Evaluation of the Performance of On Street Parking on AL-Jumhoryia Street in Baghdad city

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ABSTRACT

This paper describes a study of traffic behavior at AL-Jumhoryia street in Baghdad city . The objective is to use simulation program OSPSM to evaluate the performance of on street parking. The first stage of this research project takes the basic measurements carried out using video camera. The basic measurements are traffic flow, operating speed, parking time, unparking time, gap, and average duration. The second stage of the simulation program OSPSM was to run it using all the observed input parameters to obtain some measures of effectiveness such as the delays caused to through vehicles, the delays caused to parked vehicles, reduction in capacity, turnover rate, Parking Index, Parking accumulation. The main conclusion to the performance of on street parking is that it is reasonable, the average delay of parked vehicles and through vehicles at AL-Jmahory street is accepted value.

تقيم أداء مواقف المركبات على الطريق في شارع الجمهورية – مدينة بغداد

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المستخلص

إن الهدف الرئيسي من هذه الدراسة هو تقيم أداء مواقف المركبات على شارع الجمهورية في مدنية بغداد . تحقيقا لهذا الهدف، تم استخدام برنامج OSPSM لتقيم أداء الموقف على الطريق. المرحلة الأولى تضمنت جمع البيانات باستخدام كاميرا فيديو وهذه البيانات هي الحجم المروري ، السرعة التشغيلية ، الوقت اللازم للوقوف ، الوقت اللازم للخروج من الموقف .المرحلة الثانية تشغيل البرنامج مستخدما البيانات التي تم جمعها لإيجاد مجموعة من مقاييس الفعالية مثل معدل التأخير للمركبات المتوقفة وغير المتوقفة و مقدار النقصان في السعة واختيار نسب المجالات الفارغة .
إن الاستنتاج الذي تم التوصل إليه إن أداء مواقف على الطرق في شارع الجمهورية مقبول وان مقدار التأخير للمركبات المتوقفة وغير المتوقفة هو قيمة مقبولة .

1. Introduction

Every vehicle trip requires parking at its destination, so parking facilities are integrated components of the roadway system. Parking is one of the first experiences that people have when traveling to a destination. Convenient and affordable parking space is considered a sign of welcome. Parking place that is difficult to find, inadequate, inconvenient or expensive will frustrate users and can contribute to spillover parking problems in other areas. As a result, inadequate parking supply can create problems to both users and nonusers.

The main objective of the present paper is to evaluate the performance of the on street parking in AL-Jmahory street by using OSPSM package(Ahmed,2006) which describes traffic behavior at any parking place.

2-Back ground

Generally, parking facilities can be classified into two types: on- street parking and off-street parking. Mcshane and Roess (1990) categorized the parking facilities in a number of ways: either by physical characteristics or by type of operation, and / or by type of fee structure The most convenient place to park for a car owner is at curbsides, but this has several disadvantages. First, the flow of traffic along the street is hampered leading to congestion and delay to all travelers. Secondly, even a few parked vehicles along a road effectively reduce the width of the road, and thus reduce its ability to carry the traffic flow (Hobbs, 1979)

The most common form of curbside parking on roadway is parallel parking. It has least impact on through vehicles and requires less lane width than other parking angle. Angle parking can accommodate up to as many vehicles a long curb than parallel parking. The difference is a function of the angle used; low angles (less than 30 degrees) give little advantage. The maximum advantage is given when 90-degree parking is used (Young, 1991). Right angle parking will accommodate nearly two and half times the number of vehicle as parallel.

3-Site selection

The study area is located in AL-Jmahory street in Baghdad city between Al- Ameen square and Shorga over a length of 570 m with two through lanes and one parking lane (90-vehicle space). Vehicles parked at road way curbside by parallel angle.

4.Selection of measures of effectiveness

To evaluate the performance of the modeled system, some measures of effectiveness must be selected. These measures must be able to give a clear idea about the performance of the system. In this respect, the performance of the parking system can be measured in many ways. Usually, some suggested measures include average time to find parking place, average time to exit from the parking facility, average number of parking place used, maximum number of parking places used, minimum number of parking places used, etc. In OSPSM package some measures of performance were studied ,these are : -

4.1 Calculation of delay

Two types of delay may be encountered in the process of on- street parking. These are:

4.1.1 The delays caused to through vehicles

The delays caused by parking maneuver can be analyzed into four separate parts:

1-Delay to through vehicles due to reducing parked vehicle speed to park at the curb.

2-Time spent by through vehicles waiting or stopping until the Parker clears the traffic lane or

3- Time spent by through vehicles to change lane.

4-Time required for through vehicles to accelerate and regain its original speed.

So these four types of delay can be classified into two main parts, one deceleration delay implying first three parts and the other is the acceleration delay implying fourth one.

4.1.1.1 Deceleration and stopping delay

The deceleration and stopping delay of approaching (delayed) vehicles is the time difference between the instant of deceleration, and the instant of acceleration at which vehicle starts to increase its speed after the parked vehicle cleared the lane.

The deceleration delay is equal to the difference between the parking time and the time at which vehicle starts to accelerate .

4.1.1.2 Acceleration delay

The acceleration delay is the time required for preceding vehicle to reach its original speed Minus the arrival time of delayed vehicle.

4.1.1.3 Delay of through vehicles changing lane

Through vehicle is able to change lane when the time spent by the parked vehicle to clear the parking space is longer than available lag or gap value required to change lane.

4.1.2 The delays caused to parked vehicles

One of the most important factors, considered in OSPSM package, is the evaluation of the performance of parked vehicle when depart the parking place in terms of the delay. The total delay, the average delay, and distribution of delay are therefore estimated in this package .

4.1.2.1 The total delay

The total delay estimated in OSPSM Package by aggregating the individual delay values for all drivers as the difference between the departure time from parking place area and the time when the Parked vehicle wanted to depart the parking place. The average delay per vehicle can be calculated by dividing the total delay by the number of vehicles.

4.1.2.2 Delay distribution

The distribution of delay determined in OSPSM Package by classifying the calculated delay values into classes and calculating the frequency distribution. The cumulative distribution represents the delay distribution.

4.2Reduction in capacity

Curb parking reduces the capacity for moving traffic in two ways. First it reduces a potential traffic lane. Second the parking and through vehicle maneuvers reduce the capacity of the adjacent travel lane (Box, 2004).

4.3 Turnover rate:

The turnover rate describes the number of parked vehicles at a specified parking place per unit time. Therefore, the turnover rate reflects the demand and average duration of stay of vehicles at that place. This means that the proportion of unserved Parker's increases as the turnover rate decreases.

4.4 Parking accumulation

One measure of the parking demand is the parking accumulation, which is the sum of vehicles parked at a specified area at a given instant. Parking accumulation may be used as a measure of the amount of parking spaces required to meet the demand at a given time. The parking accumulation can be determined by the algebraic summation of in and out parking movements during any time throughout the period of study. (Matson at.el., 1955)

4.5 Parking occupancy (Parking Index)

The OECD Road Research (1979) defines parking index as the percentage of parking spaces occupied by parked vehicles at a specific limit of the time of the day.

4.6 Duration index

It is the portion of time a vehicle is parked in a given space during the simulation or the percentage of time occupied by parked vehicles at a specific limit of the spaces.

Also, other measures of performance were studied such as Proportion of unserved parkers and Proportion of empty spaces in parking place.

5. Data analysis

The measurements were carried out using video camera. The basic measurements are traffic flow, operating speed, parking time, unparking time, gap, and average duration.

5.1 Flow data

Flow measurements are the most important types of the parking data. The arrival time of any vehicle to parking place was recorded on sheets. Flow measurements were carried out using video camera continuously for one hour (from 12:30pm to 1:30pm). The traffic flow consists of passenger cars and public vehicle service(busses). Busses is equivalent to passenger cars multiplied by 3. Table (1) shows the observed flow between 12:30pm to 1:30pm at each five minutes. Figure (1) shows the fitted distribution to the observed data in a histogram form. The flow data of the analysis periods were gathered and analyzed manually to determine its mean and standard deviation The results were:

Mean arrival rate =26.14 vehicle/minute
Standard deviation= 6.43 vehicle/minute

5.2 Gap acceptance data

The decisions of drivers who exit from the parking place to their available gaps were divided into acceptance and rejections for two category. Table (2) shows the results of the observed gap acceptance, and the final results may be summarized as follows:

- Average accepted gap=2.4 sec.
- Standard deviation= 0.96 sec.

5.3 Parking time data

Parking time can be defined as the time taken by a parker to drive his/her car into the parking space. The efficiency of operation of a parking facility is influenced by the amount of interaction between vehicles. The interaction between parked and through vehicles, and also through vehicles is influenced by the time taken to carry out a maneuver. Tables (3) and (4) show the results of the observed parking time, and the final results may be summarized as follows:

-Drive in

- Average parking time =9.92 sec.
- Standard deviation= 1.89 sec.

2-Back in

- Average parking time =25.0 sec.
- Standard deviation= 3.56 sec.

5.4 Unparking Time Data

Unparking time can be defined as the time required for a parker to drive his/her vehicle out of the space. Table (5) shows the results of the observed uparking time, and the final results may be summarized as follow

- Average unparking time =5.53 sec.
- Standard deviation= 2.67 sec.

5.5 Operating speed data

AASHTO(2001) defines operating speed as " the highest overall speed at which a driver can travel on a given highway under favorable weather condition/ and under prevailing traffic condition without at any time exceeding the safe speed as determined by design speed on a section - by - section basis". Tables(6) and (7)show the results of the observed operating speed, and the final results may be summarized as follows:

1- Arrival vehicles at parking place

- Average operating speed =7.3m/ sec.
- Standard deviation= 20.15 m/ sec.

2- Delayed vehicles

- Average operating speed =1.51m/ sec.
- Standard deviation= 0.391m/ sec.

5.6 Parking duration data

One of the most important components of the parking system is parking duration. Duration values were grouped into classes and a frequency distribution was obtained. Table (8) shows the results to the observed duration, and the final results may be summarized as follows

- Average duration of stay =11.84 minute.
- Standard deviation= 12.46minute.

5.7 Parking percentage

In order to specify the percentage of parked vehicles, the parked vehicles observed between 12:30pm to 1:30pm. This value is then compared with the all flow at the parking place to specify the percentages of parked vehicles. The final results indicate to the percentages of parked vehicles is equal to 0.15.

6. Result and discussion

The simulation program OSPSM was run using all the observed input parameters to obtain the models output. Results can be summarized as follow:

6. 1 Average delay of parked vehicles

Figure (2) shows a relationship between the average delay of parked vehicles and the simulation time(time ending). It indicates that the average delay oscillates between (0.5-65.7)second during the simulation time between(300-3600)second.

In the departure process of the parking place, the available lag (or gap) is the difference between the time when parked vehicle wanted to depart and the current clock time of the system. . If the available lag (or gap) is greater or equal than the critical lag (or gap), the waiting vehicle will begin depart. The average delay of parked vehicles during the study time was equal to 17.269second.

6.2 Average delay of through vehicles

Figure(3) shows the relationship between the average delay of through vehicles and the simulation time. It indicates that the average delay of through vehicles oscillates between (0-58.32)second during the study time between(300-3600)second. The average delay of through vehicles during the study time equal to 7.152 second which indicates that the average delay of through vehicles at AL-Jmahory street is reasonable value.

6.3 Average turnover rate

Figure(4) presents an average turnover rate value (veh./hr./space) with respect to the simulation time.It is clear that the turnover rate value oscillates between (0.533-1.33) (veh./hr./space) during the study time between(300-3600)second.It indicates that always we could found empty spaces.The average turnover rate value during the study time equal to 0.967(veh./hr./space).

6. 4 Parking index

Figure(5) shows that the parking index oscillates between (4.44-11.11) during the study time between(300-3600)second. It indicates that always an empty spaces can be found.

6.5 Proportion of empty space

Figure(6) shows the proportion of empty space with respect to time. In general,it indicates that the proportion of empty space decreases with increases in time from 300 to 3600 second.

Final results

Table(9) shows the summary of results. It indicates that the performance of on street parking in AL-Jmahory street is reasonable .

Conclusion

The conclusions of this research project may be classified into the following aspects:

Analysis of Site Data:

1- Mean arrival rate equal to 26.14 vehicle/minute.
2- Average accepted gap equal to 2.4 sec.
3- Average parking time drive in equal to 9.92 sec and average parking time back in equal to 25.0.
4- Average unparking time equal to 5.53 sec.
5- Average operating speed equal to 7.3m/ sec.
6- Average duration of stay equal to 11.84 minute.
7- The percentages of parked vehicles is equal to 0.15.

OSPSM package results

1- the average delay of parked vehicles and through vehicles at AL-Jmahory street is reasonable value.

2- Always an empty space can be found during study period.

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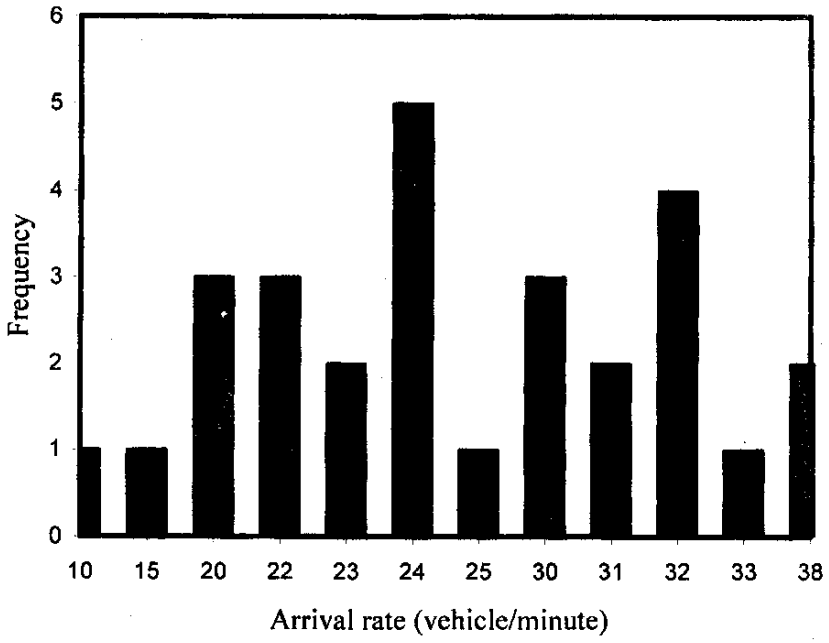

Figure(1) Relatioship between arrival rate and ferquency

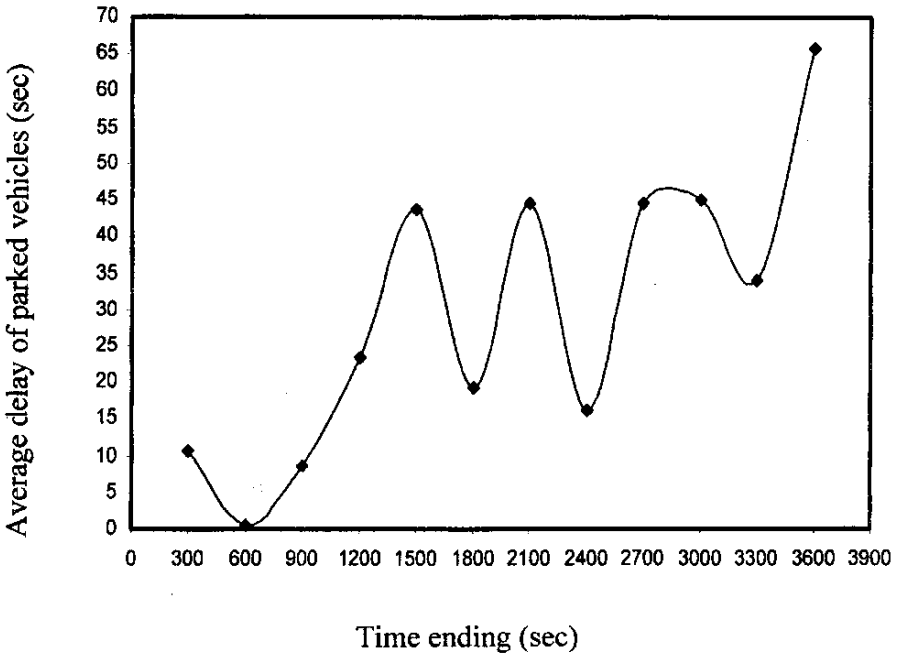

Figure (2) Relationship between time ending and Average delay of parked vehicles (sec)

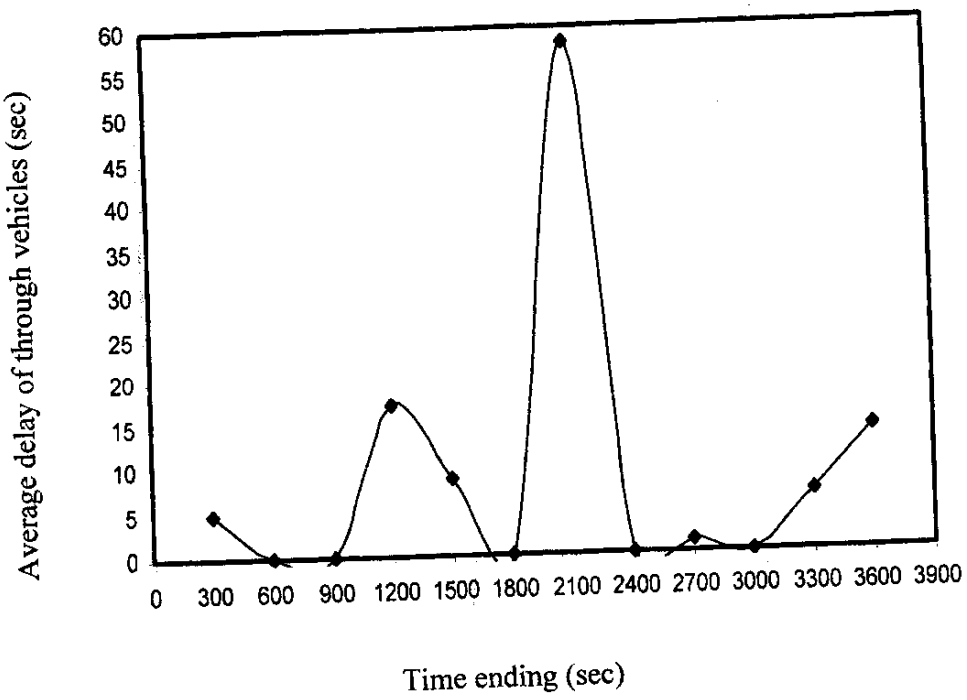

Figure (3) Relationship between time ending and Average delay of through vehicles (sec)

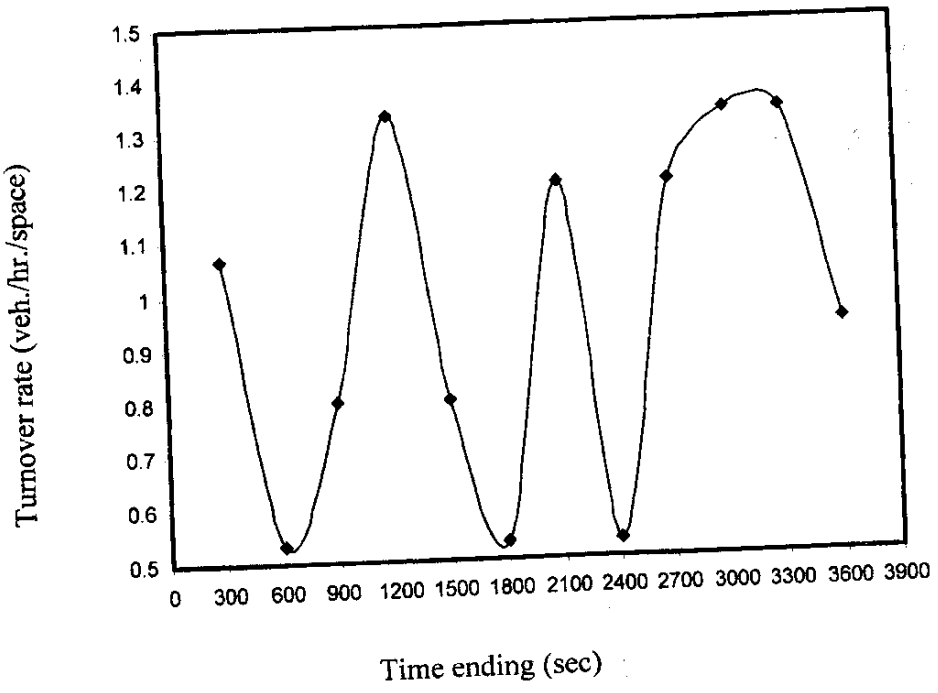

Figure (4) Relationship between time ending and Turnover rate

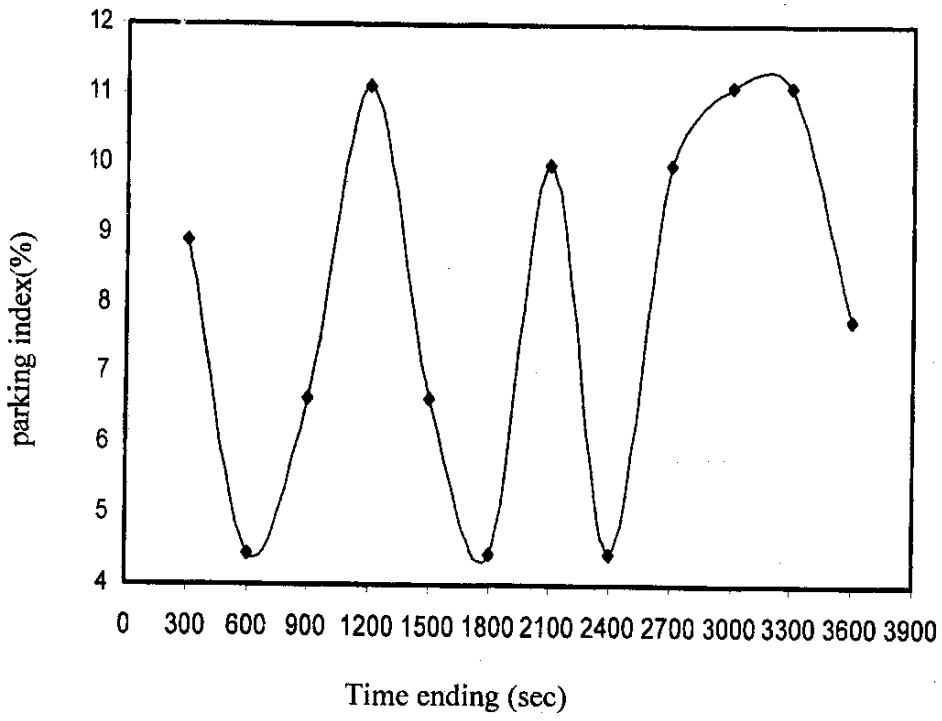

Figure (5) Relationship between time ending and parking index

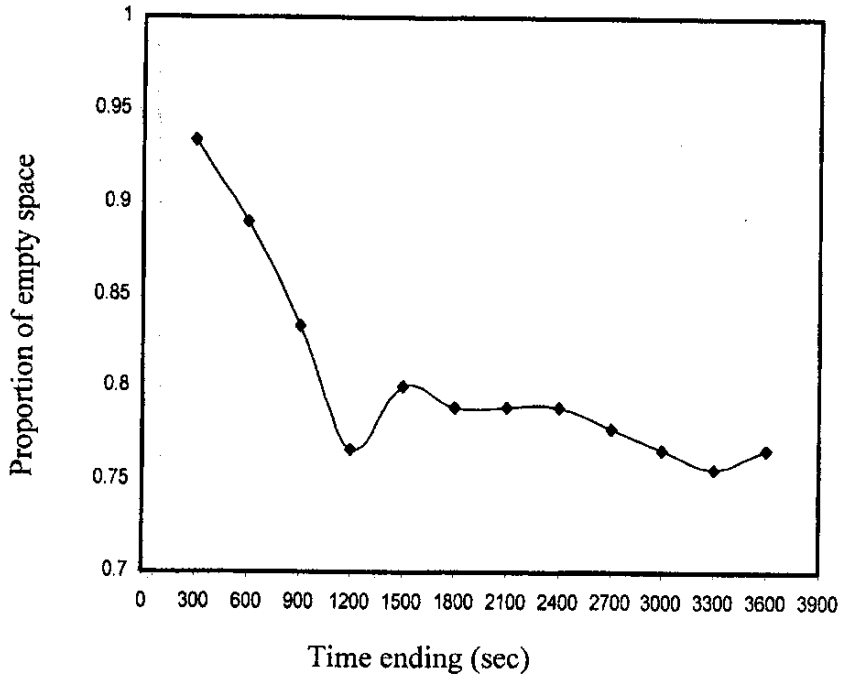

Figure (6) Relationship between time ending and Proportion of empty space