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DESIGN OF URBAN TRAFFIC AREAS

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ABSTRACT

The volume of motor vehicle traffic in Cairo rose dramatically during the last three years and is continuing to rise every day. This resulted in exceeding rates of road accidents and substantial loss of lives. The primary objective of this research paper is the reduction of the rising amount of traffic accidents in and around the greater Cairo city. Other objectives are concerned with health problems and productivity. Functional classifications of roads are recommended. Reference speeds on each type of roads are proposed. Traffic lane widths in relation to footpath and sidewalks dimensions are highlighted. Design of intersections is outlined for four and three way intersections. Finally, the design of speed reducing elements is discussed.

Keywords: traffic, transport, road planning, intersection design, road speeds, speed reducers.

INTRODUCTION

The volume of motor vehicle traffic in Cairo rose dramatically during the last three years and is continuing to rise every day. This resulted in exceeding rates of road accidents and substantial loss of lives. The primary objective of this research paper is the reduction of the rising amount of traffic accidents in and around the greater Cairo city. Other objectives are concerned with health problems and productivity [1-7]. Recently with the expanding car manufacturing and assembly, there evolved a rising recognition of the ill and bad effects that the exploding use of motorcar traffic had on the multifunctional environment of urban areas in general and of Cairo in particular. Groups within the public and many of the traffic and town planners raised the issues presented in Figure-1.

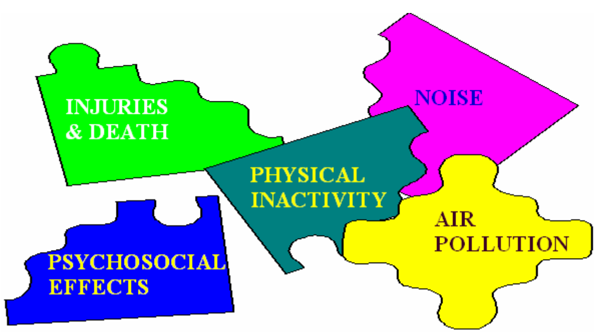

Figure-1. Consequences of the transportation problem.

In residential areas, the parents felt insecure to have their children walk on the streets, going to or back from schools. In shopping areas, street traffic created a barrier and prevented crossing from one side of the street to the other even on zebra crossings. Growing air pollution problems as well as noise made the streets very unpleasant for walking and or residence. The main streets in many smaller districts lost its traditional social and business functions as it served as a link to the interurban network of the new high and beltways. Bypasses were routed on small and narrow streets and the residual parking traffic created a barrier and became a source of horn noise of the congested traffic. In certain areas, the speed of the traffic was of more concern than the amount of traffic. Therefore, speed-reducing measures were individually constructed. Some of these voluntarily made reducers are totally out of standards. This indicates the importance of the necessary legal changes in the Egyptian road-traffic act and regulations.

A new concept of traffic integration and traffic calming needs to be adopted to maintain the social, environmental, and economic functions of the streets [8 - 11]. Accordingly, new planning and design procedures need to be adopted. The proposal in its entirety may prove successful to plan and design new urban areas in the outs of Cairo; shown in Figure-2, but its use in the older Cairo, Figure-3, where the street network is several hundred years old may need a more gradual and progressive implementation to avoid the sudden random reactions.

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Figure-2. Well planned new urban areas around Cairo.

Figure-3. Old Cairo streets.

FUNCTIONAL CLASSIFICATIONS

A functional classification of the roads can be made as follows:

Primary roads

These roads interconnect the city quarters and connect those to the downtown or the city center. It also interconnects the interurban road network.

Distributer roads

Interconnecting the areas and districts within the city quarters and giving connection to the downtown or the city center, as shown in Figure-4.

Stem roads

Interconnecting the residential areas and connecting those to the local quarter centers.

Access roads

Servicing the individual residential areas, neighborhood, houses, workplaces, institutions and shops, and finally functioning as local manipulation network

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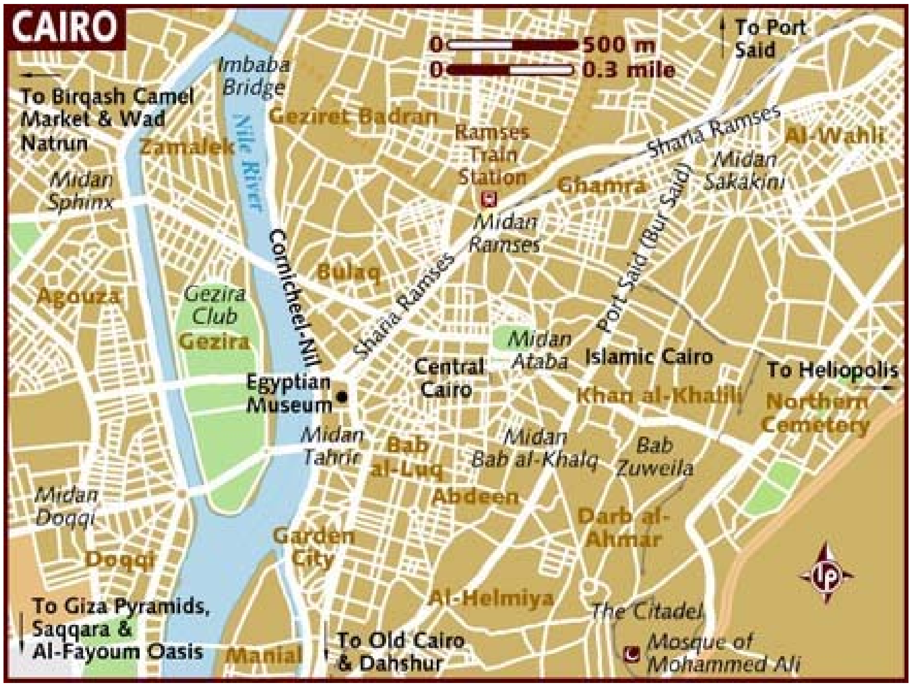

Figure-4. Road networks in central residential areas of Cairo.

However, when classifying the existing roads, consideration must be given to accessibility, pass ability, capacity, clearness, urban architecture, and safety. This may help accounting for public transport services and pin point the routes, which are likely to be designated for specific public transport service such as Mini and microbuses. To satisfy the functional requirements of the streets, the system should, where possible, on a principle of partial traffic separation on access roads or limiting specific public transport services to specific stem roads. On the other hand, the system should be based, where possible, on traffic integration on the distributer and primary roads. Many investigations have shown that the speed has a significant effect on road safety, security, and on the environment, therefore, it is important to classify the roads or parts of the road in strict compliance with a proper speed classification.

Other transportation facilities are separated by nature, such as tram, metro, train, and Nile buses, demonstrated in Figure-5. Our concern in this work goes to motor vehicle traffic including cars, taxis, microbuses, minibuses, public buses, and trucks. To this end, the basis of road design need to vary substantially from those in the relatively new urban areas where motor vehicle traffic can be effectively separated, and to the many existing roads where each road serves many functions and hence the traffic has to be integrated. In such case, the speed difference between the various groups of road users must not be too great. The concept of speed classification using some reference speeds need to be introduced in the planning and design procedures.

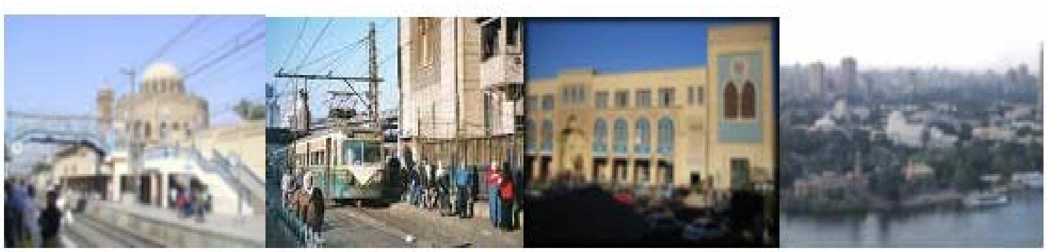

Figure-5. Separated transport, tram, metro, train, and Nile bus.

REFERENCE SPEED

When selecting the reference speed, one should comply with some of the adopted speeds on the Egyptian motor ways (80, 90, and 100 Km/hr), and hence, the following speed classes can be proposed as shown in Table-1.

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Table-1. Speed classes on the different roads.

Road type	Speed class and speed range km/hr			
	High	**Medium**	**Low**	**Very low**
Primary	60 - 70	40 - 50	30 – 40	
Distributer	50 -60	40 - 50	30 – 40	
Stem	40 - 50	30 - 40	20 – 30	15 - 20
Access	20 - 30	15 - 20	10 – 15	5 - 10

These reference speeds of access roads are selected to match many of the narrow roads within the residential areas of Cairo. For example, roads of up to 10 m width should have a very low speed limit, while wider roads of up to16 m width should have a low speed limit. Access roads having 16 - 20 m in width should have a medium speed limit. Wider access roads of more than 20 m width can have a high speed limit, which may also act as stem roads in part or in full length.

On primary and distributing roads, high speed should be used in special parts near by connections with the high and beltways. Medium speeds should be the default speed. Low speeds can be used at exits to stem roads. However, on stem and access roads, the high speed may only be used near connections with distributing and primary roads, medium speeds should be the default, whilst low speed should be used with few access or few traffic light signals. Very low speed however should be specified in sections leading to schools, institutions and shopping services. Both low and very low speeds must be reinforced by establishing various speed reducing measures. Since these speeds are somewhat different from the current designated speed limits, it is necessary to redesign part of the road network to ensure the harmonization and implement the necessary speed reducing facilities.

There are two reasons why part of the road network should be redesigned to be physically speed reducing. Firstly, road signs stating allowed or recommended maximum speeds are rare and proved to be insufficient. Secondly, it must be considered both psychologically meaningful and instrumental in achieving an appropriate traffic flow, thus car drivers can see a logical connection between the road design and the stipulated speed. For the conversion project, areas have to be converted gradually and progressively in such a way to monitor many of the traffic and non-traffic parameters.

Once a plan is worked out, the path-road crossings are determined. Furthermore, those crossings that are found to be locally necessary must be identified. The road section must also show the adjacent facilities such as bus stops, parking areas, zebra crossings and traffic light signals. It must also show the various speed reducing facilities and measures such as pre-warning signs, gates, raised areas and ramps, humps, narrowing’s, and staggering.

TRAFFIC LANES

The width of the traffic lanes is directly related to the maximum allowed speed. Guidance values are shown in Table-2.

Table-2. Traffic lane width.

Speed class (km/hr)		**Lane width** (m)
High	50-80	3.5
Medium	40 - 50	3.0
Low	20 - 40	2.75
Very low	5 - 20	2.5

SIDEWALKS AND FOOTPATH

Roads in high and medium speed classes [12-14] should be equipped with sidewalks, as shown in Figure-6. The width of sidewalk is controlled by the volume and kind of pedestrian traffic. A minimum width of 1.5 meters is recommended for a wheelchair to pass along the side. Different designs of walking ramps are shown in Figure-7, which should face one of the crossing signs shown in Figure-8

Figure-6. Sidewalks and crossing ramps.

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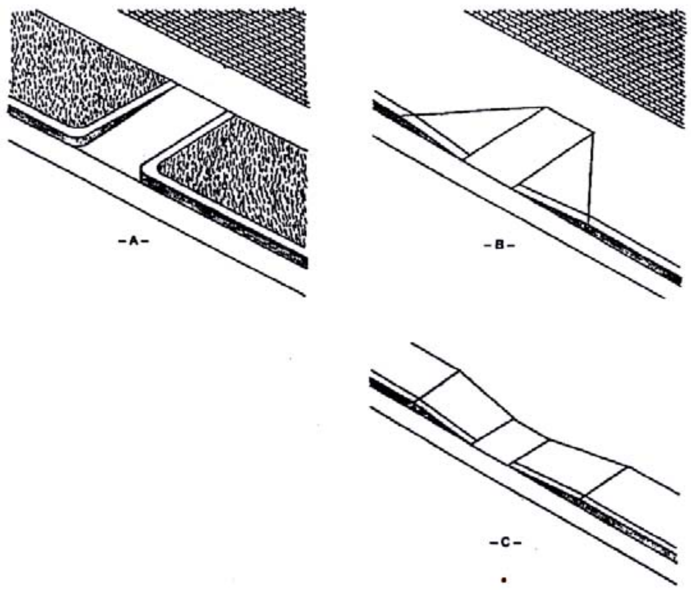

Figure-7. Walking ramps.

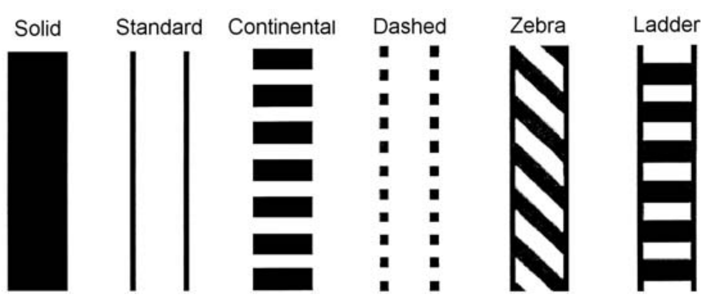

Figure-8. Typical sidewalk crossing signs.

DESIGN OF INTERSECTION

In the design of an intersection, an architectural relation should be sought between the character of the street space and of surroundings, and of the different elements, Figure-9, used in the design [15 – 16]. The design should intend to reduce speed by using one of the following techniques: Narrowing, Staggering, Central traffic island, Ramps and raised surfaces, Humps, Changes in the road surface and texture, and Traffic actuated signals.

Furthermore, the positioning of road equipments and road markings should be an integral part of the geometric design of the intersection.

The most common types of intersections are:

- Signal controlled intersection
- Priority controlled four way intersection
- Priority controlled three way intersection
- Roundabout

Signal control need to be provided in four and three ways intersections involving at least one distribution or one primary road. Signal control should be established only on roads with a maximum speed of 50 Km/hr or less. Signal control needs to be implemented for speed reductions on a road section where the actual speed is higher than the reference speed. It may be of traffic-actuated type for automatic warning.

Figure-9. Traffic control devices and signs.

Intersections of some importance without signal control must have road priorities signs. Traffic on secondary roads should give way to traffic on the primary

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road. Three way intersections would be preferred than four way intersections for minimizing the crossing conflicts shown in Figure-10, and hence for traffic safety. Roundabouts are also encouraged for their capacity and traffic safety.

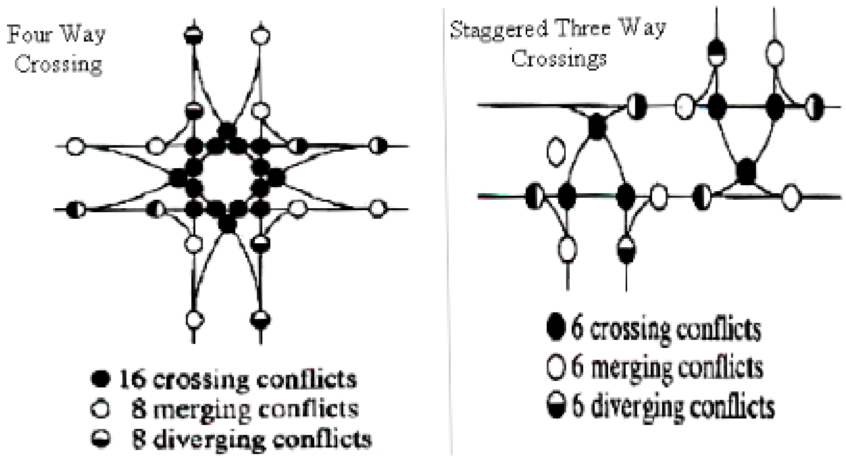

Figure-10. Four way crossing versus staggered three way crossings.

DESIGN OF SPEED REDUCING MEASURES

In a good design, there should be a clear connection between the elements of speed reducing measures and the overall design [17 – 18]. Visual speed reducers include road markings, closed road spaces with trees or gates and attractive street designs of walls, floor and roofs.

Care must be taken to ensure the right geometry of physical speed reducing elements for safety and stability of the vehicles. Standard well-accepted designs of visual and physical speed reducers are reported in the literature and demonstrated in Figure-11. Humps and raised areas are well known and commonly used in wrong dimensions in Egypt. The hump geometry is directly related to allowed traffic speed on the road. Table-3 shows these standard geometries.

Road surface changes and texture can also be changed by implanting introducing objects, but these are usually ineffective and cause vibrations, which affects the useful life of the vehicles.

When determining the distance between individual speed reducers one should consider the drivers attitude in accelerating between the successive physical speeds reducers. Well-constructed physical speed reducers must be located with enough spacing according to standards and codes as shown in Table-4.

Figure-11. Different designs of speed reducers.

Table-3. Standard humps.

Maximum allowed speed (km/hr)	**Radius** (m)	**Length of cord** (m)	**Bus speed** (km/hr)
20	11	3	5
25	15	3.5	10
30	20	4	15
35	31	5	20
40	53	6.5	25
45	80	8	30
50	113	9.5	35

Table-4. Recommended spacing between two subsequent physical speed reducers.

Allowable speed (km/hr)	**Recommended distance between two subsequent physical reducers** (m)
Below 20	20-50
30	75
40	100
50	150

CONCLUSIONS

It is evident that the rising traffic volume in Cairo had served adverse effects on the multifunctional environment of Cairo. Traffic congestion, longer time for trip, more accidents and drivers friction on the road is readily evident. This led to the need for updating the traffic planning concepts and the traffic network design. Introducing a functional classification of the roads and hence adopting maximum speed limits is now must. This emphasizes a traffic-calming concept for more safety and passability. It followed that the traffic lanes need to be redesigned in relation to the sidewalks and footpaths. Design of the three and four ways intersection is considered. Visual and physical traffic speed reducers are suggested according to well-recognized codes and standards.

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