Intersection Summary

Area Type: Other
Cycle Length: 82
Actuated Cycle Length: 82
Offset: 0 (0%), Referenced to phase 2:EBWB and 6:, Start of Green
Natural Cycle: 60
Control Type: Pretimed
Maximum v/c Ratio: 0.73
Intersection Signal Delay: 8.6 Intersection LOS: A
Intersection Capacity Utilization 58.7% ICU Level of Service B
Analysis Period (min) 15

Splits and Phases: 3: Int

1102 A – Ahırkapı Intersection – A, AM Peak, Existing

Lanes, Volumes, Timings
1102: Int

09.04.2006

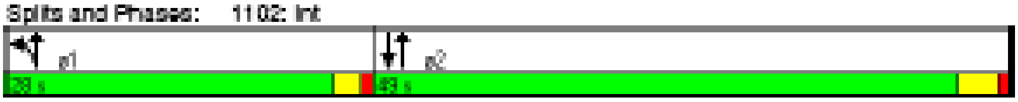
Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Ideal Flow (vphpl)	1891	1891	1891	1891	1891	1891
Lane Width (m)	3.6	3.6	3.9	3.3	3.2	3.6
Grade (%)	0%			0%	0%	
Storage Length (m)	0.0	0.0	0.0			0.0
Storage Lanes	0	0	1			0
Total Lost Time (s)	3.3	3.3	3.3	3.3	3.3	3.3
Leading Detector (m)			15.0	15.0	15.0	
Trailing Detector (m)			0.0	0.0	0.0	
Turning Speed (k/h)	25	15	25			15
Satd. Flow (prot)	0	0	1838	1792	3195	0
Flt Permitted			0.950			
Satd. Flow (perm)	0	0	1838	1792	3195	0
Right Turn on Red		Yes				Yes
Satd. Flow (RTOR)					34	
Link Speed (k/h)	50			50	50	
Link Distance (m)	204.6			204.0	96.4	
Travel Time (s)	14.7			14.7	6.9	
Volume (vph)	0	0	248	1375	366	44
Confl. Peds. (#/hr)						
Confl. Bikes (#/hr)						
Peak Hour Factor	0.92	0.92	0.84	0.96	0.90	0.79
Growth Factor	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	0%	0%	1%	2%	6%	2%
Bus Blockages (#/hr)	0	0	0	0	0	0
Parking (#/hr)						
Mid-Block Traffic (%)	0%			0%	0%	
Lane Group Flow (vph)	0	0	295	1432	463	0
Turn Type			Prot			
Protected Phases			1	1 2	2	
Permitted Phases						
Detector Phases			1	1 2	2	
Minimum Initial (s)			4.0		4.0	
Minimum Split (s)			8.0		20.0	
Total Split (s)	0.0	0.0	28.0	77.0	49.0	0.0
Total Split (%)	0.0%	0.0%	36.4%	100.0%	63.6%	0.0%
Yellow Time (s)			2.0		3.0	
All-Red Time (s)			1.0		1.0	
Lead/Lag			Lead		Lag	
Lead-Lag Optimize?			Yes		Yes	
Recall Mode			Max		Max	
Act Effct Green (s)			24.7	77.0	45.7	
Actuated g/C Ratio			0.32	1.00	0.59	
v/c Ratio			0.50	0.80	0.24	
Control Delay			30.0	8.9	7.2	
Queue Delay			0.0	0.0	0.0	
Total Delay			30.0	8.9	7.2	
LOS			C	A	A	
Approach Delay				12.5	7.2	
Approach LOS				B	A	
Queue Length 50th (m)			39.3	89.6	14.6	
Queue Length 95th (m)			58.0	174.1	21.8	
Internal Link Dist (m)	180.6			180.0	72.4	

Lanes, Volumes, Timings
1102: Int 09.04.2006

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Turn Bay Length (m)						
Base Capacity (vph)			590	1792	1910	
Starvation Cap Reductn			0	0	0	
Spillback Cap Reductn			0	0	0	
Storage Cap Reductn			0	0	0	
Reduced v/c Ratio			0.50	0.80	0.24	

Intersection Summary	
Area Type: Other	
Cycle Length: 77	
Actuated Cycle Length: 77	
Offset: 12 (16%), Referenced to phase 6:, Start of Green	
Natural Cycle: 40	
Control Type: Pretimed	
Maximum v/c Ratio: 0.80	
Intersection Signal Delay: 11.4	Intersection LOS: B
Intersection Capacity Utilization 76.0%	ICU Level of Service D
Analysis Period (min) 15	

Splits and Phases: 1102: Int



1102 B – Ahırkapı Intersection – B, AM Peak, Existing

Lanes, Volumes, Timings
3: Int 09.04.2006

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Ideal Flow (vphpl)	1891	1891	1891	1891	1891	1891
Lane Width (m)	4.4	3.6	3.6	3.3	3.0	3.6
Grade (%)	-1%			0%	0%	
Storage Length (m)	0.0	0.0	0.0			0.0
Storage Lanes	1	0	0			0
Total Lost Time (s)	3.3	3.3	3.3	3.3	3.3	3.3
Leading Detector (m)	15.0			15.0	15.0	
Trailing Detector (m)	0.0			0.0	0.0	
Turning Speed (k/h)	25	15	25			15
Satd. Flow (prot)	1795	0	0	3405	3194	0
Flt Permitted	0.972					
Satd. Flow (perm)	1795	0	0	3405	3194	0
Right Turn on Red		Yes				Yes
Satd. Flow (RTOR)	39					
Link Speed (k/h)	50			50	50	
Link Distance (m)	204.6			126.8	204.0	
Travel Time (s)	14.7			9.1	14.7	
Volume (vph)	81	57	0	1542	367	0
Confl. Peds. (#/hr)						
Confl. Bikes (#/hr)						
Peak Hour Factor	0.88	0.88	0.96	0.96	0.90	0.90
Growth Factor	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	0%	14%	0%	2%	5%	0%
Bus Blockages (#/hr)	0	0	0	0	0	0
Parking (#/hr)						
Mid-Block Traffic (%)	0%			0%	0%	
Lane Group Flow (vph)	157	0	0	1606	408	0
Turn Type						
Protected Phases	2			1	1	
Permitted Phases						
Detector Phases	2			1	1	
Minimum Initial (s)	4.0			4.0	4.0	
Minimum Split (s)	15.0			20.0	20.0	
Total Split (s)	15.0	0.0	0.0	62.0	62.0	0.0
Total Split (%)	19.5%	0.0%	0.0%	80.5%	80.5%	0.0%
Yellow Time (s)	2.0			2.0	2.0	
All-Red Time (s)	1.0			1.0	1.0	
Lead/Lag	Lag			Lead	Lead	
Lead-Lag Optimize?	Yes			Yes	Yes	
Recall Mode	Max			Max	Max	
Act Effct Green (s)	11.7			58.7	58.7	
Actuated g/C Ratio	0.15			0.76	0.76	
v/c Ratio	0.51			0.62	0.17	
Control Delay	29.0			5.4	2.7	
Queue Delay	0.6			0.0	0.0	
Total Delay	29.6			5.4	2.7	
LOS	C			A	A	
Approach Delay	29.6			5.4	2.7	
Approach LOS	C			A	A	
Queue Length 50th (m)	16.7			43.8	6.7	
Queue Length 95th (m)	33.8			58.5	10.0	
Internal Link Dist (m)	180.6			102.8	180.0	

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ISBAK INC.
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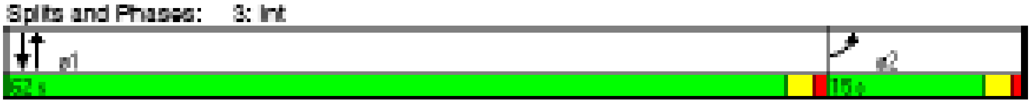
Lanes, Volumes, Timings
3: Int 09.04.2006

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Turn Bay Length (m)						
Base Capacity (vph)	306			2596	2435	
Starvation Cap Reductn	0			0	0	
Spillback Cap Reductn	27			23	0	
Storage Cap Reductn	0			0	0	
Reduced v/c Ratio	0.56			0.62	0.17	

Intersection Summary

Area Type: Other
Cycle Length: 77
Actuated Cycle Length: 77
Offset: 0 (0%), Referenced to phase 2:EBL, Start of Green
Natural Cycle: 45
Control Type: Pretimed
Maximum v/c Ratio: 0.62
Intersection Signal Delay: 6.6 Intersection LOS: A
Intersection Capacity Utilization 76.0% ICU Level of Service D
Analysis Period (min) 15

Splits and Phases: 3: Int



1102 A – Ahırkapı Intersection – A, PM Peak, Existing

Lanes, Volumes, Timings
1102: Int 09.04.2006

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Ideal Flow (vphpl)	1891	1891	1891	1891	1891	1891
Lane Width (m)	3.6	3.6	3.9	3.3	3.2	3.6
Grade (%)	0%			0%	0%	
Storage Length (m)	0.0	0.0	0.0			0.0
Storage Lanes	0	0	1			0
Total Lost Time (s)	3.3	3.3	3.3	3.3	3.3	3.3
Leading Detector (m)			15.0	15.0	15.0	
Trailing Detector (m)			0.0	0.0	0.0	
Turning Speed (k/h)	25	15	25			15
Satd. Flow (prot)	0	0	1802	1792	3351	0
Flt Permitted			0.950			
Satd. Flow (perm)	0	0	1802	1792	3351	0
Right Turn on Red		Yes				Yes
Satd. Flow (RTOR)					9	
Link Speed (k/h)	50			50	50	
Link Distance (m)	204.6			204.0	96.4	
Travel Time (s)	14.7			14.7	6.9	
Volume (vph)	0	0	115	872	1410	45
Confl. Peds. (#/hr)						
Confl. Bikes (#/hr)						
Peak Hour Factor	0.92	0.92	0.81	0.93	0.88	0.80
Growth Factor	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	0%	0%	3%	2%	2%	0%
Bus Blockages (#/hr)	0	0	0	0	0	0
Parking (#/hr)						
Mid-Block Traffic (%)	0%			0%	0%	
Lane Group Flow (vph)	0	0	142	938	1658	0
Turn Type			Prot			
Protected Phases			1	1 2	2	
Permitted Phases						
Detector Phases			1	1 2	2	
Minimum Initial (s)			4.0		4.0	
Minimum Split (s)			8.0		20.0	
Total Split (s)	0.0	0.0	23.0	92.0	69.0	0.0
Total Split (%)	0.0%	0.0%	25.0%	100.0%	75.0%	0.0%
Yellow Time (s)			2.0		3.0	
All-Red Time (s)			1.0		1.0	
Lead/Lag			Lead		Lag	
Lead-Lag Optimize?			Yes		Yes	
Recall Mode			Max		Max	
Act Effct Green (s)			19.7	92.0	65.7	
Actuated g/C Ratio			0.21	1.00	0.71	
v/c Ratio			0.37	0.52	0.69	
Control Delay			45.0	2.4	9.3	
Queue Delay			0.0	0.0	0.0	
Total Delay			45.0	2.4	9.3	
LOS			D	A	A	
Approach Delay				8.0	9.3	
Approach LOS				A	A	
Queue Length 50th (m)			26.5	21.7	77.5	
Queue Length 95th (m)			m39.6	35.8	95.0	
Internal Link Dist (m)	180.6			180.0	72.4	

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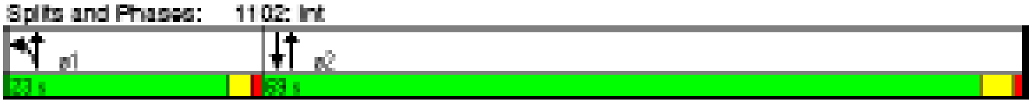
Lanes, Volumes, Timings
1102: Int 09.04.2006

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Turn Bay Length (m)						
Base Capacity (vph)			386	1792	2396	
Starvation Cap Reductn			0	0	0	
Spillback Cap Reductn			0	0	0	
Storage Cap Reductn			0	0	0	
Reduced v/c Ratio			0.37	0.52	0.69	

Intersection Summary

Area Type: Other
Cycle Length: 92
Actuated Cycle Length: 92
Offset: 12 (13%), Referenced to phase 6:, Start of Green
Natural Cycle: 45
Control Type: Pretimed
Maximum v/c Ratio: 0.69
Intersection Signal Delay: 8.8 Intersection LOS: A
Intersection Capacity Utilization 60.3% ICU Level of Service B
Analysis Period (min) 15
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 1102: Int



1102 B – Ahırkapı Intersection – B, PM Peak, Existing

Lanes, Volumes, Timings
3: Int 09.04.2006

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Ideal Flow (vphpl)	1891	1891	1891	1891	1891	1891
Lane Width (m)	4.4	3.6	3.6	3.3	3.0	3.6
Grade (%)	-1%			0%	0%	
Storage Length (m)	0.0	0.0	0.0			0.0
Storage Lanes	1	0	0			0
Total Lost Time (s)	3.3	3.3	3.3	3.3	3.3	3.3
Leading Detector (m)	15.0			15.0	15.0	
Trailing Detector (m)	0.0			0.0	0.0	
Turning Speed (k/h)	25	15	25			15
Satd. Flow (prot)	1864	0	0	3406	3288	0
Flt Permitted	0.981					
Satd. Flow (perm)	1864	0	0	3406	3288	0
Right Turn on Red		Yes				Yes
Satd. Flow (RTOR)	65					
Link Speed (k/h)	50			50	50	
Link Distance (m)	204.6			126.8	204.0	
Travel Time (s)	14.7			9.1	14.7	
Volume (vph)	81	162	0	906	1409	0
Confl. Peds. (#/hr)						
Confl. Bikes (#/hr)						
Peak Hour Factor	0.71	0.93	0.93	0.93	0.88	0.88
Growth Factor	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	0%	0%	0%	2%	2%	0%
Bus Blockages (#/hr)	0	0	0	0	0	0
Parking (#/hr)						
Mid-Block Traffic (%)	0%			0%	0%	
Lane Group Flow (vph)	288	0	0	974	1601	0
Turn Type						
Protected Phases	2			1	1	
Permitted Phases						
Detector Phases	2			1	1	
Minimum Initial (s)	4.0			4.0	4.0	
Minimum Split (s)	15.0			20.0	20.0	
Total Split (s)	19.0	0.0	0.0	73.0	73.0	0.0
Total Split (%)	20.7%	0.0%	0.0%	79.3%	79.3%	0.0%
Yellow Time (s)	2.0			2.0	2.0	
All-Red Time (s)	1.0			1.0	1.0	
Lead/Lag	Lag			Lead	Lead	
Lead-Lag Optimize?	Yes			Yes	Yes	
Recall Mode	Max			Max	Max	
Act Effct Green (s)	15.7			69.7	69.7	
Actuated g/C Ratio	0.17			0.76	0.76	
v/c Ratio	0.77			0.38	0.64	
Control Delay	43.7			4.3	5.4	
Queue Delay	0.0			0.0	0.0	
Total Delay	43.7			4.3	5.4	
LOS	D			A	A	
Approach Delay	43.7			4.3	5.4	
Approach LOS	D			A	A	
Queue Length 50th (m)	40.1			26.0	50.0	
Queue Length 95th (m)	49.0			33.8	55.3	
Internal Link Dist (m)	180.6			102.8	180.0	

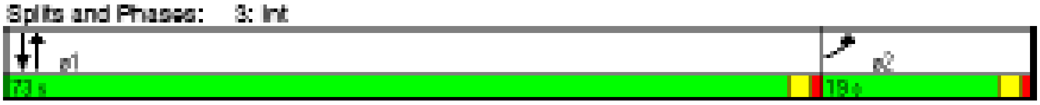
Lanes, Volumes, Timings
3: Int 09.04.2006

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Turn Bay Length (m)						
Base Capacity (vph)	372			2580	2491	
Starvation Cap Reductn	0			0	11	
Spillback Cap Reductn	0			0	0	
Storage Cap Reductn	0			0	0	
Reduced v/c Ratio	0.77			0.38	0.65	

Intersection Summary

Area Type: Other
Cycle Length: 92
Actuated Cycle Length: 92
Offset: 0 (0%), Referenced to phase 2:EBL, Start of Green
Natural Cycle: 60
Control Type: Pretimed
Maximum v/c Ratio: 0.77
Intersection Signal Delay: 8.9 Intersection LOS: A
Intersection Capacity Utilization 60.3% ICU Level of Service B
Analysis Period (min) 15

Splits and Phases: 3: Int



1102 A – Ahırkapı Intersection – A, PM Peak, Optimum

Lanes, Volumes, Timings
1102: Int

09.04.2006

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Ideal Flow (vphpl)	1891	1891	1891	1891	1891	1891
Lane Width (m)	3.6	3.6	3.9	3.3	3.2	3.6
Grade (%)	0%			0%	0%	
Storage Length (m)	0.0	0.0	0.0			0.0
Storage Lanes	0	0	1			0
Total Lost Time (s)	3.3	3.3	3.3	3.3	3.3	3.3
Leading Detector (m)			15.0	15.0	15.0	
Trailing Detector (m)			0.0	0.0	0.0	
Turning Speed (k/h)	25	15	25			15
Satd. Flow (prot)	0	0	1802	1792	3351	0
Flt Permitted			0.950			
Satd. Flow (perm)	0	0	1802	1792	3351	0
Right Turn on Red		Yes				Yes
Satd. Flow (RTOR)					11	
Link Speed (k/h)	50			50	50	
Link Distance (m)	204.6			204.0	96.4	
Travel Time (s)	14.7			14.7	6.9	
Volume (vph)	0	0	115	872	1410	45
Confl. Peds. (#/hr)						
Confl. Bikes (#/hr)						
Peak Hour Factor	0.92	0.92	0.81	0.93	0.88	0.80
Growth Factor	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	0%	0%	3%	2%	2%	0%
Bus Blockages (#/hr)	0	0	0	0	0	0
Parking (#/hr)						
Mid-Block Traffic (%)	0%			0%	0%	
Lane Group Flow (vph)	0	0	142	938	1658	0
Turn Type			Prot			
Protected Phases			1	1 2	2	
Permitted Phases						
Detector Phases			1	1 2	2	
Minimum Initial (s)			4.0		4.0	
Minimum Split (s)			8.0		20.0	
Total Split (s)	0.0	0.0	19.0	71.0	52.0	0.0
Total Split (%)	0.0%	0.0%	26.8%	100.0%	73.2%	0.0%
Yellow Time (s)			2.0		3.0	
All-Red Time (s)			1.0		1.0	
Lead/Lag			Lead		Lag	
Lead-Lag Optimize?			Yes		Yes	
Recall Mode			Max		Max	
Act Effct Green (s)			15.7	71.0	48.7	
Actuated g/C Ratio			0.22	1.00	0.69	
v/c Ratio			0.36	0.52	0.72	
Control Delay			34.6	2.4	9.2	
Queue Delay			0.0	0.0	0.0	
Total Delay			34.6	2.4	9.2	
LOS			C	A	A	
Approach Delay				6.7	9.2	
Approach LOS				A	A	
Queue Length 50th (m)			20.3	13.1	62.0	
Queue Length 95th (m)			m32.2	30.6	80.8	
Internal Link Dist (m)	180.6			180.0	72.4	

Baseline
ISBAK INC.

Synchro 6 Report
Page 1

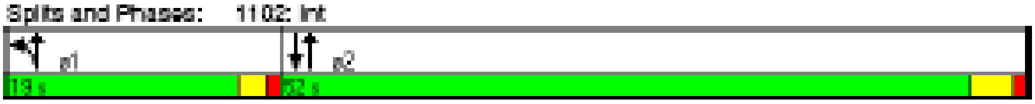
Lanes, Volumes, Timings
1102: Int 09.04.2006

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Turn Bay Length (m)						
Base Capacity (vph)			398	1792	2302	
Starvation Cap Reductn			0	0	0	
Spillback Cap Reductn			0	0	0	
Storage Cap Reductn			0	0	0	
Reduced v/c Ratio			0.36	0.52	0.72	

Intersection Summary	
Area Type: Other	
Cycle Length: 71	
Actuated Cycle Length: 71	
Offset: 12 (17%), Referenced to phase 6:, Start of Green	
Natural Cycle: 45	
Control Type: Pretimed	
Maximum v/c Ratio: 0.72	
Intersection Signal Delay: 8.2	Intersection LOS: A
Intersection Capacity Utilization 60.3%	ICU Level of Service B
Analysis Period (min) 15	

m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 1102: Int



1102 B – Ahırkapı Intersection – B, PM Peak, Optimum

Lanes, Volumes, Timings
3: Int 09.04.2006

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Ideal Flow (vphpl)	1891	1891	1891	1891	1891	1891
Lane Width (m)	4.4	3.6	3.6	3.3	3.0	3.6
Grade (%)	-1%			0%	0%	
Storage Length (m)	0.0	0.0	0.0			0.0
Storage Lanes	1	0	0			0
Total Lost Time (s)	3.3	3.3	3.3	3.3	3.3	3.3
Leading Detector (m)	15.0			15.0	15.0	
Trailing Detector (m)	0.0			0.0	0.0	
Turning Speed (k/h)	25	15	25			15
Satd. Flow (prot)	1864	0	0	3405	3288	0
Flt Permitted	0.981					
Satd. Flow (perm)	1864	0	0	3405	3288	0
Right Turn on Red		Yes				Yes
Satd. Flow (RTOR)	57					
Link Speed (k/h)	50			50	50	
Link Distance (m)	204.6			126.8	204.0	
Travel Time (s)	14.7			9.1	14.7	
Volume (vph)	81	162	0	906	1409	0
Confl. Peds. (#/hr)						
Confl. Bikes (#/hr)						
Peak Hour Factor	0.71	0.93	0.93	0.93	0.88	0.88
Growth Factor	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	0%	0%	0%	2%	2%	0%
Bus Blockages (#/hr)	0	0	0	0	0	0
Parking (#/hr)						
Mid-Block Traffic (%)	0%			0%	0%	
Lane Group Flow (vph)	288	0	0	974	1601	0
Turn Type						
Protected Phases	2			1	1	
Permitted Phases						
Detector Phases	2			1	1	
Minimum Initial (s)	4.0			4.0	4.0	
Minimum Split (s)	15.0			20.0	20.0	
Total Split (s)	16.0	0.0	0.0	55.0	55.0	0.0
Total Split (%)	22.5%	0.0%	0.0%	77.5%	77.5%	0.0%
Yellow Time (s)	2.0			2.0	2.0	
All-Red Time (s)	1.0			1.0	1.0	
Lead/Lag	Lag			Lead	Lead	
Lead-Lag Optimize?	Yes			Yes	Yes	
Recall Mode	Max			Max	Max	
Act Effct Green (s)	12.7			51.7	51.7	
Actuated g/C Ratio	0.18			0.73	0.73	
v/c Ratio	0.76			0.39	0.67	
Control Delay	37.0			4.2	7.0	
Queue Delay	0.0			0.0	0.0	
Total Delay	37.0			4.2	7.0	
LOS	D			A	A	
Approach Delay	37.0			4.2	7.0	
Approach LOS	D			A	A	
Queue Length 50th (m)	30.9			21.2	48.6	
Queue Length 95th (m)	40.3			29.1	73.6	
Internal Link Dist (m)	180.6			102.8	180.0	

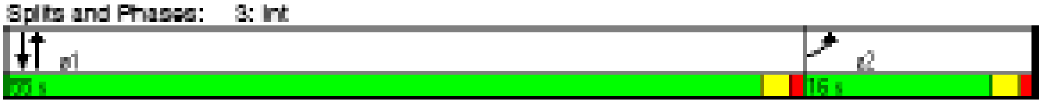
Lanes, Volumes, Timings
3: Int 09.04.2006

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Turn Bay Length (m)						
Base Capacity (vph)	380			2479	2394	
Starvation Cap Reductn	0			0	0	
Spillback Cap Reductn	0			0	0	
Storage Cap Reductn	0			0	0	
Reduced v/c Ratio	0.76			0.39	0.67	

Intersection Summary

Area Type: Other
Cycle Length: 71
Actuated Cycle Length: 71
Offset: 0 (0%), Referenced to phase 2:EBL, Start of Green
Natural Cycle: 60
Control Type: Pretimed
Maximum v/c Ratio: 0.76
Intersection Signal Delay: 9.1 Intersection LOS: A
Intersection Capacity Utilization 60.3% ICU Level of Service B
Analysis Period (min) 15

Splits and Phases: 3: Int



1115 – Silivrikapı Intersection – Off-peak, Optimum C=51

Lanes, Volumes, Timings

1115: Int   26.03.2006

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1891	1891	1891	1891	1891	1891	1891	1891	1891	1891	1891	1891
Lane Width (m)	3.6	2.5	3.6	3.6	3.2	3.6	3.6	3.3	3.6	3.6	3.2	3.6
Grade (%)		0%			1%			2%			-5%	
Total Lost Time (s)	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
Turning Speed (k/h)	25		15	25		15	25		15	25		15
Satd. Flow (prot)	0	1469	0	0	3161	0	0	3244	0	0	3326	0
Flt Permitted		0.975			0.984							
Satd. Flow (perm)	0	1469	0	0	3161	0	0	3244	0	0	3326	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		35			161						18	
Link Speed (k/h)		50			50			50			50	
Link Distance (m)		212.8			268.8			190.4			220.8	
Travel Time (s)		15.3			19.4			13.7			15.9	
Volume (vph)	35	0	33	125	113	143	0	710	0	0	848	50
Peak Hour Factor	0.94	0.94	0.94	0.89	0.89	0.89	0.91	0.91	0.91	0.89	0.89	0.89
Heavy Vehicles (%)	0%	0%	6%	0%	0%	1%	0%	6%	0%	0%	5%	4%
Lane Group Flow (vph)	0	72	0	0	428	0	0	780	0	0	1009	0
Turn Type	Split			Split								
Protected Phases	3	3		2	2			1			1	
Permitted Phases												
Minimum Split (s)	5.0	5.0		10.0	10.0			20.5			20.5	
Total Split (s)	8.5	8.5	0.0	12.0	12.0	0.0	0.0	30.5	0.0	0.0	30.5	0.0
Total Split (%)	16.7%	16.7%	0.0%	23.5%	23.5%	0.0%	0.0%	59.8%	0.0%	0.0%	59.8%	0.0%
Yellow Time (s)	2.5	2.5		2.0	2.0			2.0			2.0	
All-Red Time (s)	1.0	1.0		0.0	0.0			2.0			2.0	
Lead/Lag				Lag	Lag			Lead			Lead	
Lead-Lag Optimize?				Yes	Yes			Yes			Yes	
Act Effct Green (s)		4.9			8.4			26.9			26.9	
Actuated g/C Ratio		0.10			0.16			0.53			0.53	
v/c Ratio		0.42			0.65			0.46			0.57	
Control Delay		21.3			17.6			8.6			9.6	
Queue Delay		0.0			0.0			0.0			0.0	
Total Delay		21.3			17.6			8.6			9.6	
LOS		C			B			A			A	
Approach Delay		21.3			17.6			8.6			9.6	
Approach LOS		C			B			A			A	
Queue Length 50th (m)		3.4			12.4			21.7			30.0	
Queue Length 95th (m)		13.2			23.9			32.9			43.8	
Internal Link Dist (m)		188.8			244.8			166.4			196.8	
Turn Bay Length (m)												
Base Capacity (vph)		173			655			1711			1763	
Starvation Cap Reductn		0			0			0			0	
Spillback Cap Reductn		0			0			0			0	
Storage Cap Reductn		0			0			0			0	
Reduced v/c Ratio		0.42			0.65			0.46			0.57	

Intersection Summary

Area Type: Other

Cycle Length: 51

Actuated Cycle Length: 51

Offset: 0 (0%), Referenced to phase 2:WBTL, Start of Green

Natural Cycle: 40

Lanes, Volumes, Timings
1115: Int

26.03.2006

Control Type: Pretimed
Maximum v/c Ratio: 0.65
Intersection Signal Delay: 11.1 Intersection LOS: B
Intersection Capacity Utilization 50.5% ICU Level of Service A
Analysis Period (min) 15

Splits and Phases: 1115: Int

1115 – Silivrikapı Intersection – Off-peak, Optimum C=82

Lanes, Volumes, Timings
1115: Int

26.03.2006

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1891	1891	1891	1891	1891	1891	1891	1891	1891	1891	1891	1891
Lane Width (m)	3.6	2.5	3.6	3.6	3.2	3.6	3.6	3.3	3.6	3.6	3.2	3.6
Grade (%)		0%			1%			2%			-5%	
Storage Length (m)	0.0		0.0	0.0		0.0	0.0		0.0	0.0		0.0
Storage Lanes	0		0	0		0	0		0	0		0
Total Lost Time (s)	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
Leading Detector (m)	15.0	15.0		15.0	15.0			15.0			15.0	
Trailing Detector (m)	0.0	0.0		0.0	0.0			0.0			0.0	
Turning Speed (k/h)	25		15	25		15	25		15	25		15
Satd. Flow (prot)	0	1470	0	0	3126	0	0	3275	0	0	3359	0
Flt Permitted		0.973			0.983							
Satd. Flow (perm)	0	1470	0	0	3126	0	0	3275	0	0	3359	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		29			139						16	
Link Speed (k/h)		50			50			50			50	
Link Distance (m)		212.8			268.8			190.4			220.8	
Travel Time (s)		15.3			19.4			13.7			15.9	
Volume (vph)	34	0	28	127	98	136	0	728	0	0	794	58
Confl. Peds. (#/hr)												
Confl. Bikes (#/hr)												
Peak Hour Factor	0.97	0.97	0.97	0.96	0.96	0.96	0.99	0.99	0.99	0.97	0.97	0.97
Growth Factor	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	0%	0%	7%	0%	2%	2%	0%	5%	0%	0%	4%	0%
Bus Blockages (#/hr)	0	0	0	0	0	0	0	0	0	0	0	0
Parking (#/hr)												
Mid-Block Traffic (%)		0%			0%			0%			0%	
Lane Group Flow (vph)	0	64	0	0	376	0	0	735	0	0	879	0
Turn Type	Split			Split								
Protected Phases	3	3		2	2			1			1	
Permitted Phases												
Detector Phases	3	3		2	2			1			1	
Minimum Initial (s)	1.5	1.5		4.0	4.0			4.0			4.0	
Minimum Split (s)	5.0	5.0		10.0	10.0			20.5			20.5	
Total Split (s)	10.5	10.5	0.0	20.0	20.0	0.0	0.0	51.5	0.0	0.0	51.5	0.0
Total Split (%)	12.8%	12.8%	0.0%	24.4%	24.4%	0.0%	0.0%	62.8%	0.0%	0.0%	62.8%	0.0%
Yellow Time (s)	2.5	2.5		2.0	2.0			2.0			2.0	
All-Red Time (s)	1.0	1.0		0.0	0.0			2.0			2.0	
Lead/Lag				Lag	Lag			Lead			Lead	
Lead-Lag Optimize?				Yes	Yes			Yes			Yes	
Recall Mode	Max	Max		Max	Max			Max			Max	
Act Effct Green (s)		6.9			16.4			47.9			47.9	
Actuated g/C Ratio		0.08			0.20			0.58			0.58	
v/c Ratio		0.43			0.51			0.38			0.45	
Control Delay		32.0			20.9			9.9			10.3	
Queue Delay		0.0			0.0			0.0			0.0	
Total Delay		32.0			20.9			9.9			10.3	
LOS		C			C			A			B	
Approach Delay		32.0			20.9			9.9			10.3	
Approach LOS		C			C			A			B	
Queue Length 50th (m)		6.5			17.8			31.1			38.2	
Queue Length 95th (m)		17.7			31.4			42.5			51.5	
Internal Link Dist (m)		188.8			244.8			166.4			196.8	

Lanes, Volumes, Timings
1115: Int 26.03.2006

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Turn Bay Length (m)												
Base Capacity (vph)		150			736			1913			1969	
Starvation Cap Reductn		0			0			0			0	
Spillback Cap Reductn		0			0			0			0	
Storage Cap Reductn		0			0			0			0	
Reduced v/c Ratio		0.43			0.51			0.38			0.45	

Intersection Summary

Area Type: Other
Cycle Length: 82
Actuated Cycle Length: 82
Offset: 0 (0%), Referenced to phase 2:WBTL, Start of Green
Natural Cycle: 40
Control Type: Pretimed
Maximum v/c Ratio: 0.51
Intersection Signal Delay: 12.7 Intersection LOS: B
Intersection Capacity Utilization 48.3% ICU Level of Service A
Analysis Period (min) 15

Splits and Phases: 1115: Int

1115 – Silivrikapı Intersection – Off-peak, Existing

Lanes, Volumes, Timings
1115: Int 26.03.2006

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1891	1891	1891	1891	1891	1891	1891	1891	1891	1891	1891	1891
Lane Width (m)	3.6	2.5	3.6	3.6	3.2	3.6	3.6	3.3	3.6	3.6	3.2	3.6
Grade (%)		0%			1%			2%			-5%	
Storage Length (m)	0.0		0.0	0.0		0.0	0.0		0.0	0.0		0.0
Storage Lanes	0		0	0		0	0		0	0		0
Total Lost Time (s)	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
Leading Detector (m)	15.0	15.0		15.0	15.0			15.0			15.0	
Trailing Detector (m)	0.0	0.0		0.0	0.0			0.0			0.0	
Turning Speed (k/h)	25		15	25		15	25		15	25		15
Satd. Flow (prot)	0	1438	0	0	3145	0	0	3275	0	0	3326	0
Flt Permitted		0.978			0.983							
Satd. Flow (perm)	0	1438	0	0	3145	0	0	3275	0	0	3326	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		47			120						11	
Link Speed (k/h)		50			50			50			50	
Link Distance (m)		212.8			268.8			190.4			220.8	
Travel Time (s)		15.3			19.4			13.7			15.9	
Volume (vph)	31	0	39	126	115	134	0	711	0	0	874	50
Confl. Peds. (#/hr)												
Confl. Bikes (#/hr)												
Peak Hour Factor	0.83	0.83	0.83	0.94	0.94	0.94	0.87	0.87	0.87	0.89	0.89	0.89
Growth Factor	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	6%	0%	3%	1%	1%	1%	0%	5%	0%	0%	5%	4%
Bus Blockages (#/hr)	0	0	0	0	0	0	0	0	0	0	0	0
Parking (#/hr)												
Mid-Block Traffic (%)		0%			0%			0%			0%	
Lane Group Flow (vph)	0	84	0	0	399	0	0	817	0	0	1038	0
Turn Type	Split			Split								
Protected Phases	3	3		2	2			1			1	
Permitted Phases												
Detector Phases	3	3		2	2			1			1	
Minimum Initial (s)	4.0	4.0		4.0	4.0			4.0			4.0	
Minimum Split (s)	15.0	15.0		19.5	19.5			20.5			20.5	
Total Split (s)	15.0	15.0	0.0	19.5	19.5	0.0	0.0	45.5	0.0	0.0	45.5	0.0
Total Split (%)	18.8%	18.8%	0.0%	24.4%	24.4%	0.0%	0.0%	56.9%	0.0%	0.0%	56.9%	0.0%
Yellow Time (s)	2.0	2.0		2.0	2.0			2.5			2.5	
All-Red Time (s)	1.0	1.0		0.0	0.0			2.0			2.0	
Lead/Lag				Lag	Lag			Lead			Lead	
Lead-Lag Optimize?				Yes	Yes			Yes			Yes	
Recall Mode	Max	Max		Max	Max			Max			Max	
Act Effct Green (s)		11.4			15.9			41.9			41.9	
Actuated g/C Ratio		0.14			0.20			0.52			0.52	
v/c Ratio		0.34			0.55			0.48			0.59	
Control Delay		20.7			23.2			13.3			14.8	
Queue Delay		0.0			0.0			0.0			0.0	
Total Delay		20.7			23.2			13.3			14.8	
LOS		C			C			B			B	
Approach Delay		20.7			23.2			13.3			14.8	
Approach LOS		C			C			B			B	
Queue Length 50th (m)		5.3			20.8			40.8			56.0	
Queue Length 95th (m)		16.1			35.1			52.8			73.6	
Internal Link Dist (m)		188.8			244.8			166.4			196.8	

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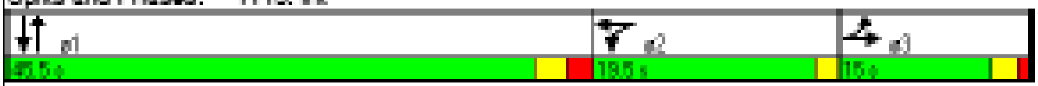
Lanes, Volumes, Timings
1115: Int 26.03.2006

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Turn Bay Length (m)												
Base Capacity (vph)		245			721			1715			1747	
Starvation Cap Reductn		0			0			0			0	
Spillback Cap Reductn		0			0			0			0	
Storage Cap Reductn		0			0			0			0	
Reduced v/c Ratio		0.34			0.55			0.48			0.59	

Intersection Summary
Area Type: Other
Cycle Length: 80
Actuated Cycle Length: 80
Offset: 0 (0%), Referenced to phase 2:WBTL, Start of Green
Natural Cycle: 60
Control Type: Pretimed
Maximum v/c Ratio: 0.59
Intersection Signal Delay: 15.9 Intersection LOS: B
Intersection Capacity Utilization 51.2% ICU Level of Service A
Analysis Period (min) 15

Splits and Phases: 1115: Int



1162 A – Unverdi Intersection – Off-peak

Lanes, Volumes, Timings
3: Int 27.03.2006

Lane Group	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Ideal Flow (vphpl)	1891	1891	1891	1891	1891	1891	1891	1891	1891	1891	1891	1891
Lane Width (m)	3.6	3.5	3.6	3.6	3.5	3.6	3.6	3.8	4.8	3.6	3.6	4.8
Grade (%)		0%			0%			0%			0%	
Storage Length (m)	0.0		0.0	0.0		0.0	0.0		0.0	0.0		0.0
Storage Lanes	0		0	0		0	0		1	0		1
Total Lost Time (s)	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
Leading Detector (m)	15.0	15.0		15.0	15.0		15.0	15.0	15.0	15.0	15.0	15.0
Trailing Detector (m)	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Turning Speed (k/h)	25		15	25		15	25		15	25		15
Satd. Flow (prot)	0	4622	0	0	4835	0	0	3391	1822	0	3293	2143
Flt Permitted		0.983			0.986			0.990			0.984	
Satd. Flow (perm)	0	4622	0	0	4835	0	0	3391	1822	0	3293	2143
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		51			6				3			
Link Speed (k/h)		50			50			50			50	
Link Distance (m)		228.0			200.8			231.1			235.3	
Travel Time (s)		16.4			14.5			16.6			16.9	
Volume (vph)	361	361	143	179	428	26	174	725	3	278	564	0
Confl. Peds. (#/hr)												
Confl. Bikes (#/hr)												
Peak Hour Factor	0.93	0.93	0.93	0.95	0.95	0.95	0.91	0.91	0.91	0.96	0.96	0.96
Growth Factor	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	3%	4%	14%	3%	3%	15%	4%	8%	0%	4%	9%	0%
Bus Blockages (#/hr)	0	0	0	0	0	0	0	0	0	0	0	0
Parking (#/hr)												
Mid-Block Traffic (%)		0%			0%			0%			0%	
Lane Group Flow (vph)	0	923	0	0	666	0	0	988	3	0	878	0
Turn Type	Split			Split			Split		Free	Split		Free
Protected Phases	2	2		1	1		4	4		3	3	
Permitted Phases									Free			Free
Detector Phases	2	2		1	1		4	4		3	3	
Minimum Initial (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Minimum Split (s)	20.0	20.0		15.0	15.0		20.5	20.5		20.5	20.5	
Total Split (s)	20.0	20.0	0.0	15.0	15.0	0.0	31.0	31.0	0.0	24.0	24.0	0.0
Total Split (%)	22.2%	22.2%	0.0%	16.7%	16.7%	0.0%	34.4%	34.4%	0.0%	26.7%	26.7%	0.0%
Yellow Time (s)	2.0	2.0		2.0	2.0		2.0	2.0		2.0	2.0	
All-Red Time (s)	1.0	1.0		1.0	1.0		1.0	1.0		1.0	1.0	
Lead/Lag	Lag	Lag		Lead	Lead		Lag	Lag		Lead	Lead	
Lead-Lag Optimize?	Yes	Yes		Yes	Yes		Yes	Yes		Yes	Yes	
Recall Mode	Max	Max		Max	Max		Max	Max		Max	Max	
Act Effct Green (s)		16.4			11.4			27.4	90.0		20.4	
Actuated g/C Ratio		0.18			0.13			0.30	1.00		0.23	
v/c Ratio		0.93			1.08			0.96	0.00		1.18	
Control Delay		62.5			97.4			61.3	0.0		126.4	
Queue Delay		0.0			0.0			0.0	0.0		0.0	
Total Delay		62.5			97.4			61.3	0.0		126.4	
LOS		D			F			D	A		F	
Approach Delay		62.5			97.4			61.2			126.4	
Approach LOS		D			F			D			F	
Queue Length 50th (m)		61.3			~49.8			92.4	0.0		~101.6	
Queue Length 95th (m)		#76.7			#74.8			#134.4	0.0		#139.6	
Internal Link Dist (m)		204.0			176.8			207.1			211.3	

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ISBAK INC.

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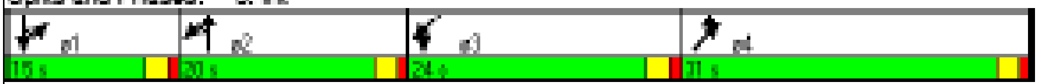
Lanes, Volumes, Timings
3: Int 27.03.2006

Lane Group	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Turn Bay Length (m)												
Base Capacity (vph)		884			618			1032	1822		746	
Starvation Cap Reductn		0			0			0	0		0	
Spillback Cap Reductn		0			0			0	0		0	
Storage Cap Reductn		0			0			0	0		0	
Reduced v/c Ratio		0.93			1.08			0.96	0.00		1.18	

Intersection Summary

Area Type: Other
Cycle Length: 90
Actuated Cycle Length: 90
Offset: 60 (67%), Referenced to phase 6:, Start of Green
Natural Cycle: 100
Control Type: Pretimed
Maximum v/c Ratio: 1.18
Intersection Signal Delay: 80.3 Intersection LOS: F
Intersection Capacity Utilization 90.4% ICU Level of Service E
Analysis Period (min) 15
~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 3: Int



1163 – Yayla Intersection – Off-peak

Lanes, Volumes, Timings
1163: Int

26.03.2006

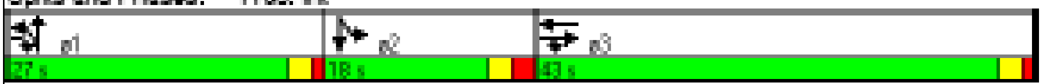
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1891	1891	1891	1891	1891	1891	1891	1891	1891	1891	1891	1891
Lane Width (m)	3.6	3.5	3.6	3.6	3.9	3.6	3.6	4.8	3.6	3.6	4.8	3.6
Grade (%)		0%			0%			0%			0%	
Storage Length (m)	0.0		0.0	0.0		0.0	0.0		0.0	0.0		0.0
Storage Lanes	0		1	0		0	0		0	0		0
Total Lost Time (s)	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
Leading Detector (m)		15.0	15.0		15.0		15.0	15.0		15.0	15.0	
Trailing Detector (m)		0.0	0.0		0.0		0.0	0.0		0.0	0.0	
Turning Speed (k/h)	25		15	25		15	25		15	25		15
Satd. Flow (prot)	0	3260	1576	0	3250	0	0	1918	0	0	1863	0
Flt Permitted								0.981			0.984	
Satd. Flow (perm)	0	3260	1576	0	3250	0	0	1918	0	0	1863	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			45		18			5			13	
Link Speed (k/h)		50			50			50			50	
Link Distance (m)		232.0			249.6			161.6			147.2	
Travel Time (s)		16.7			18.0			11.6			10.6	
Volume (vph)	0	901	41	0	709	83	120	163	27	185	263	123
Confl. Peds. (#/hr)												
Confl. Bikes (#/hr)												
Peak Hour Factor	0.92	0.92	0.92	0.95	0.95	0.95	0.83	0.83	0.83	0.96	0.96	0.96
Growth Factor	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	0%	9%	2%	0%	12%	16%	7%	10%	4%	18%	6%	6%
Bus Blockages (#/hr)	0	0	0	0	0	0	0	0	0	0	0	0
Parking (#/hr)												
Mid-Block Traffic (%)		0%			0%			0%			0%	
Lane Group Flow (vph)	0	979	45	0	833	0	0	374	0	0	595	0
Turn Type			pt+ov				Split			Split		
Protected Phases		3	3 1		3		1	1		2	2	
Permitted Phases												
Detector Phases		3	3 1		3		1	1		2	2	
Minimum Initial (s)		4.0			4.0		4.0	4.0		4.0	4.0	
Minimum Split (s)		20.0			20.0		8.0	8.0		15.0	15.0	
Total Split (s)	0.0	43.0	70.0	0.0	43.0	0.0	27.0	27.0	0.0	18.0	18.0	0.0
Total Split (%)	0.0%	48.9%	79.5%	0.0%	48.9%	0.0%	30.7%	30.7%	0.0%	20.5%	20.5%	0.0%
Yellow Time (s)		2.0			2.0		2.0	2.0		2.0	2.0	
All-Red Time (s)		1.0			1.0		1.0	1.0		2.0	2.0	
Lead/Lag							Lead	Lead		Lag	Lag	
Lead-Lag Optimize?							Yes	Yes		Yes	Yes	
Recall Mode		Max			Max		Max	Max		Max	Max	
Act Effct Green (s)		39.4	66.4		39.4			23.4			14.4	
Actuated g/C Ratio		0.45	0.75		0.45			0.27			0.16	
v/c Ratio		0.67	0.04		0.57			0.73			1.88	
Control Delay		22.0	1.0		19.5			38.6			434.0	
Queue Delay		0.0	0.0		0.0			0.0			0.0	
Total Delay		22.0	1.0		19.5			38.6			434.0	
LOS		C	A		B			D			F	
Approach Delay		21.1			19.5			38.6			434.0	
Approach LOS		C			B			D			F	
Queue Length 50th (m)		69.7	0.0		54.4			59.7			~163.6	
Queue Length 95th (m)		91.7	2.1		73.0			82.2			#229.4	
Internal Link Dist (m)		208.0			225.6			137.6			123.2	

Lanes, Volumes, Timings
1163: Int 26.03.2006

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Turn Bay Length (m)												
Base Capacity (vph)		1460	1200		1465			514			316	
Starvation Cap Reductn		0	0		0			0			0	
Spillback Cap Reductn		0	0		0			0			0	
Storage Cap Reductn		0	0		0			0			0	
Reduced v/c Ratio		0.67	0.04		0.57			0.73			1.88	

Intersection Summary
Area Type: Other
Cycle Length: 88
Actuated Cycle Length: 88
Offset: 20 (23%), Referenced to phase 6:, Start of Green
Natural Cycle: 65
Control Type: Pretimed
Maximum v/c Ratio: 1.88
Intersection Signal Delay: 109.9 Intersection LOS: F
Intersection Capacity Utilization 70.5% ICU Level of Service C
Analysis Period (min) 15
~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 1163: Int



1164 – Kocasinan Girisi Intersection – Off-peak

Lanes, Volumes, Timings
1164: Int 26.03.2006

Lane Group	EBL	EBT	WBT	WBR	SEL	SER
Lane Configurations						
Ideal Flow (vphpl)	1891	1891	1891	1891	1891	1891
Lane Width (m)	3.6	3.5	3.8	2.5	4.2	2.5
Grade (%)		0%	0%		0%	
Storage Length (m)	0.0			0.0	0.0	0.0
Storage Lanes	0			1	1	1
Total Lost Time (s)	3.6	3.6	3.6	3.6	3.6	3.6
Leading Detector (m)	15.0	15.0	15.0	15.0	15.0	15.0
Trailing Detector (m)	0.0	0.0	0.0	0.0	0.0	0.0
Turning Speed (k/h)	25			15	25	15
Satd. Flow (prot)	0	3392	3465	1260	1726	1344
Flt Permitted		0.660			0.950	
Satd. Flow (perm)	0	2252	3465	1260	1726	1344
Right Turn on Red				Yes		Yes
Satd. Flow (RTOR)				307		135
Link Speed (k/h)		50	50		50	
Link Distance (m)		235.2	294.4		249.3	
Travel Time (s)		16.9	21.2		17.9	
Volume (vph)	142	988	848	298	343	127
Confl. Peds. (#/hr)						
Confl. Bikes (#/hr)						
Peak Hour Factor	0.88	0.88	0.97	0.97	0.94	0.94
Growth Factor	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	5%	4%	6%	12%	11%	5%
Bus Blockages (#/hr)	0	0	0	0	0	0
Parking (#/hr)						
Mid-Block Traffic (%)		0%	0%		0%	
Lane Group Flow (vph)	0	1284	874	307	365	135
Turn Type	Prot			pt+ov		Free
Protected Phases	2	2 3	3	3 1	1	
Permitted Phases						Free
Detector Phases	2	2 3	3	3 1	1	
Minimum Initial (s)	4.0		4.0		4.0	
Minimum Split (s)	20.0		8.0		20.0	
Total Split (s)	14.0	68.0	54.0	76.0	22.0	0.0
Total Split (%)	15.6%	75.6%	60.0%	84.4%	24.4%	0.0%
Yellow Time (s)	2.0		2.0		2.0	
All-Red Time (s)	1.0		1.0		2.0	
Lead/Lag	Lag				Lead	
Lead-Lag Optimize?	Yes				Yes	
Recall Mode	Max		Max		Max	
Act Effct Green (s)		60.8	50.4	72.4	18.4	90.0
Actuated g/C Ratio		0.68	0.56	0.80	0.20	1.00
v/c Ratio		1.00	0.45	0.29	1.03	0.10
Control Delay		36.9	12.6	0.9	94.3	0.1
Queue Delay		0.0	0.0	0.0	0.0	0.0
Total Delay		36.9	12.6	0.9	94.3	0.1
LOS		D	B	A	F	A
Approach Delay		36.9	9.6		68.8	
Approach LOS		D	A		E	
Queue Length 50th (m)		~47.5	45.9	0.0	~72.1	0.0
Queue Length 95th (m)		#83.4	60.3	3.8	#126.8	0.0
Internal Link Dist (m)		211.2	270.4		225.3	

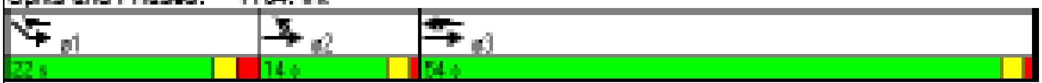
Lanes, Volumes, Timings
1164: Int 26.03.2006

Lane Group	EBL	EBT	WBT	WBR	SEL	SER
Turn Bay Length (m)						
Base Capacity (vph)		1283	1940	1074	353	1344
Starvation Cap Reductn		0	0	0	0	0
Spillback Cap Reductn		0	0	0	0	0
Storage Cap Reductn		0	0	0	0	0
Reduced v/c Ratio		1.00	0.45	0.29	1.03	0.10

Intersection Summary

Area Type: Other
Cycle Length: 90
Actuated Cycle Length: 90
Offset: 22 (24%), Referenced to phase 2:EBTL and 6:, Start of Green
Natural Cycle: 65
Control Type: Pretimed
Maximum v/c Ratio: 1.03
Intersection Signal Delay: 31.4 Intersection LOS: C
Intersection Capacity Utilization 84.2% ICU Level of Service E
Analysis Period (min) 15
~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 1164: Int



1165 – Sirinevler Intersection – Off-peak

Lanes, Volumes, Timings
1165: Int

26.03.2006

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Ideal Flow (vphpl)	1891	1891	1891	1891	1891	1891
Lane Width (m)	3.6	3.6	3.6	3.6	4.4	4.4
Grade (%)		-7%	5%		-5%	
Storage Length (m)	0.0			0.0	0.0	0.0
Storage Lanes	0			1	1	1
Total Lost Time (s)	3.6	3.6	3.6	3.6	3.6	3.6
Leading Detector (m)		15.0	15.0	15.0	15.0	15.0
Trailing Detector (m)		0.0	0.0	0.0	0.0	0.0
Turning Speed (k/h)	25			15	25	15
Satd. Flow (prot)	0	3610	3258	1371	1966	1671
Flt Permitted					0.950	
Satd. Flow (perm)	0	3610	3258	1371	1966	1671
Right Turn on Red				Yes		Yes
Satd. Flow (RTOR)				246		79
Link Speed (k/h)		50	50		50	
Link Distance (m)		212.4	330.0		278.4	
Travel Time (s)		15.3	23.8		20.0	
Volume (vph)	0	809	770	221	309	62
Confl. Peds. (#/hr)						
Confl. Bikes (#/hr)						
Peak Hour Factor	0.90	0.90	0.91	0.90	0.91	0.78
Growth Factor	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	0%	3%	3%	4%	2%	2%
Bus Blockages (#/hr)	0	0	0	0	0	0
Parking (#/hr)						
Mid-Block Traffic (%)		0%	0%		0%	
Lane Group Flow (vph)	0	899	846	246	340	79
Turn Type				pt+ov		custom
Protected Phases		1 2	1	1 3	3	
Permitted Phases						2
Detector Phases		1 2	1	1 3	3	2
Minimum Initial (s)			4.0		4.0	4.0
Minimum Split (s)			20.0		8.0	8.0
Total Split (s)	0.0	69.0	56.0	77.0	21.0	13.0
Total Split (%)	0.0%	76.7%	62.2%	85.6%	23.3%	14.4%
Yellow Time (s)			2.0		2.0	2.0
All-Red Time (s)			1.0		2.0	1.0
Lead/Lag			Lead			Lag
Lead-Lag Optimize?			Yes			Yes
Recall Mode			Max		Max	Max
Act Effct Green (s)		65.4	52.4	73.4	17.4	9.4
Actuated g/C Ratio		0.73	0.58	0.82	0.19	0.10
v/c Ratio		0.34	0.45	0.21	0.89	0.32
Control Delay		4.9	11.5	0.7	63.1	13.1
Queue Delay		0.0	0.0	0.0	0.0	0.0
Total Delay		4.9	11.5	0.7	63.1	13.1
LOS		A	B	A	E	B
Approach Delay		4.9	9.1		53.7	
Approach LOS		A	A		D	
Queue Length 50th (m)		26.0	44.0	0.0	60.9	0.0
Queue Length 95th (m)		34.0	58.4	3.5	#110.5	9.7
Internal Link Dist (m)		188.4	306.0		254.4	

Lanes, Volumes, Timings
1165: Int

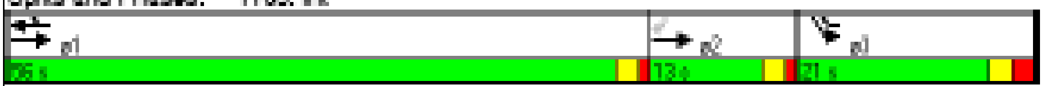
26.03.2006

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Turn Bay Length (m)						
Base Capacity (vph)		2623	1897	1164	380	245
Starvation Cap Reductn		0	0	0	0	0
Spillback Cap Reductn		0	0	0	0	0
Storage Cap Reductn		0	0	0	0	0
Reduced v/c Ratio		0.34	0.45	0.21	0.89	0.32

Intersection Summary

Area Type: Other
Cycle Length: 90
Actuated Cycle Length: 90
Offset: 34 (38%), Referenced to phase 6:, Start of Green
Natural Cycle: 40
Control Type: Pretimed
Maximum v/c Ratio: 0.89
Intersection Signal Delay: 15.3 Intersection LOS: B
Intersection Capacity Utilization 48.9% ICU Level of Service A
Analysis Period (min) 15
\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 1165: Int



1426 – UEFA Intersection – Off-peak

Lanes, Volumes, Timings
3: Int 26.03.2006

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1891	1891	1891	1891	1891	1891	1891	1891	1891	1891	1891	1891
Lane Width (m)	3.6	3.5	3.6	3.6	3.5	3.6	3.6	3.6	3.6	3.6	3.6	3.6
Grade (%)		0%			0%			0%			0%	
Storage Length (m)	0.0		0.0	30.0		0.0	0.0		0.0	0.0		0.0
Storage Lanes	0		0	1		0	0		0	0		0
Total Lost Time (s)	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
Leading Detector (m)		15.0		15.0	15.0					15.0	15.0	
Trailing Detector (m)		0.0		0.0	0.0					0.0	0.0	
Turning Speed (k/h)	25		15	25		15	25		15	25		15
Satd. Flow (prot)	0	3296	0	0	3325	0	0	0	0	0	1700	0
Flt Permitted					0.727						0.992	
Satd. Flow (perm)	0	3296	0	0	2422	0	0	0	0	0	1700	0
Right Turn on Red			No			No			No			No
Satd. Flow (RTOR)												
Link Speed (k/h)		50			50			50			50	
Link Distance (m)		137.4			176.2			250.3			228.1	
Travel Time (s)		9.9			12.7			18.0			16.4	
Volume (vph)	0	886	243	65	1060	212	0	0	0	34	91	97
Confl. Peds. (#/hr)												
Confl. Bikes (#/hr)												
Peak Hour Factor	0.77	0.77	0.77	0.86	0.86	0.86	0.90	0.90	0.90	0.83	0.83	0.83
Growth Factor	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	2%	5%	2%	6%	4%	4%	2%	2%	2%	3%	4%	4%
Bus Blockages (#/hr)	0	0	0	0	0	0	0	0	0	0	0	0
Parking (#/hr)												
Mid-Block Traffic (%)		0%			0%			0%			0%	
Lane Group Flow (vph)	0	1467	0	0	1556	0	0	0	0	0	268	0
Turn Type				Prot						Split		
Protected Phases		3		2	2 3					1	1	
Permitted Phases												
Detector Phases		3		2	2 3					1	1	
Minimum Initial (s)		5.0		1.0						5.0	5.0	
Minimum Split (s)		20.0		3.0						20.0	20.0	
Total Split (s)	0.0	61.0	0.0	8.0	69.0	0.0	0.0	0.0	0.0	21.0	21.0	0.0
Total Split (%)	0.0%	67.8%	0.0%	8.9%	76.7%	0.0%	0.0%	0.0%	0.0%	23.3%	23.3%	0.0%
Yellow Time (s)		2.0		2.0						2.0	2.0	
All-Red Time (s)		1.0		0.0						1.0	1.0	
Lead/Lag				Lag						Lead	Lead	
Lead-Lag Optimize?				Yes						Yes	Yes	
Recall Mode		Max		Max						Max	Max	
Act Effct Green (s)		57.4			61.8						17.4	
Actuated g/C Ratio		0.64			0.69						0.19	
v/c Ratio		0.70			1.37						0.81	
Control Delay		12.9			190.5						55.8	
Queue Delay		0.0			0.0						0.0	
Total Delay		12.9			190.5						55.8	
LOS		B			F						E	
Approach Delay		12.9			190.5						55.8	
Approach LOS		B			F						E	
Queue Length 50th (m)		82.4			~127.1						47.1	
Queue Length 95th (m)		79.2			#165.3						#76.4	
Internal Link Dist (m)		113.4			152.2			226.3			204.1	

Baseline Synchro 6 Report
ISBAK INC. Page 1

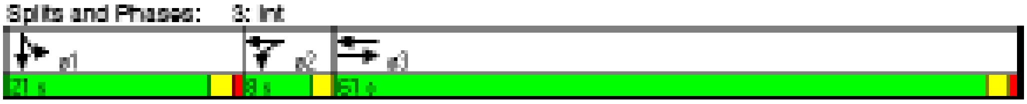
Lanes, Volumes, Timings
3: Int 26.03.2006

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Turn Bay Length (m)												
Base Capacity (vph)		2102			1135						329	
Starvation Cap Reductn		0			0						0	
Spillback Cap Reductn		0			0						0	
Storage Cap Reductn		0			0						0	
Reduced v/c Ratio		0.70			1.37						0.81	

Intersection Summary

Area Type: Other
Cycle Length: 90
Actuated Cycle Length: 90
Offset: 29 (32%), Referenced to phase 2:WBTL and 6:, Start of Green
Natural Cycle: 90
Control Type: Pretimed
Maximum v/c Ratio: 1.37
Intersection Signal Delay: 100.4 Intersection LOS: F
Intersection Capacity Utilization 93.2% ICU Level of Service F
Analysis Period (min) 15
~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 3: Int



2204 – Dolmabahce Intersection – PM Peak

Lanes, Volumes, Timings
3: Int 18.05.2006

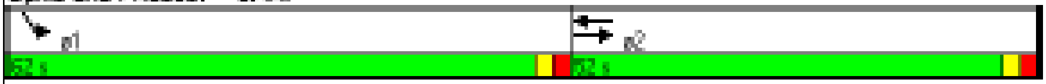
Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Ideal Flow (vphpl)	1891	1891	1891	1891	1891	1891
Lane Width (m)	3.6	3.9	3.5	3.6	3.1	3.6
Grade (%)		0%	0%		-10%	
Storage Length (m)	0.0			0.0	0.0	0.0
Storage Lanes	0			0	3	0
Total Lost Time (s)	3.6	3.6	3.6	3.6	3.6	3.6
Leading Detector (m)		15.0	15.0		15.0	
Trailing Detector (m)		0.0	0.0		0.0	
Turning Speed (k/h)	25			15	35	15
Satd. Flow (prot)	0	4529	3017	0	4347	0
Flt Permitted					0.950	
Satd. Flow (perm)	0	4529	3017	0	4347	0
Right Turn on Red				Yes		Yes
Satd. Flow (RTOR)						
Link Speed (k/h)		50	50		50	
Link Distance (m)		288.2	321.4		281.6	
Travel Time (s)		20.8	23.1		20.3	
Volume (vph)	0	1976	910	0	2102	0
Confl. Peds. (#/hr)						
Confl. Bikes (#/hr)						
Peak Hour Factor	0.82	0.82	0.96	0.96	0.90	0.90
Growth Factor	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	0%	6%	6%	0%	4%	0%
Bus Blockages (#/hr)	0	0	0	0	0	0
Parking (#/hr)						
Mid-Block Traffic (%)		0%	0%		0%	
Lane Group Flow (vph)	0	2410	948	0	2336	0
Turn Type						
Protected Phases		2	2		1	
Permitted Phases						
Detector Phases		2	2		1	
Minimum Initial (s)		4.0	4.0		4.0	
Minimum Split (s)		20.0	20.0		20.0	
Total Split (s)	0.0	52.0	52.0	0.0	62.0	0.0
Total Split (%)	0.0%	45.6%	45.6%	0.0%	54.4%	0.0%
Yellow Time (s)		2.0	2.0		2.0	
All-Red Time (s)		2.0	2.0		2.0	
Lead/Lag		Lag	Lag		Lead	
Lead-Lag Optimize?		Yes	Yes		Yes	
Recall Mode		Max	Max		Max	
Act Effct Green (s)		48.4	48.4		58.4	
Actuated g/C Ratio		0.42	0.42		0.51	
v/c Ratio		1.25	0.74		1.05	
Control Delay		149.0	31.9		61.6	
Queue Delay		0.0	0.0		0.0	
Total Delay		149.0	31.9		61.6	
LOS		F	C		E	
Approach Delay		149.0	31.9		61.6	
Approach LOS		F	C		E	
Queue Length 50th (m)		~259.5	96.4		~212.0	
Queue Length 95th (m)		#248.4	122.4		#241.3	
Internal Link Dist (m)		264.2	297.4		257.6	

Lanes, Volumes, Timings
3: Int 18.05.2006

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Turn Bay Length (m)						
Base Capacity (vph)		1928	1281		2227	
Starvation Cap Reductn		0	0		0	
Spillback Cap Reductn		0	0		0	
Storage Cap Reductn		0	0		0	
Reduced v/c Ratio		1.25	0.74		1.05	

Intersection Summary
Area Type: CBD
Cycle Length: 114
Actuated Cycle Length: 114
Offset: 0 (0%), Referenced to phase 6:, Start of Green
Natural Cycle: 120
Control Type: Pretimed
Maximum v/c Ratio: 1.25
Intersection Signal Delay: 93.6 Intersection LOS: F
Intersection Capacity Utilization 93.9% ICU Level of Service F
Analysis Period (min) 15
~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 3: Int



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