

## NEED FOR EFFECTIVE BUS TRANSPORT IN MIDDLE SIZE EGYPTIAN CITIES

الأتوبيس كوسيلة نقل فعالة في حل مشاكل المرور بالمدن المتوسطة الحجم في جمهورية مصر العربية

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### الملخص العربي

يهدف البحث إلى توضيح إمكانية استخدام الأتوبيس كوسيلة نقل عام أساسية لنقل الركاب داخل المدن المتوسطة الحجم في جمهورية مصر العربية والتي تعاني من المشاكل المرورية العديدة . ويوضح البحث في البداية مشاكل النقل وللتقل العام الموجودة في معظم المدن متوسطة الحجم مثل مدن المنصورة وطنطا والزقازيق والقويس . وفي هذا البحث تم الاستدلال بالوضع الحالي لأحدى هذه المدن وهي مدينة المنصورة وذلك على أحد المحاور الرئيسية بها وهو محور شارع الجمهورية وذلك نظرا لما يعانيه من الاختناقات المرورية وخصوصا في اوقات الذروة .

وبعد تحليل نتائج العمل الميداني أمكن للتوصل إلى بعض المقترحات والتوصيات اللازمة للمحافظة على مستوى أداء مناسب للنقل العام لتشجيع استخدام الأتوبيس كوسيلة نقل أساسية داخل المدن متوسطة الحجم وبالتالي تحسين مستوى الخدمة على المحاور المختلفة للتخلص من المشاكل المرورية التي تعاني منها تلك المدن حالياً .

### Abstract

Egypt is one of the biggest countries of Africa. It has a number of middle size cities that suffer from traffic problems in the form of low speeds, low level of service, excessive traffic noise and unorganized public transport.

The main objective of this paper is to investigate the possibility of using the public bus as a principle mode for passenger transport in middle size Egyptian cities. Mansoura is taken as case study.

Proposed recommendations could lead to a considerable improvement of public urban traffic not only in Mansoura city but also in cities of similar conditions in Egypt.

### 1. Introduction

Egypt has a population of nearly 60 millions. Most of the population is concentrated in the Delta and Nile valley regions. In all Egyptian cities, the number of passenger trips made on public transport increased at a faster rate than the population growth rates. The increase in car ownership and usage has given rise to many problems in these cities, which were not designed to cater for the current levels of traffic. The result has been severe traffic congestion and deterioration of environment. In many existing cities, public transportation could play the main role in preservation of the environment and solving many transportation and traffic problems . This can be best achieved by means of encouraging people to use public transport services which, in turn, must be improved and managed for easy access to all areas. It should attract

more people away from their cars by providing a sufficiently economic and comfortable service in order to fulfill the necessary social requirements .

The aim of this paper is to show how the public bus would become a principle mode for passenger transport in middle size Egyptian cities with the city of Mansoura taken as a case study. The results of this paper confirm with the findings of a recent study on the bus network optimization in Mansoura city, where 32 buses on 8 different routes were suggested, and encourages the use of public buses in Gomhoria street, Mansoura city [ 1,2 ].

## 2. Common traffic characteristic in middle Egyptian size cities

Middle size cities such as Mansoura, Tanta, Zagazig and Fayoum suffer from acute traffic problems. The general traffic characteristic in the above cities can be characterised as follows:

### 2.1. Low speeds

The average running speeds in cities, such as Mansoura, Tanta, Zagazig and Fayoum are low. Tabel (1) shows the average speeds in these cities. Most of speed levels are below 25 km /hr. The speed levels in this table are based on field observations on selected C.B.D main roads and represent the afternoon peak hours periods .

### 2.2. Low level of service

The problems of high traffic volumes, lack of parking spaces and pedestrian curbs have considerable effects on the level of service of main arterials. Values of computed (v/c) ratio and the corresponding level of service of a sample of congested streets at some of these cities are given in Tabel (2). The (v/c) ratios and the corresponding level of service in this table are based on field measurement on selected C.B.D main roads and represent the afternoon peak hours periods .

### 2.3. Unorganized public transport

The main objective of a public transport is to move people efficiently from origin to destination. An unorganized public transport is the one that has one or more of the following defects:

- No restricted time table is available.
- No bus stop bays at stations are provided; therefore, drivers stops randomly between stations.
- Neglecting the density of public transport users when appointing the number of busses serving a certain lines.
- Lack of parking spaces for transport modes.

The above mentioned defects result in a low operating standard for a public transport. For example, in Tanta city, especially in Baher street, it was observed that bus drivers were used to stop between stations. Therefore, the efficiency of traffic flow was significantly reduced. Also, in Zagazig city, increase of road users and vehicle ownership results in an unorganized public transport, especially in congested streets.

## 2.4. Traffic noise

With the rapid development of motor transportation in middle size Egyptian cities, the level of traffic noise increases due to the saturation of the roads. It causes annoyance, speech interference hearing impairment, rise in blood pressure for all people working in the vicinity of the congested streets. Therefore noise pollution level in these streets such as Gomhoria street in Mansoura city, Baher street in Tanta city and Horia street in Shibeen El-koom city should be measured in order to assess the adverse effect of such rapid growth of running vehicles on the above streets on the environment. Table (3) presents the noise level in (dBA) in some of congested Egyptian streets and the typical reaction of the affected people [3]. It is clear that traffic noise levels are much higher than the values recommended by World Health Organisation.

## 2.5. Lack of coordination among transport modes

The coordination between transport modes relies on timetables for the public transport networks. In some cities such as Tanta and Fayoum, there was no coordination between public and private transport. In Tanta the density of public transport busses was much lower than private cars and shared taxies. The lack of coordination between the Two modes even increased the complexity of the problem. In Fayoum, there was no public transport busses in service; only shared taxies are provided. As well known; such private modes are operated randomly without any timetables or schedules.

## 3. The case of Mansoura

### 3.1. Mansoura city

Mansoura city is considered one of the most rapidly expanding cities in Egypt. Over the last 20 years its population has increased considerably to reach approximately 500,000 capita as a result of the migration of people from surrounding rural areas and high rate of birth. Educational, industrial, commercial, and new residential developments in the urban and suburban areas have led to acute traffic problem especially along the main corridors of the city. As a result of continuing growth in vehicle ownership and lack of road spaces, many arterials of Mansoura road network started to suffer from various traffic problems. The most important corridors in Mansoura, Gomhuria, Port-Said, and Abdel-Salam Aref streets are shown in Fig. (1). These corridors are considerably oversaturated arterials specially during the rush hours. In addition, the public transport service did not keep in step with the growth of urban activities. Therefore, a great deal of lack in public transport services was noticed an encourage situation that the private sector to take part towards solving these problems.

There are only 3-main lines for public buses along Gomhoria street, namely, Gamaa-Sandoub, Gamaa-Magzar, and Gamaa-Azhar. In addition to these buses, there are a number of public buses working along the lines which serve the students commuting from surrounding towns such as Aga, Belgas, Nabrooh and Senbelewain [1].

Two procedures have been followed in collecting relevant public bus transport data in Mansoura city [2]: Firstly, data from the operating companies such as the number of buses and those actually in operation, bus crew, route, stations and the total daily number of passengers served by each line. Secondly, data collected from field observation such as, waiting times, average boarding and alighting times at each station, running and overall travel speed, and traffic volume accompanied by the hours of survey.

### 3.2. Traffic volumes and composition

Traffic counts were carried out on Gomhoria and Mashaya street and their intersection in order to evaluate the amount and composition of traffic on the street under study. The traffic counts and the variation in traffic volumes were used to determine the morning and afternoon peak hours on the street under study as well as the traffic composition.

Six intersections were selected on the Gomhoria street to evaluate the turning traffic movements entering and leaving the street. Traffic counts were collected for 10 hours starting at 7 a.m. till 5 p.m. in April 1995. The traffic counts survey lasted for 10 hours in order to have most of the day traffic volume fluctuation.

Peak hour traffic volumes in passenger car units (p.c.u) were obtained and given in Table(4) for afternoon peak. Table (5) shows the number of passengers transport modes and their percentages during peak hour for Gomhoria street.

### 3.3. Traffic speed survey and level of service

The running speed studies were undertaken using moving observer car method. The results of this survey would help in determining the level of service on Gomhoria street and could be seen in Table (6). Table (6) shows the average running speed for public buses, shared taxis, cars and taxis transport during afternoon peak hour in both direction for Gomhoria street, Mansoura city. It clear that average running speed for different transport modes are lower than the allowable speed in urban cities ( 25 km/hr ).

Based on the actual widths obtained from field measurements of the street under consideration, the corresponding capacities were determined and then the (v/c) ratios were calculated and listed in Table (7). Table (7) shows the level of service and (v/c) ratios on many corridor sections started to reach its practical capacity and some sections already exceeded the critical value of (v/c). On the other hand, there is spare capacity on some other sections ( e.g. Mashaya ).

### 3.4 Occupancy rate

The occupancy rate survey was carried out at a representative section of Gomhoria street. This survey was conducted in the vicinity of an oversaturated intersection along the street in order to catch most of the travelling passenger vehicles. It is worth mentioning that the observers became able to record the number of passenger inside most of passing vehicles while stopping at the traffic signal of an intersection in Gomhoria street with Port-Said and Gihan streets. While they were instructed to register only the number of vacant seats in shared taxis or buses instead of counting the whole passengers inside.

Table (8) gives the number of transport mode, occupancy rate, number of passengers, and percentage of the different modes running along Gomhoria street during the peak hour. The Table (8) shows that percentage of public buses which running along Gomhoria street during afternoon peak hour are much lower than the percentage of both shared taxis and private cars.

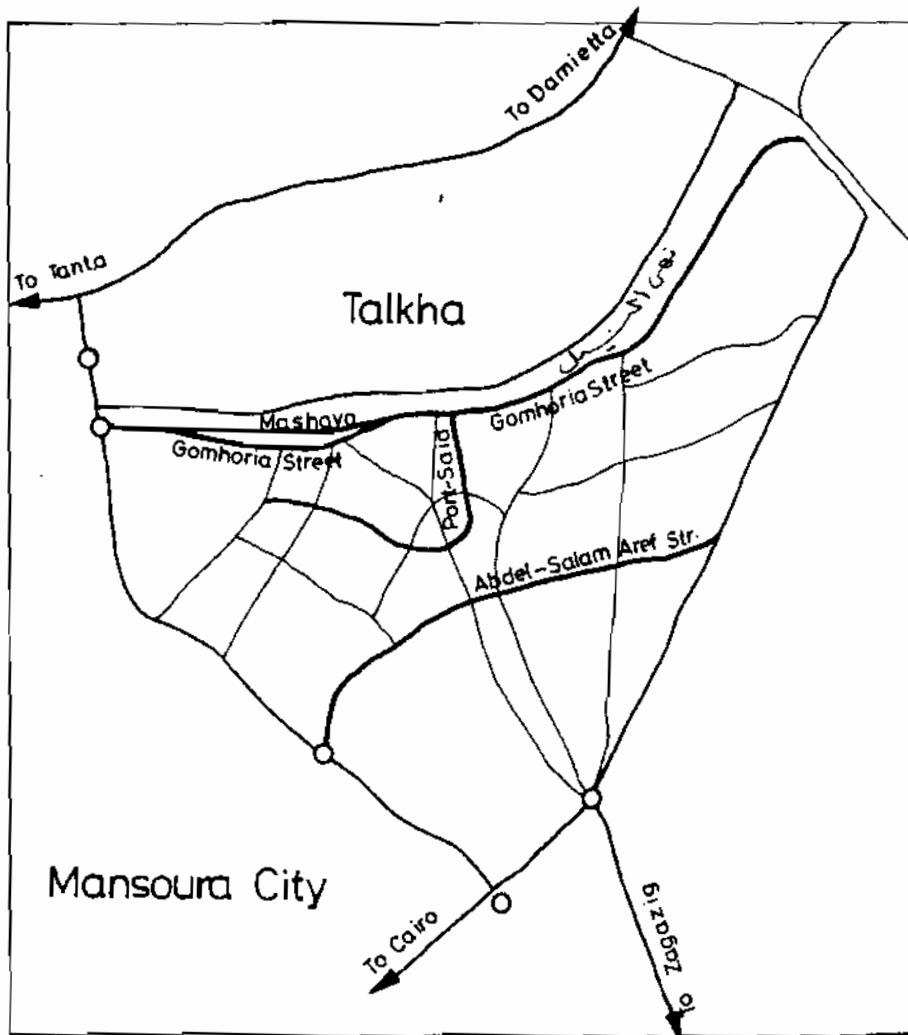


Fig. (1) Locations of the Gomhoria, Port-Said and Abdel-Salam Aref streets in Mansoura city

Tabel (1): Average running speeds in some middle size cities

City	Average running speed (km/hr)
Mansoura	22,5 <sup>a</sup>
Tanta	21,9 <sup>b</sup>
Zagazig	23,2 <sup>c</sup>
Fayoum	24,2 <sup>d</sup>

Based on field measurements on :

- (a) Gomhuria, Port-Said and Abdel-Salam Aref streets.
- (b) Baher, Gisch and Mahata streets.
- (c) Garna and Gomhuria streets .
- (d) Mostafa Kamel, Horia and Saad Basha streets .

Tabel (2): Level of service in congested cities streets

City name	w/c ratio	level of service
Tanta	0.95	(E - F) <sup>a</sup>
Shibeen El-koom	0.80	(E) <sup>b</sup>
Zagazig	0.92	(E - F) <sup>c</sup>
Fayoum	0.75	(D - E) <sup>d</sup>

Based on field measurements on :

- (a) Baher, Gisch and Mahata streets.
- (b) Horia, Tahlet Harb and Saad Zahlool streets .
- (c) Garna and Gomhuria streets .
- (d) Mostafa Kamel, Horia and Saad Basha streets .

Tabel (3): Traffic noise in some Egyptian cities

Sound Source		Value of traffic noise dBA	Typical Reaction
City	Street		
Mansoura	Gomhoria	(85.45) <sup>a</sup>	Very annoying
Tanta	Baher	(88.38) <sup>b</sup>	and causing
Shibeen El-koom	Horia	(79.77) <sup>c</sup>	hearing damage

Based on field measurements on :

- (a) Gomhuria street .
- (b) Baher street .
- (c) Horia street .

**Table (4) : Peak hour traffic volume, Gomhoria street, Mansoura city**

<i>Street</i>	<i>Traffic Direction</i>	<i>Traffic Volume P.C.U</i>
		<i>Peak hour</i>
		<i>2-3 P.M</i>
Gomhoria	From University	3130
Gomhoria	To University	2770
<b>Total</b>		<b>5900</b>

**Table (5): Number of transport modes and their percentages during peak hour for Gomhoria street**

<i>Street</i>	<i>Traffic direction</i>	<i>Traffic Composition</i>					
		<i>Peak hour 2 - 3 P.M</i>					
		<i>Public Buses</i>		<i>Shared Taxies</i>		<i>Cars &amp; Taxies</i>	
		<i>No.</i>	<i>%</i>	<i>No.</i>	<i>%</i>	<i>No.</i>	<i>%</i>
Gomhoria	From University	115	4.54	870	34.32	1550	61.14
Gomhoria	To University	103	4.72	770	34.18	1380	61.10
<b>Total</b>		<b>218</b>	<b>4.55</b>	<b>1640</b>	<b>34.25</b>	<b>2930</b>	<b>61.20</b>

**Table (6) : Average running speed for different transport modes during afternoon peak hour (2-3 P.M) in Gomhoria street.**

Type of mode		Public bus	Shared taxi	Cars & Taxis
Direction	Distance (Km)	Speed (Km/hr)	Speed (Km/hr)	Speed (Km/hr)
From University	3.5	12.15	12.80	19.30
		12.34	10.30	16.45
		12.25	14.15	16.35
To University	3.4	14.10	18.15	22.15
		13.45	16.45	18.45
		15.90	14.85	20.15
From University (Average)	3.5	12.25	12.42	17.37
To University (Average)	3.4	14.48	16.48	20.25

**Table (7) Values of (v/c) ratios during afternoon peak hour (2-3 P.M) along Gomhoria street, Mansoura city**

Street	Section Name	Facility Type	Area Type	Practical Capacity	Peak hr. V/C ratio
Gomhoria (coming from university)	Railway Bridge	Two-way	Rural	920	0.866
	Randoblou	divided	C.B.D	880	0.720
	Mohmed Fathy	Arterial	C.B.D	880	0.964
	Mansoura University	—	Residential	615	1.065
Gomhoria (going to university)	Railway Bridge	Two-way	Rural	920	1.183
	Randoblou	divided	C.B.D	880	0.422
	Mohmed Fathy	Arterial	C.B.D	880	0.731
	Mansoura University	—	Residential	615	0.626
	Mashaya	One-way	Rural	920	0.799

**Table (8) :Percentage of the different modes running along Gomhoria street during peak hour**

Transport mode	Public Buses	Shared Taxis	cars & Taxis
Traffic volume	115	870	1550
Occupancy rate	16.6	7.6	4.7
No. of passengers	1909	6612	3780
Percentage (passengers)	15.52	53.75	30.73



### 3.5. Traffic noise

The measurements conducted on Gomhoria street in Mansoura city indicated that traffic generated noise at this heavily traveled street were found considerably high and exceeded the permissible standard values. The sample noise level measurements showed that traffic - generated noise levels ranged from 87 to 94 dBA with absolute maximum of 100 dBA. Noisiness of this street due to the continuous increase of traffic volumes on the Gomhoria street will be more harmful for both living human and the whole environment [ 4].

### 3.6 Survey results

Inspection of the results obtained from data collection procedure showed that there is a considerable deficiency in state owned public buses in both numbers and productivity. Only 15.52% of the total number of passengers along Gomhoria street was carried by public buses, while 84.48% was carried by shared taxies, metered taxies and private cars as shown in table (8).

Also, as regard to traffic composition, analysis of the different transport modes percentages as presented in Table (5) indicates that private cars and taxies represent a high values compared with all other transport modes. The private cars and taxies percentages amount to 61.14% and 61.10% along both directions of Gomhoria street while shared taxi percentage amounts 34.32% and 34.18% along both directions of the same street. On the other hand, percentage of public buses (in both direction) represent low values (amount to 4.54% and 4.72%) compared with shared taxies, private cars and taxies.

A single road lane can carry 500 to 600 car /hr. representing perhaps 1000 to 1200 passenger [5]. Using the observed occupancy rate given in table (8), approximately 160 shared taxies or 72 public buses using a very low occupancy rate for buses . If public buses were fully loaded (e.g. 50 passenger / bus ) only 24 buses would have been required to carry the same number of passengers . This gives advantage to the use of public buses in Mansoura city .

It should be noted that the increasing number of taxies and shared taxies cause serious traffic problems on Gomhoria street and also most of the city streets due to :

- a. Lack of areas required as terminal stations specially in the valuable road space.
- b. The shared taxies have a relatively low passenger carrying capacity as well as they take up a high proportion of the road space.
- c. Large number of shared taxies adversely affect the level of service since in most cases (traffic volume/road capacity) ratios increase and a high level of congestion is reached as currently observed in Gomhoria street (see Table 7).

Also, Table (6) shows the results of running speed in Km/hour for different modes of transport during different time periods as a result of field surveys. It can be concluded from Table (6) that the average running speed for the direction leading to university was 14.8 Km/hour, 16.8 Km/hour, and 20.3 Km/hour for a public bus, shared taxi and private car respectively.

For the other direction, the average running speed were 12.25 Km/hour, 12.42 Km/hour and 17.37 Km/hour for a public bus, shared taxi and private car respectively. It should be mentioned that the running speed for public transport modes on Gomhoria street was 12-17 Km/hour during the peak periods which is relatively low in such area types. This low speed problem is due to traffic congestions created from excessive number of shared taxies and private cars. Limitation of shared taxies and private cars use along Gomhoria street would give an advantage for the use of public bus transportation facility, especially during peak hours..

#### 4. The potential role of public transport

Several effectiveness measures could be taken for improving public transport role in Egypt. These measures aim at improving the accessibility to the transport mode, its reliability (i.e. number of buses taking  $x$  minutes longer than schedule), its comfort, its convenience (i.e. stop spacing, number of transfer, route directness, and hours of service), and its safety which can be measured by the number of accidents /veh.km.

Also, to realize the coordinate between different transport modes, two conditions must be examined. First, the sidewalk should be wide enough to accommodate waiting passengers and allow easy passage for other pedestrians. Second, transport mode (bus as example) stop bays should be designed. Bus-stop bays are particularly useful on street with one lane / direction where stopping in a driving lane causes major delays and disruption of traffic flow.

After analyzing the obtained survey results for selected corridor study in Mansoura city, the next stage was to identify potential solution and some traffic management measures. These measures can be utilized to improve the efficiency of public busses transport in Mansoura city, specially in congested streets such as Gomhoria street. These measures are :

1. On Gomhoria street, the one-way system over some sections was suggested, especially in university direction in order to relieve congestion and improve the level of service by reducing the v/c ratios.
2. Provision of bus-bays along Gomhoria street, which would decrease traffic interruption and increase the practical capacity of the street.
3. Sidewalk should be wide enough to accommodate waiting passengers and allow easy passage for other pedestrians.
4. The traffic regulations and rules should be strictly enforced regarding parking and other drivers aggressive and bad behavior.
5. Ban of some vehicles types such as animal-driven cars and other slow motion vehicles should be applied.
6. Relocating bus stops, especially at congested locations.
7. The bus drivers should adhere to the schedule set by public buses authority.

At the same number of passengers and according to occupancy rate given in table (8), reducing the percentage of shared taxis and private cars volumes only 20%, the traffic volume along Gomhoria street would be decreased to reach 20%. In response to that, value of (v/c) along the mentioned corridor would be also decreased to reach a value of 0.8 instead of 1.065, feeding to an increase in serviceability level to (D - E) instead of (F). ( see Table 7 ).

As regard to the new Nile bridge nearby the university, it should be utilized to relieve the growing traffic demand on Gomhoria street which will eventually results in severe traffic congestions. Also more degradation in the level of service and environmental conditions will eventually be expected in the near future. Therefore, the policies should be directed to encourage the people to use the public bus transport, especially in Gomhoria street and other congested streets.

Although the above measures are drawn based on data for Mansoura, yet they generally apply to cities of similar character in Egypt.

## 5. Concluding Remarks

This paper studied the possibility of using public bus and improve the efficiency of bus transport, especially in middle size cities with its high traffic problems. Gomhoria street in Mansoura city is taken as case study.

Based on our analysis, it can be concluded that, shared taxies, private cars and taxies increased congestion on Mansoura city, especially on Gomhoria street. It suffered from severe traffic problems during peak hours. However, the bus system would remain free from congestion at all times than other vehicles. Also, the main results can be concluded as follows:-

- 1- The average running speed for all modes of transport which running along Gomhoria street during peak hour for both direction fluctuated between 14.48 km/hr and 20.25 km/hr.
- 2- Most of speed levels are below 25 km/hr.
- 3- Percentage of public buses in both direction represent low values ( amount to 4.54% and 4.62% ) compared with shared taxies and private cars.
- 4- The level of service and (v/c) ratios on many sections of Gomhoria street in Mansoura city, would he exceeded the critical value of (v/c).
- 5- According to the survey results obtained, investigation of using public bus and taking some of traffic management to improve the efficiency of bus transport are necessary to relieve the traffic congestion of the study street. Therefore, the efficiency of the transport system as a whole would be raised by giving buses priority over other vehicles. This is because buses normally carry more people than other vehicles.

## 6. References

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