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Research of the current Egyptian roads service facilities placement condition

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The state and provision level of road traffic participants to the objects of service on Egypt highways have been analysed. In general, there are a number of significant shortcomings regarding the systematic approach in justifying and standardizing the distances of the road services location, considering the requirements of road users. With the help of Google Earth and real survey, the current status of the service objects along the Egypt highways and in foreign countries of the world has been surveyed. The obtained data show that service facilities are unevenly located in Egypt, often do not meet normative requirements and are not characterized by complexity. Instead, in foreign countries there is even more distribution of complex service facilities along highways, all service facilities has transition-high-speed bands and the vast majority have separate congresses.

Keywords: highway**,** service objects, patrol station, functional need, spatial corridor

Дослідження існуючого стану розміщення об’єктів сервісу доріг Єгипту

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За даними Всесвітної організації охорони здоров'я щорічно майже 1,24 мільйона людей гине в результаті дорожньо-транспортних подій на автомобільних дорогах, а 50 мільйонів – отримують серйозні травми. Майже 90% смертельних випадків трапляються на автомобільних дорогах слаборозвиненних країн, зокрема Єгипту. Враховуючи ці обставини, в роботі проведено аналіз стану та рівня забезпечення учасників дорожнього руху об'єктами сервісу на дорогах Єгипту. Виокремлено ряд істотних недоліків щодо системного підходу в обґрунтуванні та стандартизації відстаней розташування дорожніх послуг з урахуванням вимог користувачів доріг. За допомогою програми Google Earth та натурних вишукувань обстежено існуючий стан розміщення об'єктів сервісу вздовж автомобільних доріг Єгипту та інших країнах світу, зокрема Австралії. В результаті натурного обстеження виявлено наступні недоліки розташування об’єктів сервісу на дорогах Єгипту: погане облаштування, низька якість утримання, відсутність туалетів, використання місць відпочинку як складських територій, відсутність місць для стоянки вантажівок, заборонено в’їзд на багато зон для відпочинку, недостатній розмір місць відпочинку (недостатньо пропускної спроможності для необхідної кількості вантажних автомобілів). Фактичний стан об'єктів сервісу в Єгипті характеризується невідповідністю нормативним вимогам, відсутністю комплексого підходу до структури та нерівномірністю розташування (відстань між об’єктами змінюється від 5 до 25 км, середнє значення – 7 км). Натомість стан обєктів сервісу Австралії характеризується більш комплексною структурою та рівномірним розташуванням вздовж автомобільних доріг (середня відстань між об’єктами сервісу – 24 м). У результаті проведеного аналізу визначено рекомендації щодо поліпшення транспортно-експлуатаційного стану автомобільних доріг та обєктів сервісу Єгипту, що має позитивно вплинути на рівень аварійності на автомобільних дорогах.

Ключові слова: автомагістраль, об’єкт сервісу, автозаправна станція, функціональна потреба, просторовий коридор.

Introduction

Safety and security are of primary concern for any transport system. Fatalities and injuries caused by crashes are an increasing international health epidemic. Nearly 1.24 million people perish yearly in road crashes and an estimated 50 million are seriously injured. It is the highest cause of fatalities the young. Road crashes costs around 1-3% of the world GDP. Ninety percent of fatalities and injuries caused by road crashes happen in developing countries. Although the percentage of fatalities are estimated to drop in developed countries due to excellent health care conditions and modern technology advancements, it is unfortunately predicted to rise by 80% in the rest of the world [1]. Almost ninety-percent of the fatalities caused by traffic crashes happened in poor developing countries, even though it possesses half of the world number of vehicles [1]. Half of crash fatalities happen among road users such as pedestrians and bicyclists and heavy vehicles, they are more likely than drivers to be harmed in a road crash.

Injuries due to road crashes cause large economic losses to victims, their families and to national economy as well. These losses come from the cost of treatment and rehabilitation in addition to lost productivity for those killed or disabled, and for family members who need to take to care for the victims. The road network efficiency is vital to the transport system of Egypt as the country invests in developing major economic growth centers. Almost 93 percent of passengers in Egypt use the road network whereas rail and air passengers' percentage are 6.6% and 0.4% respectively [1].

The HSM provided transportation professionals with a quantitative evaluation and analysis of road safety. It offers tools and methods to estimate crash frequency and to economically evaluate proposed solutions to reduce crash frequency and severity. It was published by AASHTO in 2010 summing up years of research and experience in modelling crash data in the transportation field. The HSM used SPFs developed in the United States using road and crash data specific to the environment in the United States. Therefore, it was encouraged that the SPFs be calibrated or developed locally to suit the local characteristics of roads and crashes.

The challenge faced by researcher was the large amount of required data such as roadway geometric characteristics, recorded traffic volumes, and multiple years of recorded crashes. It could be very difficult in most developing countries, since the availability and quality of data in developing countries such as Egypt is questionable.

Egypt is a middle-income country, belonging to the Eastern Mediterranean Region (EMR). It has a population of almost 99,375,741 (2018) with the GDP per capita of USD 12,100. Egypt used to be the worst performing EMR country, with just over 45 fatalities per 100,000 populations (according to WHO modelled data.

Though the number of reported road traffic fatalities decreased to 16,800 in 2011 from about 24,400 in 2010, it is deemed necessary to take more action and additional measures to face these road safety challenges in order to build a safer road infrastructure [2].

Even though the road infrastructure in Egypt is designed using the Egyptian Code of Roads [3] which is mainly based on the AASHTO (2011) [4], there are still many safety issues that could be tackled through using a systematic approach. This procedure could be enhanced through initially quantifying the crashes on Egyptian roads, to have better understanding of the deficiencies and means of improvement Therefore, this research is constructing and it improves more rest stations along the roads to let vehicle drivers rest during long journeys.

Road economy is the main infrastructure element of any country's development. World experience proves that it was precisely from the development of highways that the economic crisis of many countries began to emerge. Along with the development of the road complex, road service facilities, which are an integral part of the roads, should be developed. Road service facilities are important for drivers. The rest area is an important element, because drivers constantly need rest. Driving a car requires energy and effort, and leads to physical and emotional fatigue. Therefore, it is important that along the roads there are complexes where you could have a rest.

Service may be essential even if there is a fairly low demand for it. For example, if only one in ten thousand motorists passing a rest area is so sleepy that he/she needs to stop, providing a safe place to take a nap for that person may save his/her life as well as other people's lives. On the other hand, a rest area may attract hundreds or thousands of motorists every day because it is a convenient place to buy snacks or obtain tourist information. But if the rest area were to be closed, existing fast food restaurants and convenience stores at the next exit may easily be able to provide the same services, if information is provided to the motorist. There may certainly be exceptions to this in areas that are rural. In other words, it is not only quantifying rest area usage that should form the basis of whether to keep a rest area or not and which services to provide there with. Also, the necessity of these services and available alternatives should be considered.

Filling stations are the most important service objects, because the car needs regular fueling.

Service stations are often "rescue islands" for drivers, because the car is a mechanism that has a function of wear. Replacement parts, repairs, car wash are also often needed by drivers and their car.

To focus on the high development of road service, the experience of foreign countries should be considered. In these countries there is an integrated approach to the development of road infrastructure.

Review of research sources and publications

Thomas Kweku Taylor, Chanda Sichinsambwe and Blessings Chansa from Kitwe Zambia research location of manufacturing and service activities in urban areas are guided by planning principles and standards,

expressed in either structure plans or land use development plans. The paper is an exploratory study that applied a cross-sectional descriptive research design to find answers to the research questions and to validate the following hypotheses: Environmental Impact Assessment (EIA) Criteria is positively related to the location of filling stations in Kitwe; Entrepreneurs preferential location choices is positively related to location of filling stations; and Planning principles, standards and regulations positively influence locations of filling stations in the City of Kitwe. The t-test statistics was used to validate the hypotheses. The main finding was that, filling stations are located influenced by choices made by service station entrepreneurs [5].

David W. Fowler, Joseph F. Malina, Jr., Kirby W. Perry, Gary C. Vliet have researched design recommendations for rest areas. Based on the findings presented in reports, recommended design procedures are presented. Recommendations include spacing, site requirements, example architectural designs, materials, mechanical systems, and operations and maintenance. Recommendations for energy sources, water systems, and wastewater systems are made [6].

Zapolsky Yu. studied the buildings system formation and structures in the highways landscapes. His works devoted to determining the size of these objects [7]. Famous Russian researchers like Babkov V., Ornatsky N., Treskinsky S. devoted their works to the Russian highways improvement. Belarussian architect Sardarov A. studied the architecture of Belarus road environment [8].

Definition of unsolved aspects of the problem

Fatigue is a significant issue for drivers in Egypt and particularly for those travelling long distances in highway. It is estimated that fatigue is the main contributing factor in approximately 25% of road crashes involving serious injury.

Commercial vehicle operators in Egypt drive for long distances and often through periods when they should naturally be sleeping. Transport regulations require operators to have short rest breaks of 30 minutes duration (or two × 15 minutes) for every six hours of driving. Operators are also required to stop for a minimum sleep break of six hours under the regulations. Recent research has highlighted the benefits of taking short naps, especially in relation to the re-charging function of a power nap. The ability to utilize this and other rest time to the benefit of driver safety is therefore paramount. Roadside rest areas for commercial vehicle operators should provide for the needs of these drivers [9].

There appears to be a lack of consistency in the frequency of rest areas provided and the manner in which they are established. It is apparent that there is the need to promulgate nationally consistent guidelines for the provision of rest areas for heavy vehicle drivers. Further, it is suggested that an audit of rest area locations on long distance highways is warranted in the short term, especially where such audits have not been previously carried out. The results from these audits together with future freight movement forecasts assist in planning for future rest area demand.

The provision of rest opportunities through rest areas represents a management tool in addressing fatigue-related crashes. A major challenge to realize the potential benefits of rest areas is to increase patronage by those road users travelling long distances.

The increased use of rest areas depends largely on the quality of the rest provided area. The ability to maintain and provide a clean and attractive rest facility considers a major factor in attracting and retaining their use by road users.

Historically rest areas in Egypt have been subject to a great deal of criticism by road users and representative groups. Common issues identified through consultation with regard to rest areas in Egypt include (fig.1):

– Poor quality.
– Poorly maintained.
– Lack of toilets.
– Use of rest areas as sites for stacking aggregate.
– Lack of ‘truck friendly’ rest areas.
– Many rest areas are truck prohibited.
– Inappropriate size of rest areas – not enough capacity for the required number of trucks.

Figure 1 – ATM Service on highway in Egypt

Problem statement

In this research there are attempts to address these issues: a key component in the development has been the level of understanding gained through consultation of the use of rest areas by the different user groups. This research attempts to consider the key requirements of these different user groups, with the common aim of providing and encouraging greater use of rest areas for fatigue management. Additionally, recognition of the importance of a comprehensive well planned and managed network of rest opportunities has also been achieved. This aspect should ensure that the provision of rest areas and the facilities in them are strategically assessed against user demand.

Purpose of the research is improving the parameters of service objects locations along highways of Egypt.

Objectives of the research:

- Analysis of existing research on the problem service objects placed along highway.
- Survey of the current state of the service facilities placement along Egyptian roads and comparison with foreign experience.

Basic material and results

The objects of the service include: rest area, filling stations (gas stations) and gas filling stations, service stations, trading posts Fig.2.

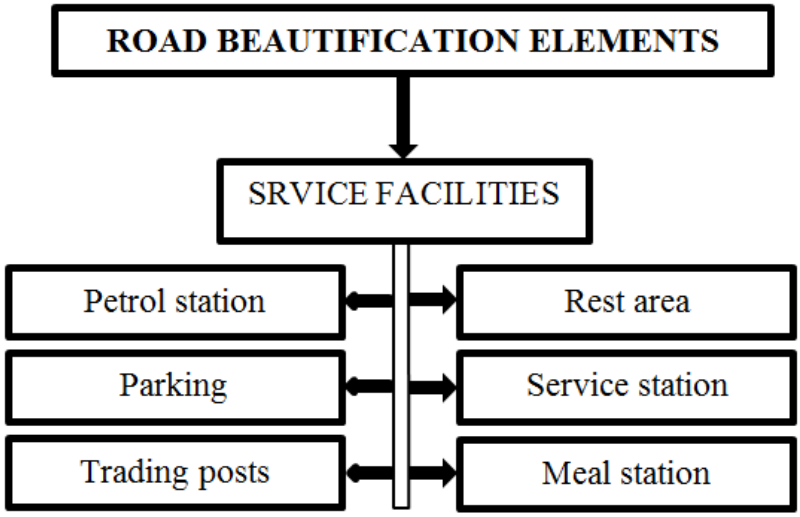

Figure 2 – Classification of highways service facilities

Description of the research methodology.

In the final form, a measurable object was conducted using Google Earth (Google Earth). This is a free, downloadable, Google-powered program that displays a virtual globe. The principle is based on aerial photographs and satellite images of most of the Earth. For some regions, these photos are of very high quality.

The order of the research:

1. To use the "Line" function to select "Line", measure-ment in meters. Thus, from a point to point distance from the edge of the travel section to the beginning of the service object, the width and length of the territory were measured.

In the final form the metered object shown on the fig. 3 – 4.

2. Also the distance to the next service object along the road in the same direction was measured. To conduct it, in the "Ruler" function, the tab "Path" in kilometers was chosen

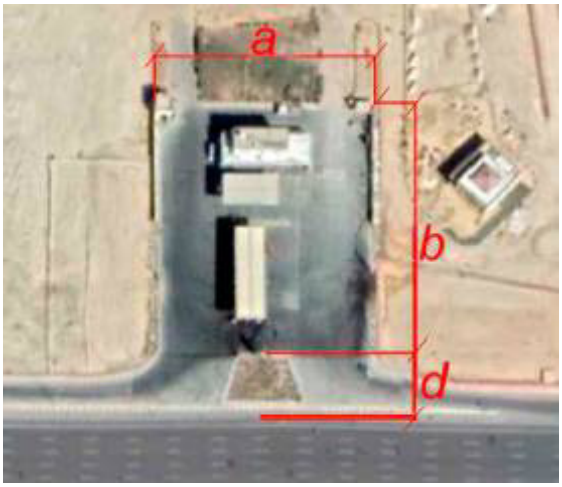

Figure 3 – An example of a measured petrol station in Google Earth

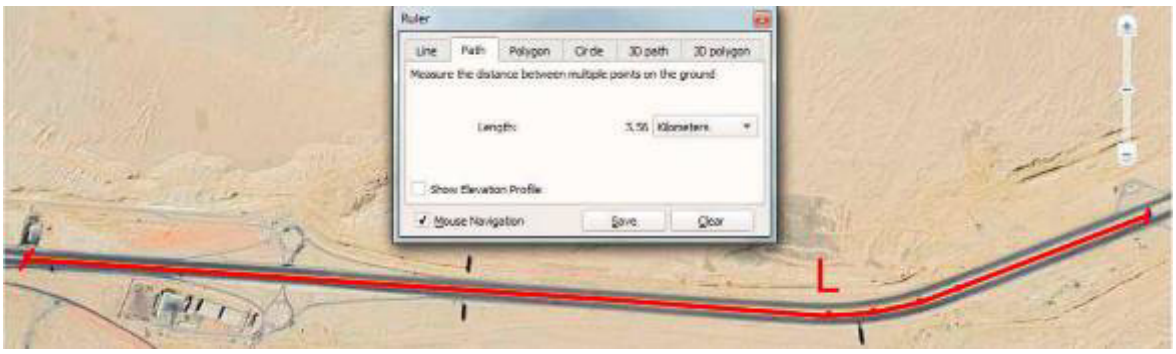

Figure 4 – An example of measuring the distance between a petrol station in the Google Earth program

Survey of the service objects placement in Egypt.

The study of service objects in Egypt was carried out according to ministry of petroleum data. As of June 30, 2014, the number of registered gas stations in Egypt is 2902 petrol station [1]. In addition, unfortunately, in Egypt there are a very small number of service facilities that should include gas stations, parking lots, hotel, car-care centers, food items, which are very typical for foreign countries. In the regions of Egypt, gas stations are often located separately from service stations.

In Egypt, 52 stations were measured on the routes Cairo Alex-Cairo Desert Road – Wadi El natron Elalmin – Al Ain el Sokhna – Cairo (Fig.5).

According to the obtained data on the location of petrol stations in Egypt and the obtained data on the location of service facilities in Australia, the data from the edge of the roadway to the service object and the distance between the service objects along the route are compared.

Fig 6. It is shown the distance between station and from the edge of the roadway in Alex-Cairo Desert Road.

Fig 7. It is shown the distance between station and from the edge of the roadway in Wadi El natron Elalmin.

Fig 8. It is shown the distance between station and from the edge of the roadway in Al Ain el Sokhna – Cairo.

Table 1. It is shown the averaged data for 52 petrol sta-tions in Egypt.

Table 1 – Averaged data for 52 petrol stations in Egypt

Distance from the roadway edge (d, m)	Distance between stations (L, km)
24.71	7.1

The next step of research was the survey of the service objects placement along highways in foreign country.

Egypt

a

b

Figure 5 – Planning solution of service station
a – Green Desert along Cairo Alex-Cairo Desert Road;
b – rest area along Wadi El natron Elalmin

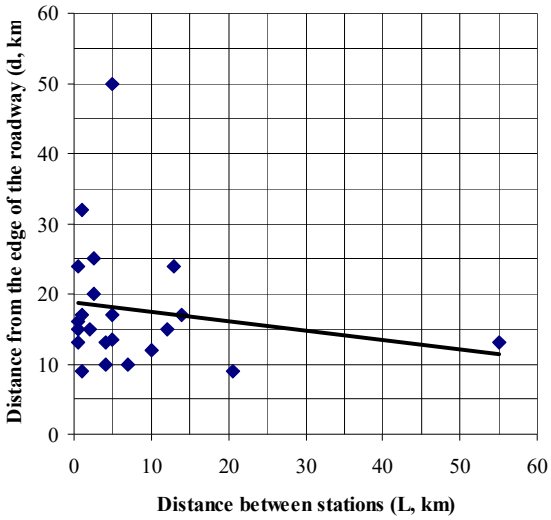

Figure 6 – Determine the distance between station and from the edge of the roadway

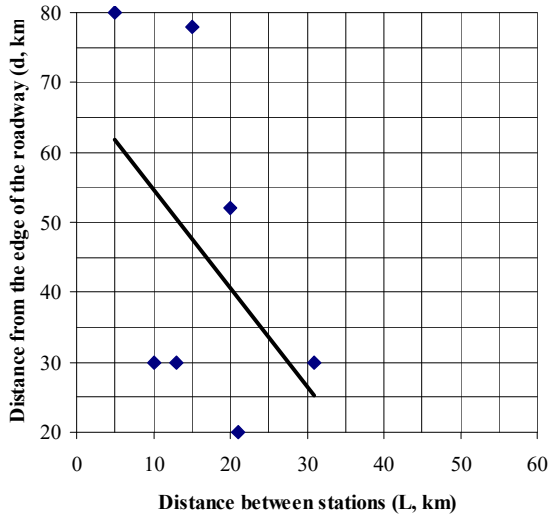

Figure 7 – It is determined the distance between stations and from the roadway edge

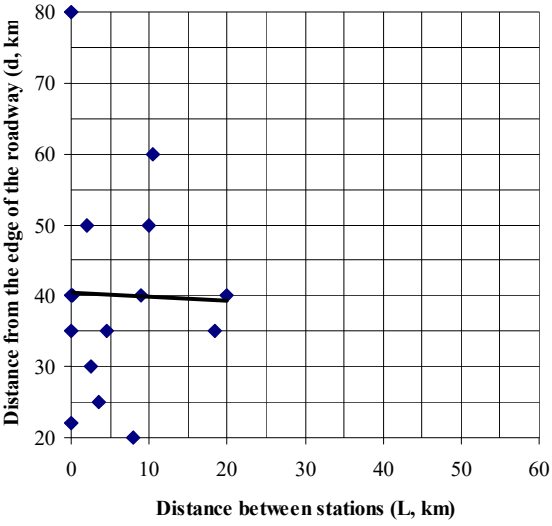

Figure 8 – It is determined the distance between station and from the edge of the roadway

Australia

Fig 9. It is shown the distance between station and from the edge of the roadway in Hume Highway.

Fig 10. It is shown the distance between station and from the edge of the roadway in Pacific Highway.

Table 2. It is shown the averaged data for 56 petrol stations in Australia

Table 2 – Averaged data for 56 petrol stations in Australia

Distance from the roadway edge (d, m)	Distance between stations (L, km)
38.56	23.91

Table 3. There are average values for the 5 roads studied to compare all the obtained parameters.

Table 3 – Average values for the 5 roads studied to compare all the obtained parameters

N	Name of Road	Distance		
		d/n	S/n	L/n
1.1	Alex-Cairo Desert Road	24	12302.	5.3
1.2	Wadi El natron Elalmin	41.5	6618	14.5
1.3	Al Ain el Sokhna – Cairo	41.5	6740.9	5.5
2.1	Hume Highway	42.9	3220.4	24.65
2.2	Pacific Highway	33.24	3634.4	23

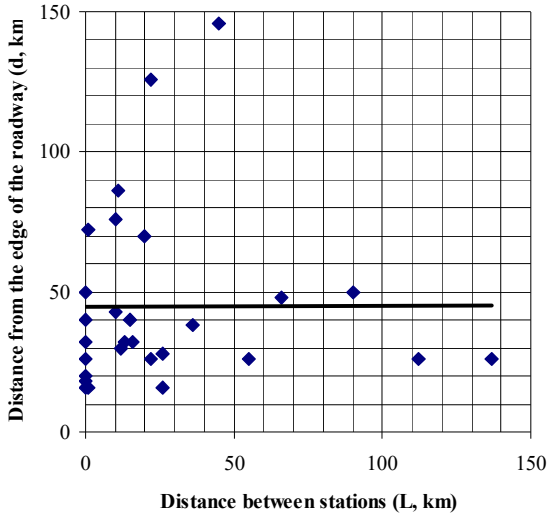

Figure 9 – It is determined the distance between stations and from the roadway edge

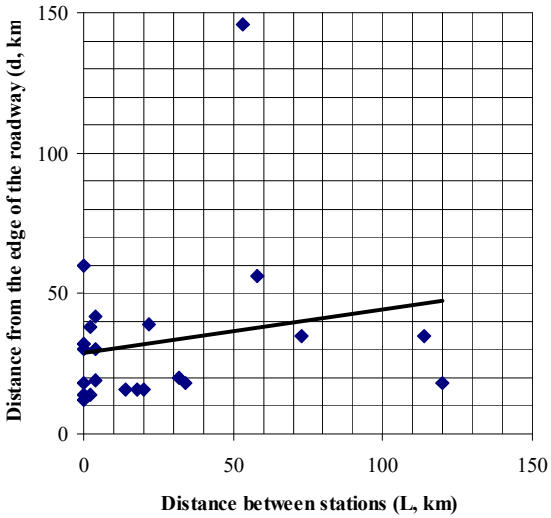

Figure 10 – It is determined the distance between stations and from the roadway edge

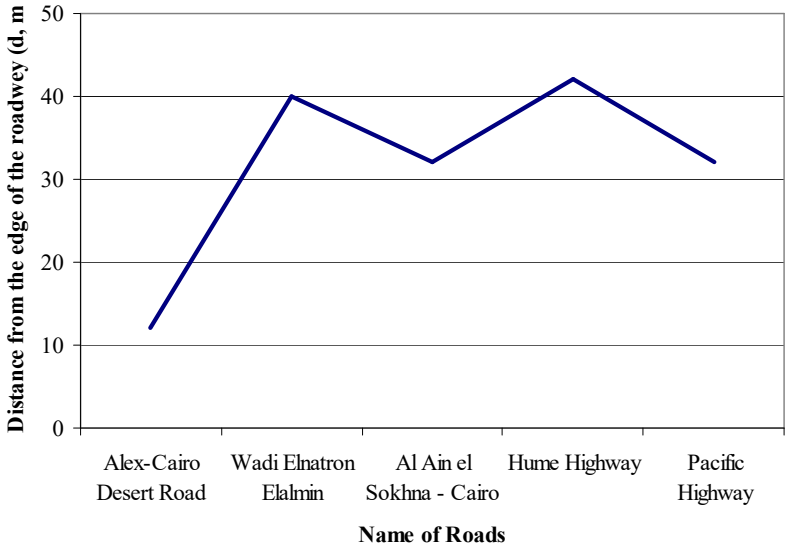

Figure 11 – Diagram for all roads for distance from the roadway edge (d, m)

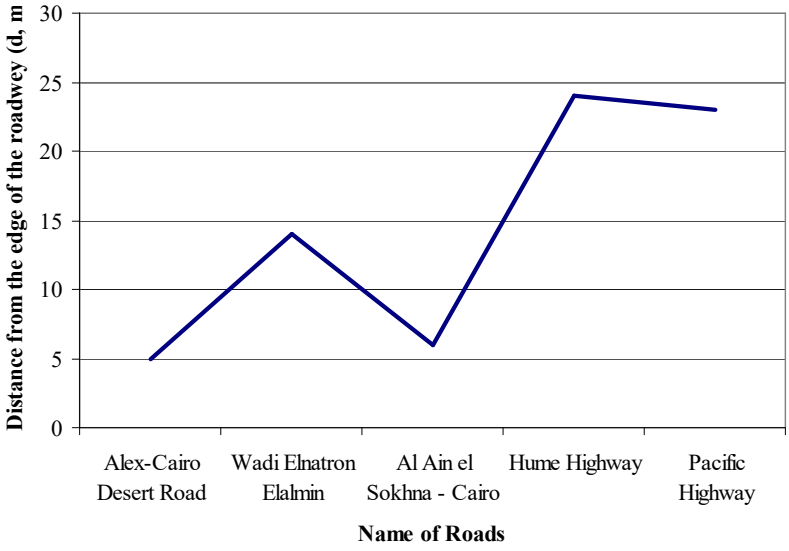

Figure 12 – Diagram for all roads for Distance between stations (L, Km)

Conclusions

The main tasks for improvement in Egypt include:

1) to develop new rest areas in locations where current spacing does not meet research requirements.

2) to improve safety of entry/egress through sealed shoulders, aprons, and acceleration/deceleration lanes if required.

3) to install appropriate facilities (including bins, lighting etc.) to create functionally attractive spaces for road users to utilize.

4) to install toilets in high demand rest are-as.

5) to resurface poor pavements (sealed & un-sealed as necessary) to create safe trafficable and hard stand areas.

6) to fence the rest areas to create clearly defined boundaries there.

7) to improve distribution of rest area information (maps, electronic data, on-route signage etc).

8) the distance from the edge in Egypt should be at least 15 m. In foreign countries, average values indicate that similar requirements are met. The greater the distance from the edge to the object service, the less probability of an accident.

9) the distance to the next service object in Egypt should be from 15 km to 40 km. These data are very volatile in Egypt. In foreign countries this indicator is more moderate.

10) the area of service objects in the investigated foreign countries is many times higher than Egyptian. They include: hotels, car parks, petrol stations. There were no additional services at the some petrol stations explored in Egypt.

11) transition speed bands are not present at all petrol stations in Egypt. Unlike Egypt in all investigated service facilities in foreign countries there are transitional high speed bands.

The placement of service objects in Egypt and abroad should be done with the help of Google Earth.

The difference between the placement of service objects in Egypt and foreign countries was revealed. The distance to the roadway edge in Egypt often does not meet regulatory requirements, as opposed to foreign countries, where there is a consistency of these indicators in countries. The distance between the objects of service in Egypt varies from 0, 25 km to 60 km (according to regulatory requirements it should be from 15 km to 30 km), in foreign countries this indicator is even more. The area of service objects in foreign countries is many times higher than in Egypt.

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