

## Estimating Passenger Car Unit Factors for Buses and Animal Driven Carts in Gaza City, Palestine

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**ملخص:** مهندسو الطرق والمواصلات والخبراء والمختصون في فلسطين، لا يتوفر لهم مراجع محلية معتمدة لتحديد القيمة المكافئة للمركبة بوحدة سيارة الركاب المعروفة عالميا بإسم (passenger car unit)، ولذلك فهم يستخدمون حاليا مراجع معتمدة في دول أخرى دون التحقق من ملاءمتها محليا. يحاول المؤلفان في هذا العمل التحقق المحلي لبعض القيم المكافئة للمركبة المعتمدة دوليا.

الهدف من ورقة العمل هذه هو تقدير القيمة المكافئة بوحدة سيارة الركاب لكل من الحافلة و العربة التي يجرها حيوان أثناء مرورها بتقاطعات الطرق التي تستخدم الإشارات الضوئية في مدينة غزة.

القيمة المكافئة للمركبة هي معامل يستخدم لتحويل جميع أنواع المركبات إلى وحدة سيارة الركاب. قام فريق البحث بجمع البيانات المطلوبة من ثلاث تقاطعات طرق رئيسة في مدينة غزة باستخدام كاميرا فيديو رقمية، وتم استخدام طريقة (headway method)، أظهر التحليل الإحصائي للنتائج أن القيمة المكافئة للحافلة بلغت 2 سيارة ركاب بينما بلغت القيمة المكافئة للعربة التي يجرها حيوان 1.67 سيارة ركاب. كما أثبت التحليل الإحصائي أن القيمة المكافئة للحافلة في غزة كانت مشابهة للقيمة المعتمدة في بريطانيا ولكنها مختلفة عن مثيلتها في الهند. ولكن التحليل الإحصائي أظهر أن القيمة المكافئة للعربة التي يجرها حيوان في غزة كانت مختلفة عن مثيلتها في الهند.

تجعل هذه النتائج المختصين المحليين في فلسطين يستخدمون القيم المكافئة للحافلة بمزيد من الثقة في التطبيقات المحلية. كما يوصي المؤلفان بضرورة قيام أبحاث أخرى لتأكيد القيمة الجديدة التي أظهرها هذا العمل للعربة التي يجرها حيوان.

**Abstract:** Transportation engineers and professionals in Palestine do not have local standards to use for passenger car unit (PCU) values. They currently use standards adopted by other countries without local validation. In this work the authors are trying to provide local validation for some PCU values.

The purpose of this paper is to estimate PCU values for buses and animal-driven carts at signalized intersections in Gaza City. PCU (or passenger-car equivalent unit, PCEU) is a factor used to convert all vehicle types other than passenger car into passenger car. The research team collected the required data at three main signalized intersections in Gaza City using a digital video recorder. To calculate PCU values the headway method was used. Statistical analysis of the results shows that a PCU value for buses was found to be 2.0 while that for animal-driven carts was 1.67. The PCU for a bus in Gaza was found to be similar to that in UK but different from India. The PCU for an animal-driven cart in Gaza was found to be different from that in India. Local traffic engineers may now use these results with more confidence of their local applicability. However, it is recommended to conduct further research on other vehicle types as well as to confirm the obtained PCU value for animal-driven carts.

**Keywords:** Passenger car unit (PCU), Headway Method, bus, animal-driven cart, Gaza, Palestine.

## **INTRODUCTION**

Different vehicle types occupy different spaces on the road, move at different speeds, and start at different accelerations. Furthermore, the behavior of drivers of the different types of vehicles may also vary considerably. This poses a problem for designing roads, intersections, and traffic signals. A uniform measure of vehicles is thus necessary to estimate traffic volume and capacity of roads under mixed traffic flow. This is rather difficult to achieve unless the different vehicle types are stated in terms of a common standard vehicle unit.

For this reasons, the concept of Passenger Car Unit (PCU) or Passenger Car Equivalent (PCE) was developed to become as a common practice to convert the other vehicle types into PCUs. It is generally expressed as PCU per hour, PCU per lane per hour, or PCU per kilometer length of lane.

Transportation engineers and professionals in Palestine and more specifically in Gaza Strip do not have local standards to use for PCU values. International standards provided by the Highway Capacity Manual [1] adopted in the USA and standards provided by the Department of Transport in the UK are usually

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used. These values are being used without local validation. In this work the authors are trying to provide local validation for some PCU values.

The main objective of this paper is to determine the value of passenger car units for animal-driven carts and buses at signalized intersections in Gaza City. Like many other cities in developing countries, Gaza City traffic includes animal-driven carts in addition to other motorized vehicles. The paper will also compare the estimated Gaza PCU values to those from United Kingdom and India.

### LOCAL STATISTICS

It is important to present relevant local statistics showing the composition of traffic flow in Gaza Strip. This is to show the percentage of buses and animal driven carts in traffic flow. A report published by the Ministry of Planning in 2010 included several important local statistics [2]. This report indicated that the records of the Ministry of Transportation show that the total number of registered vehicles in Gaza Strip in 2009 is 64,938 vehicles. It also shows that traffic counts on Salah El Din Road and Haroun El Rasheed Road indicate that the traffic composition consists of 0.99% and 1.60% buses and 2.03% and 2.25% animal driven carts respectively. On some main roads and intersections the percentage of buses and animal-driven carts reaches more than 3% and 5.8% respectively causing several problems to traffic movement.

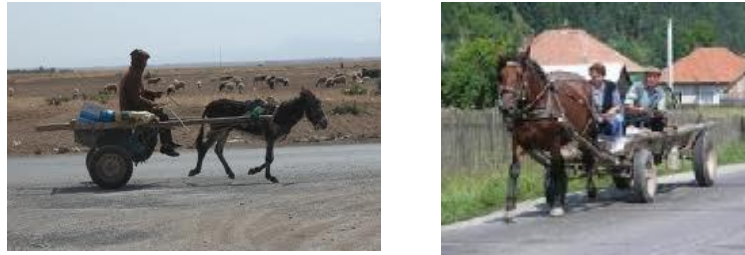
#### Definitions

A bus is a large road vehicle intended to carry more than 20 persons in addition to the driver and sometimes a conductor.



**Figure (1) Two sample pictures of a bus**

Animal – Driven Cart is a vehicle with two or four wheels driven by an animal (horse, mule or donkey), designed for transport.



**Figure (2) Two sample pictures of an animal-driven cart**

### **LITERATURE REVIEW**

Several methods are explained in several references for the determination of passenger car unit values for different types of vehicles. Most of these methods were developed for the case of multilane highways and some methods were used at road intersections.

(Cunagin and Messer, 1983) [3] used a combination of the Walker method of relative numbers of passing and the relative delay method to calculate PCU values on multilane highways.

PCUs as reported in TRB Circular 212 were developed based on the constant v/c method. An article published by (Linzer et al, 1979) [4] describes the constant v/c method, whereby PCUs are calibrated such that the mixed traffic flow will produce the same v/c ratio as a passenger car only flow.

(Huber, 1982) [5] developed the above method by relating PCU to the flow of a passenger car only traffic stream and a mixed vehicle traffic stream. The effect of trucks is quantified by relating the traffic flows for an equal level of service (LOS).

(Sumner et al, 1984) [6] expanded the relationship described by Huber to calculate the PCU of a single truck in a mixed traffic stream, which includes multiple truck types. This calculation requires an observed base flow, mixed flow, and flow with the subject vehicles.

Kockelman and Shabih 1999 [7] found that light-duty trucks such as single large sport-utility vehicles in through traffic is equivalent to 1.41 passenger cars; and a van is equivalent to 1.34. They used the headway method to determine these PCE values at two signalized intersections in Austin, Texas. They also concluded that such long headways reduce intersection capacity and increase urban congestion.

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(Van Aerde and Yagar, 1984) [8] developed a methodology to calculate PCU based on relative rate of speed reduction.

The PCU for a vehicle type n is calculated as:

$$E_n = \frac{C_n}{C_1} \quad (1)$$

Where  $C_n$  is the speed reduction coefficient for vehicle type n and  $C_1$  is the speed reduction coefficient for passenger cars.

### • PCUs Based on Headways

(Greenshields et al, 1947) [9] estimated PCU value by the following equation. This method is known as basic headway method.

$$PCU_i = H_i / H_c \quad (2)$$

Where:  $PCU_i$  = passenger car unit of vehicle type i.

$H_i$  = average headway of vehicle type i, (sec).

$H_c$  = average headway of passenger car, (sec).

(Miller, 1968) [10] developed PCU values at intersections based on the headway a heavy vehicle would require over a passenger car. His result for PCU value of a truck was 1.85.

(Werner and Morrall, 1976) [11] suggested that the headway method is the best method to determine PCUs at low levels of service. The PCU is calculated as:

$$E_T = \frac{\frac{H_M - P_C}{H_B}}{P_T} \quad (3)$$

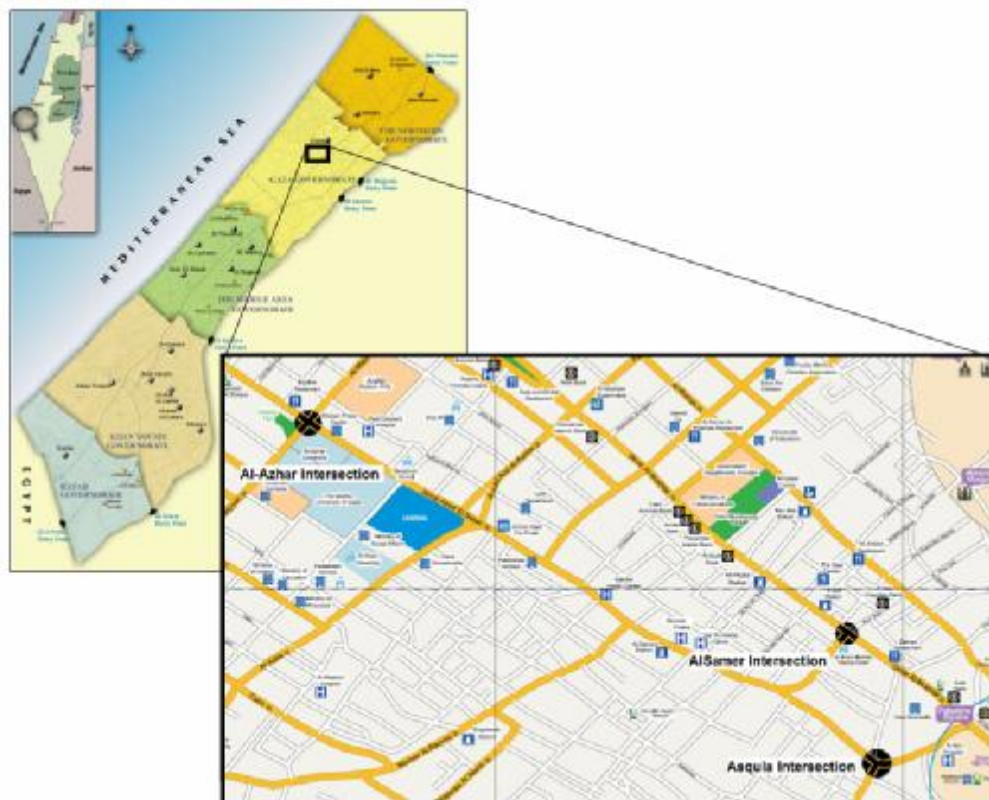
Where  $H_M$  is the average headway for a sample including all vehicle types,  $H_B$  is the average headway for a sample of passenger cars only,  $P_C$  is the proportion of cars, and  $P_T$  is the proportion of trucks.

Other methods were also used to calculate PCU values based on Queue Discharge Flow (Al-Kaisy et al, 2002) [12] and traffic density (Webster and Eleftheriadou, 1999) [13].

## METHODOLOGY

Although many methods exist to calculate PCU values, the authors utilized the Headway method for its simplicity and easy application. Furthermore, the literature review showed that the Headway method is well suited to determine PCU on level terrain and at low levels of service, the prevailing conditions in Gaza City.

The chosen method requires measurements of time headway data. The research team collected time headway data from three major signalized intersections meeting the following criteria: high traffic volume, good mix of different vehicle types, no parking allowed on the intersection approach, the presence of traffic signals or a traffic policeman to organize traffic flow. Figure (3) shows the location of these selected sites.



**Figure 3: Location of the three selected sites.**

Using an 8-mm digital video recorder, vehicle movements at the three sites were recorded for the period from February 4<sup>th</sup> to April 5<sup>th</sup>, 2008. Data were collected under dry weather conditions and during day time only. Data were then transferred to a computer and processed in the office to add a time stamp on the video display to track time of each vehicle considered.

The recordings were then replayed and discharge time headways for passenger cars, buses, and animal-driven carts were then manually computed for vehicles

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in the queue as the elapsed time, front bumper to front bumper, as successive vehicles passed the intersection stop line.

To ensure the validity of results, a representative and a statistically accepted sample was chosen in which time headways of the following vehicles were rejected and excluded from the analysis:

- The first three vehicles discharging from the queue.
- Vehicles impeded by pedestrians or turning vehicles.
- Platoons within which vehicles did not stop before entering an intersection.
- Platoons with turning vehicles.

The result is a sample of 431 (228 passenger cars, 103 buses, 100 animal-driven carts) time headway measurements. Equation 2 was then used to compute PCU factors for both buses and animal-driven carts at the three sites in Gaza City.

### **ANALYSIS OF RESULTS**

The values of passenger car unit at the three representative intersections and their average are shown in Table 1.

Table 1: PCU values for buses and animal-driven carts in Gaza City

|               | <b>AL- Azher<br/>intersection</b> | <b>AL-Samer<br/>intersection</b> | <b>Asqoula<br/>intersection</b> | <b>Average<br/>value of PCU</b> |
|---------------|-----------------------------------|----------------------------------|---------------------------------|---------------------------------|
| PCU of a bus  | 1.91                              | 2.04                             | 2.0                             | 2.0                             |
| PCU of a cart | 1.76                              | 1.52                             | 1.58                            | 1.6                             |

**Figure (4) shows the variation of PCU of buses & animal-driven carts at the selected intersections respectively.**

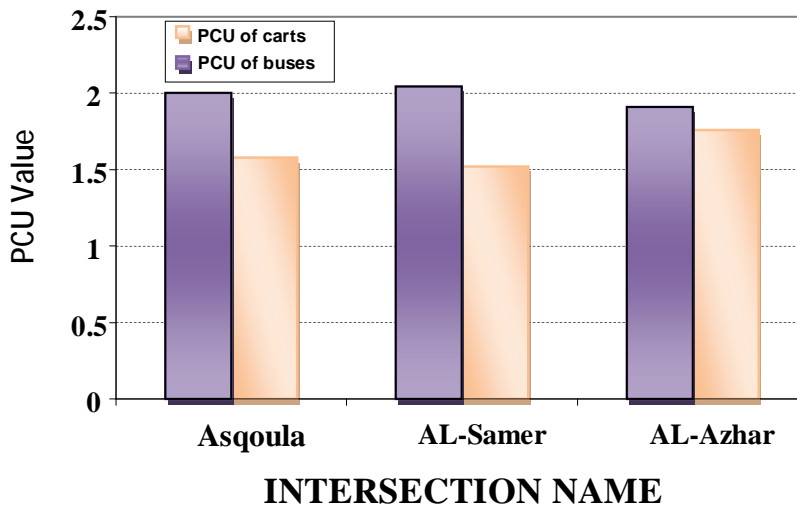


Figure 4: PCU values of Buses and Animal-Driven Carts at Each Intersection. Prior to generalize these results, the researchers conducted a statistical analysis to show the homogeneity of the calculated PCU values among the three intersections, and to show if there is a significant difference or not in PCU values for buses and animal-driven carts between Gaza, UK and India.

**Comparisons of results at the studied intersections**

The purpose of this analysis is to compare the results obtained at the three sites in Gaza City, namely; Al-Azhar, Al-Samer, and Asquola intersections. Time headway values are used to estimate the homogeneity of PCU values at the studied intersections for each vehicle type. In other words if time headway values are homogeneous for each vehicle type at the three intersections, the PCU values are homogeneous and these values may be generalized and considered as representative to Gaza City traffic conditions.

To achieve this purpose the analysis of variance (ANOVA) is used.

The one-way ANOVA is a method for testing the hypothesis that three or more population means are equal; i.e., null hypothesis ( $H_0$ ):  $\mu_1 = \mu_2 = \mu_3 = \dots$

$\mu_k$  thus, reject  $H_0$  if the P-value  $\leq 0.05$  for 95% confidence level and fail to reject  $H_0$  if the P-value  $\geq 0.05$ . If there is at least one mean different, the alternative hypothesis ( $H_1$ )<sup>(8)</sup> will be assumed. It is an essential step before

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performing one way ANOVA test to check normality of the input data as well as homogeneity of the variances of the data groups.

One-Sample Kolmogorov Smirnov [14] (SPSS Inc. 2009) test was performed to check normality of each group of data. There is not sufficient evidence that the time headway of vehicles does not have a normal distribution with Level of significance  $\alpha = 0.05$  (95% confidence level). Also, Levene test (SPSS Inc. 2009) cleared that the homogeneity of the variances of the data groups is achieved at level of significance  $\alpha = 0.05$  (95% confidence level).

Table (2) shows the average time headway for passenger cars at the three sites. It is clear that the average time headway values for passenger cars at the three intersections are close to each other, which is confirmed by the small standard deviations. Therefore, it is likely that there are no major variations in these values among the three intersections. To prove whether these variations among the three sites are statistically significant, we further used the ANOVA test. ANOVA test result reflects p-value of 0.895 that is greater than the level of significance  $\alpha = 0.05$ . So, no significant difference in time headway for passenger cars among the three intersections with level of significance  $\alpha = 0.05$  (95% confidence level).

Table 2: Descriptive statistics for passenger cars

| <b>Group<br/>(Road Intersection)</b> | <b>No. of<br/>samples</b> | <b>Average time headway<br/>(seconds)</b> | <b>Standard<br/>deviation</b> |
|--------------------------------------|---------------------------|---|-------------------------------|
| <i>Asqoula</i>                       | 48                        | 2.45                                      | 0.5889                        |
| <i>AL-Samer</i>                      | 84                        | 2.39                                      | 0.6363                        |
| <i>AL-Azhar</i>                      | 96                        | 2.41                                      | 0.6482                        |

Table (3) shows the average time headway for buses at the three sites. The average time headway values are close, especially between Asqoula and Al-Samer intersections. ANOVA test shows p-value of 0.433 that is greater than the level of significance  $\alpha = 0.05$ . So, no significant difference in time headway for buses among the three intersections with level of significance  $\alpha = 0.05$ .

**Table 3: Descriptive statistics for buses**

| <b>Group<br/>(Road Intersection)</b> | <b>No. of<br/>samples</b> | <b>Average time headway<br/>(seconds)</b> | <b>Standard<br/>deviation</b> |
|--------------------------------------|---------------------------|---|-------------------------------|
| <i>Asqoula</i>                       | 30                        | 5.07                                      | 1.6701                        |
| <i>AL-Samer</i>                      | 30                        | 4.94                                      | 1.2394                        |
| <i>AL-Azhar</i>                      | 43                        | 4.66                                      | 1.2387                        |

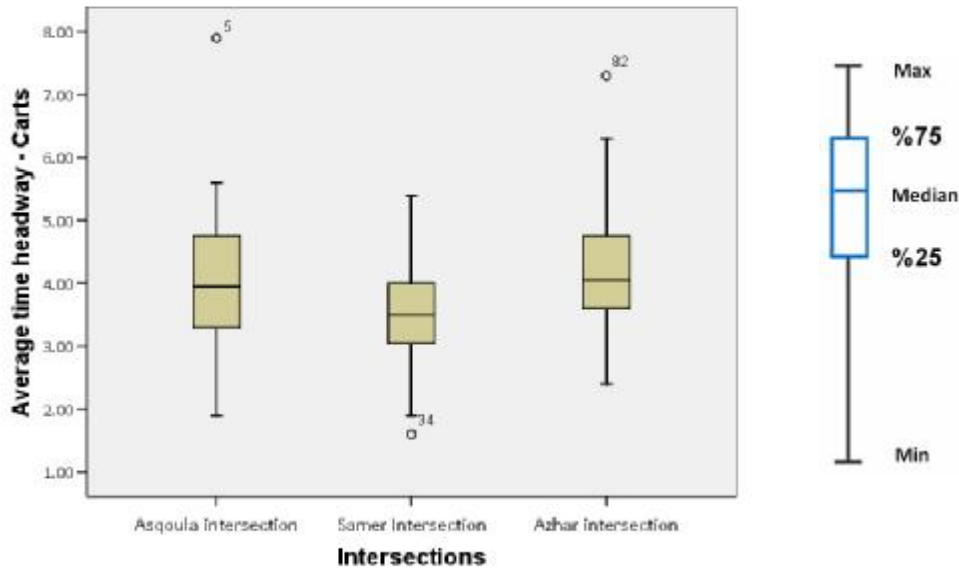
Table (4) shows the average time headway for animal-driven carts at the three sites. There are clear differences between the average time headways for the animal-driven carts, especially that for Al-Samer intersection. ANOVA shows a p-value of 0.008 that indicates a significant difference in time headway for animal-driven carts among the three intersections with level of significance  $\alpha = 0.05$ .

**Table 4 : Descriptive statistics for animal-driven carts**

| <b>Group<br/>(Road Intersection)</b> | <b>No. of<br/>samples</b> | <b>Average time headway<br/>(seconds)</b> | <b>Standard<br/>deviation</b> |
|--------------------------------------|---------------------------|---|-------------------------------|
| <i>Asqoula</i>                       | 32                        | 4.06                                      | 1.1177                        |
| <i>AL-Samer</i>                      | 36                        | 3.51                                      | 0.8779                        |
| <i>AL-Azhar</i>                      | 32                        | 4.26                                      | 1.0603                        |

Figure 5 shows some center measures of time headway data such as the median, the first quartile, the third quartile, the minimum value and the maximum value in each intersection.

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**Figure 5: Some center measures of time headway data among the three intersections**

It can be inferred from Table 4 and Figure 5 that AL-Samer intersection has the lower average time headway as well as the lower median and quartiles than the other intersections.

Independent samples T-test was performed between time headway data of Asqoula intersection and time headway data of AL-Azhar intersection. With p-value of 0.472, there is no significant difference in time headway for carts between the two intersections. Also, this test was performed between time headway data of Asqoula intersection and time headway data of AL-Samer intersection. The p-value was 0.025 which is lower than the level of significance  $\alpha = 0.05$ . So there is a significant difference in time headway for carts between the two intersections with level of significance  $\alpha = 0.05$ . The same test between time headway data of AL-Azhar intersection and time headway data of AL-Samer intersection was performed and the p-value was 0.002 which reflects a significant difference in time headway for buses between the two intersections with level of significance  $\alpha = 0.05$ .

The probabilities (P-value) for passenger cars and buses are greater than 0.05 but the probability for animal-driven carts is less than 0.05. This means that there are no statistically significant differences among the three intersections for

passenger cars and buses. However, the differences among the three sites are significant for the animal-driven carts.

In other words there is no significant difference in PCU values for buses among the three intersections and there is a significant difference in PCU values for animal-driven carts among the three intersections. However, there is no significant difference in PCU values between Asqoula intersection and AL-Azhar intersection for animal-driven carts that reflects a specialty for AL-Samer intersection.

Thus, the PCU for animal driven carts at AL-Samer intersection will be neglected, and the average PCU value for Al-Azhar and Asqoula intersections will only be considered giving an average value of 1.67.

#### **Comparisons with other Countries**

The purpose of this analysis is to compare the computed PCU values for Gaza to those for other countries. Comparison is to be made with values from a developed country and others from a developing country. The authors decided to choose the United Kingdom and India. The reason for that is because local transportation engineers usually use United Kingdom standards where local standards are not available. India was selected to represent developing countries because authors could not find values produced in other developing countries. Table (5) and Figure (6) show the PCU values for both buses and animal-driven carts in Gaza, UK and India.

**Table 5 : PCU for buses and animal-driven carts in Gaza, India and UK**

| <b>PCU Value</b>    | <b>Gaza</b> | <b>UK<sup>[15]</sup></b> | <b>India<sup>[16]</sup></b> |
|---------------------|-------------|--------------------------|-----------------------------|
| Bus                 | 2.00        | 2.00                     | 3.6                         |
| Animal -driven cart | 1.67        | -                        | 2.6                         |

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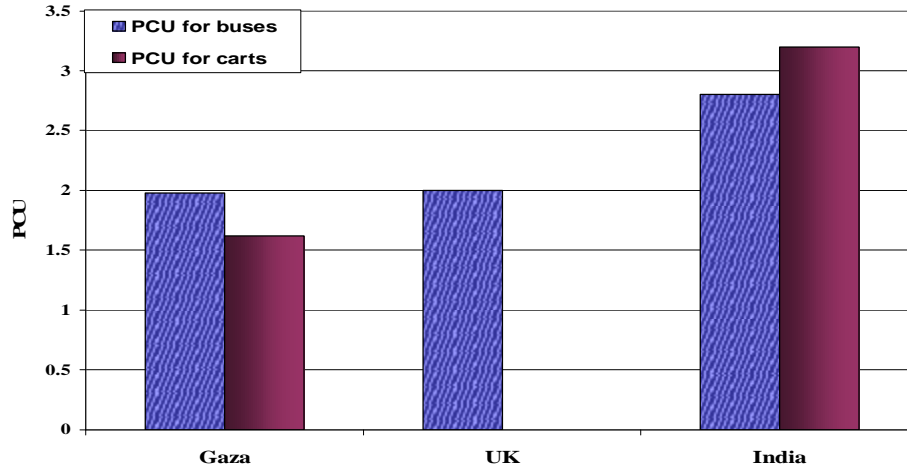


Figure 6: PCU values of buses and animal-driven carts in Gaza, UK and India  
In order to conduct this analysis hypothesis testing using the student t-test was employed:

$$t = \frac{\bar{x} - m}{\frac{s}{\sqrt{n}}} \quad (4)$$

Where:

$t$ : statistical test value which compare with tabulated  $t$  value for  $t$ -distribution ( $t_{crit}$ )

$\bar{x}$ : sample mean

$\mu$ : population mean

$s$ : is the standard deviation

$n$ : is the sample size

In order to use the  $t$ -test, it was assumed that the sample mean is the PCU value for Gaza and the population mean is the PCU value for UK or India. Since our sample measurements are for headways rather than for PCU, the standard deviation for PCU was estimated as the ratio of the standard deviation for buses or animal-driven carts to the standard deviation of passenger cars. Finally, the least number of measurements was used as the sample size.

### t-statistic Calculations and Results

Table (6) show a summary of the headway values after averaging the three sites in Gaza:

**Table 6 : A summary of the headway values after averaging the three sites in Gaza**

| Type of vehicle | Sample size (n) | Average time headway (H) | Standard deviation (s) |
|-----------------|-----------------|--------------------------|------------------------|
| Passenger Car   | 228             | 2.4136                   | 0.6293                 |
| Buses           | 103             | 4.8631                   | 1.37584                |
| Carts           | 100             | 3.929                    | 1.0589                 |

Comparison with UK

The pcu value for buses in Gaza can be calculated as follows:

$$PCU_{bus} = \frac{H_{bus}}{H_{car}} = \frac{4.8631}{2.4136} = 2.015$$

$$\bar{x} = PCU_{bus} = 2.015$$

$$S = \frac{S_{bus}}{S_{car}} = \frac{1.37584}{0.6293} = 2.1862$$

$$\mu = 2.0 \text{ (Table 5)}$$

$$n = 103$$

The statistical test value (t) = 0.07.  $t_{crit} = 1.983$ . Because  $t < t_{crit}$ , it can be concluded that there is not sufficient evidence that the population mean of  $PCU_{bus}$  in Gaza differs from that in UK. In other words, the average  $PCU_{bus}$  value in Gaza is not different from that in UK.

Comparison with India

**For Buses**

$$PCU_{bus} = \frac{H_{bus}}{H_{car}} = \frac{4.8631}{2.4136} = 2.015$$

$$\bar{x} = PCU_{bus} = 2.015$$

$$S = \frac{S_{bus}}{S_{car}} = \frac{1.37584}{0.6293} = 2.1862$$

$$\mu = 3.6 \text{ (Table 5)}$$

$$n = 103$$

The statistical test value (t) =  $|-7.358| = 7.358$ .  $t_{crit} = 1.983$ . Because  $t > t_{crit}$ , it can be concluded that there is a sufficient evidence that the population mean of

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PCU<sub>bus</sub> in Gaza differs from that in India. In other words, the average PCU value of buses in Gaza is different from that in India.

Trying to explain the reason for PCU<sub>bus</sub> in Gaza to be similar to that in UK but different from the same value in India, the authors suggest that the reason might be because the size and type of buses used in Gaza are similar to those in UK and might also be because the driving environment is also be similar. It is also suggested that the driving environment in India might be different form that in Gaza.

#### For Animal-Driven Carts

The pcu value for animal-driven carts in Gaza can be calculated as follows:

$$\begin{aligned} \text{PCU}_{\text{cart}} &= \frac{H_{\text{cart}}}{H_{\text{car}}} = \frac{3.929}{2.4136} = 1.6278 \\ \bar{x} &= \text{PCU}_{\text{cart}} = 1.6278 \\ S &= \frac{S_{\text{cart}}}{S_{\text{car}}} = \frac{1.0589}{0.6293} = 1.6826 \\ \mu &= 2.6 \text{ (Table 5)} \\ n &= 100 \end{aligned}$$

The statistical test value (t) = |-5.864| = 5.864.  $t_{\text{crit}} = 1.983$ . Because  $t > t_{\text{crit}}$ , it can be concluded that there is a sufficient evidence that the population mean of PCU<sub>cart</sub> in Gaza differs from that in India. In other words, the average PCU value of carts in Gaza is different from that in India.

It is suggested that PCU<sub>cart</sub> value in Gaza is different from that in India because of the difference in the type of animal used to drive the cart in both countries as well as the difference in the driving environment.

#### CONCLUSIONS

This paper presented an analysis of PCU values for buses and animal-driven carts in Gaza, using the headway method. This method was used because of its simplicity and suitability to determine PCU values on level terrain at a low level of service. To conduct this analysis, the work team chose three main signalized intersection sites; Al-Azhar, Asqoula, and Al-Samer. The three sites are located in Gaza City, Palestine. All locations were with through lanes, and they were carefully selected so that there was no obvious deficiency of roadway or traffic condition that would affect the estimated PCU value. Data were

collected under dry weather conditions and during morning and afternoon periods. The minimum sample size was selected to be 30 samples of each vehicle type at each intersection.

The result of PCU value for buses is 2.00 and for animal-driven carts is 1.67. Using one-way ANOVA test, no significant difference was found between passenger car unit values for buses at the three signalized intersections. No significant difference was found between passenger car unit values for animal driven carts at Al-Azhar and Asqula intersections. However, passenger car unit value for animal-driven carts at Al-Samer intersection was significantly different.

Furthermore, using t-statistic test no significant difference was found in passenger car units for buses between Gaza and UK. However, a significant difference was found between Gaza and India. The value of passenger car units for animal-driven carts was found to be significantly different between Gaza and India. This variation might be due to the animal type, the prevailing roadway and traffic conditions, and driver behavior between Gaza and India.

Several problems were faced during the data collection stage such as: traffic signals did not function all the time due to frequent electricity cutoffs, animal-driven carts rarely followed traffic law and vehicles don't always respect the traffic regulations.

It is suggested that local traffic engineers may now use the  $PCU_{bus} = 2$  with some confidence of its applicability to the situation in Palestine. They might also use  $PCU_{cart} = 1.67$  instead of the value of 5 PCU that was suggested by Dornier System Consult Company [17] a German engineering firm in their report Master Traffic Plan in Gaza City, which was carried out in 1996.

### **Recommendations**

This research is probably the first to be carried out in Gaza in order to investigate the passenger car unit values for buses and animal-driven carts. Therefore, it is recommended to conduct more research in this field in order to collect more data and to investigate the PCU values at different locations and sites and for various types of vehicle such as; heavy commercial vehicles, medium commercial vehicles, bicycles and motorcycles. During the past few years, a new mode of transportation has been introduced in Gaza Strip. It is a three-wheeled vehicle known locally as the Toktok. Therefore, it is highly recommended to establish PCU value for this new type of vehicle.

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Further research is also required to produce a more reliable value of PCU for animal driven carts in Gaza. This is necessary because a significant difference between passenger car unit values for animal-driven carts was found at the three signalized intersections.

### **Acknowledgements**

The authors would like to express thanks and gratitude to those who supported this research and helped in producing it. Special thanks are due to Heba Sbeeh , Raniah Shaat and Najlaa abu Ghrabah who participated in the data collection and analysis as part of their graduation project. Thanks are also expressed to Dr. Khaled Hamad and Mr. Tamer Eshtawi for their valuable comments and help in reviewing the statistical tests

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