A Guideline of Design Criteria for Highway Rest Areas in Libya

Dr. Mariam M Shibub Dr Mohammed Betro
Engineering faculty, Architecture Department and Urban Planning
Tripoli University
Dr.mariamshibub@gmail.com mbetro17@gmail.com

Abstract

Rest areas for highways are one of the important highway services to meet the needs, requirements, and activities of highway users and motorized vehicles. This paper discusses the problem of the weak and deteriorating infrastructure of service stations and highway rest areas linking Libyan cities. Consequently, this problem causes an increase in the number of accidents on highways because of fatigue suffered by the travellers. This paper aims to detail a guideline for designing standard highway rest areas. This effective tool will reduce the rates of serious accidents on highways in Libya and create comfortable and accessible services facilities distributed regularly on both sides of the highways. From this standpoint, this paper raises a number of questions through which it sheds light on all types, components, standards, characteristics, and services provided by the rest areas. The methodology adopted in this paper is the inductive approach to a number of strategies that have been used to develop highway rest areas in several countries around the world. It also uses the analytical method for collecting data by questioning users of the Sixty's Rest House located on the Nalut Road, Libya, using the two types of tools, the questionnaire and the interview. This paper concludes that it is necessary to develop this type of service facility through the improvement of existing rest areas and the establishment of new rest areas. Each rest area should follow the requirements of the modern era in highway services, according to the standard guidelines for planning, distribution, and design outlined in this paper.

Keywords: rest areas, highways, users, traffic, security, criteria.

1-Introduction

Rest areas are considered one of the most important elements of the highway infrastructure, as they provide advanced services for long-distance travellers who need a break from driving long distances. In light of the circumstances and challenges facing Libya, traffic safety and security on highways are among the most important requirements for users of highways that link Libyan cities.

This paper discusses a number of strategies for developing highway services used presently in several developed countries, including America, Europe, and Australia. These strategies include directives, principles, and standards related to rest areas on highways, which provide a service to the beneficiaries. They should have characteristics and advantages that keep pace with the service development of highways around the world. Rest areas here play an important role in the highway network as they provide passengers of small and heavy vehicles with an opportunity to refuel, use the sleeping rooms to rest for a limited period of time, stop for nutritional refreshments, stop to relieve oneself, or even stop to use a mobile phone as well as to allow children to play and have physical respite. The diversity of these activities

inside the rest areas has a direct impact on the planning, distribution, and design characteristics of these types of rest areas (Researcher, 2020).

Fatigue caused by driving is a very important issue for drivers, especially for long-distance travellers. According to a number of studies, about 25% of road accidents result in serious injuries and the main factor of these accidents is fatigue of the driver. Many services inside the rest areas on both sides of the highways help in reducing fatigue and this reduces the probability of accidents related to driver fatigue and tiredness [1]. To improve the safety and comfort of road users, it is necessary to raise the level of the DCRE system (Driver - Car - Road - Environment). In addition, it is vital to concentrate on rest areas and their relation to road regulations [23].

Equipping highway rest facilities for various purposes is essential to raise the level of highway services, especially for long-term drivers. The rate of occupancy of rest areas depends on the planning, distribution, and design of rest areas. In addition, the ability to maintain the cleanliness and performance through the design of attractive architectural elements provides high service for travellers and ensures the permanence of their use. Therefore, there is a challenge for architects in balancing the needs of road users and the increasing number of motorized vehicles, and also designing a distinguished architectural project. Accurate information about the number of potential motorized vehicles entering and using highway rest areas is important in estimating the needs of passengers and motorized vehicles [21].

2- Research problem

As a result of the absence of rest areas and their logical distribution on both sides of the highway, as well as the inability of existing poor rest areas to meet the needs of the users and automated vehicles, we have seen the emergence of many problems. Here are some of the problems we have observed:

- The absence of a guideline for planning and designing standards for rest areas and highway services in Libya.
- The increasing number of accidents on highways that have resulted in many deaths and permanent disabilities because of the lack of road services, such as rest areas. Statistics and police records show numbers of traffic accidents from 1998 to 2002, where the number of accidents during these five years totaled 59,542. The number of deaths was 7,191 people, and the number of permanent disabilities and deformities was recorded to be 1502 people (Traffic Authority Tripoli 2012).
- As a result of excessive fatigue and the lack of a suitable place to stop and sleep, a driver who pulls over to sleep on the side of the road may become the victim of murder or robbery.
- Travellers may feel hungry and if they resort to eating on the side of the road and throwing their waste onto the road, it contributes to an increase in waste and dirt on both sides of the highway and thus this waste may cause disease which could spread among people.
- Another problem is the poor or weak financial support for such projects. The cost of rest areas varies, depending on the type and level of services provided by these rest areas, as well as on the age and dimensions of the building and its capability to comprehensively serve the number of road users. It may be expensive.

3- Research paper questions

1- What is the reason for the small number of highways rest areas in Libya and the low level of their services, (if any)?

2- What are the planning and design criteria for the highway's rest areas?

3- What are the service facilities that must be provided within the highway rest areas?

4- Research paper goals

- Coming up with guidelines for planning and designing criteria for highway rest areas in Libya to raise the level of services to be an effective tool to reduce simultaneous accidents associated with fatigue of motorists on highways, and the dilemma of security and safety.
- Shedding light on the importance of providing and equipping typical rest areas according to international standards in terms of the necessary services that meet all the needs of highway users.
- Developing a mechanism for using highway rest areas as a tool to increase the general income of the state.
- Determining the type of services that are provided through rest areas.

5- The methodology used in the research paper

The methodology in this paper is based on the use of the inductive approach as a framework of knowledge to shed light on the importance of rest areas on both sides of the highways, as well as identifying all the criteria, characteristics, and requirements of the rest areas on the highway. This paper also uses the analytical approach for a set of information obtained from users and pioneers of the case study at Sixty's Rest-house by using the tools of questionnaires and interviews.

6- The importance of highway rest-areas

Highway rest areas are a way to overcome the fatigue for travellers and to reduce the percentage of accidents on the highways. Rest areas provide for travellers' needs and requirements during their road travel from one city to another within the same country. In addition, the rest areas offer an opportunity to rest, even if it is short. There is an increasing demand by tourist travellers in developed countries such as Britain and America for camping in rest areas. They can spend the night in a safe place where they will not be harassed by the general public. They can also take advantage of the services provided by the rest area at any time, but the administration of it does not allow them to stay for more than 24 hours, so it must be equipped with advanced services that provide passengers with comfort to organize their trip [8]. A good design of rest areas on the highway provides a comfortable climate for travellers and reduces the risks to which the traveller may be exposed. There are several advantages to the rest areas:

- Reducing theft of goods carried by passengers by offering a safe parking place, ensuring the free movement of goods and people, and ensuring the safety and comfort of the driver, passengers and vehicles.
- Growing the country's economy due to the high-value services provided to large numbers of passengers and vehicles throughout highway rest areas.

- Assisting in reducing garbage on both sides of the road as a result of the random stops of motorized vehicles.
- Supporting and encouraging tourism in the country and assisting local communities in marketing and promotions.
- Motivating travellers to use motorway services provided in a sophisticated fashion [3].

7- Principles for planning highway rest areas

Locating and planning highway rest area is not an easy task, as it is determined on the basis of the nature of each location and the needs of the area where the highway passes through. The planning of rest areas on both sides of highway is important in terms of the development of the country's economy, road safety and the successful management of passenger fatigue [16].

Designers must take into account some important strategies when planning rest areas on both sides of highways, including:

- Designing the rest area to be in line with the general appearance and nature of the surrounding area, taking into consideration the historical architectural background of the area in which the rest area is located and trying to reflect this historical architectural background in the general form of the rest area.
- Arranging for safe areas that are fenced off or treated with vegetation to protect pedestrians, especially children within rest areas that have parking lots near the road as it shown in Figure No (1) [8].

Fig.1 Truck parking on both sides of the road

(Department of Transport and Main Road, 2014, P. 4) (Sixty's rest-house, in Nalut Road-Libya Source, Researcher, 2010)

- Considering the varying needs during different seasons of the year so that the highway rest areas are prepared to be used year round [9].

When planning rest areas, we need to determine the average distance and time between rest areas, and specify the number of car parks relative to the number of motorized vehicles entering the rest areas [19]. King conducted a study in 1989, where he collected field data for 13 rest areas in five American states to estimate the proportion of major traffic that might use highway rest areas based on the distance between these rest areas. Traffic entry percentages ranged between 5.5% and 17.7 %; average entry was 10.3%; and average vehicle occupancy was 2.2% of people. Perfater studied eleven Virginia rest areas in 1989, and recorded the number of visits and rest times at these sites. Questionnaires were also distributed to rest

area's users. The results showed that an average of 12% of Virginia's cars passengers entered the rest areas and 23% of truck traffic. This depended on the site and its area [3].

8- Standards of spacing between highway's rest-areas

Under USA law, spacing distances between highway rest areas must be at most 50 to 60 miles (80 to 97 kilometers) with a driving time of one hour, taking into account the needs of road users and traffic safety [7]. As for the standards of European countries, the rest areas are arranged on the highways at distances from 50-60 km and up to 80 km with the provision of all services. Rest areas with minimal services are distributed every 15-20 km or 25 km [13]. Figure No (2) displays the distances between rest areas with services and rest areas without services.

The following guidelines are from the National Transportation Committee of South Australia, which issued a guideline for the distances between the different classifications of rest areas and their carrying capacity.

- The major rest areas which are for extended stays must be distributed every 100 km and the number of beds must be 20 beds and about 20 motorized vehicles.
- Small rest areas for short stays must be distributed every 50 km. The number of beds is 8 and with parking for about 8 motorized vehicles.
- Rest areas with parking designated for trucks desiring short rest periods or a safe place to load merchandise safely are distributed every 30 km, and the number of beds 6 and about 4-6 trucks [8].

The spacing between highway's rest areas depends on many factors, such as:

- The picturesque landscapes and their characteristics and the nature of the region that the highway passes through.
- Traffic density and its formations.
- The expected average driving speed in the area through which the highway passes.

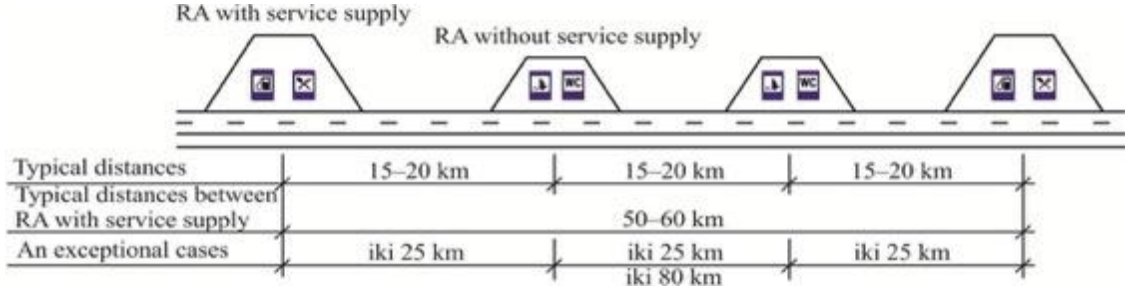


Fig. 2 Distances between the rest-areas (Bertuliene, L& Zilinskiene, L. (2014, P.6)

9- Criteria for selecting the site and its area for Rest-areas

The poor choice of location for rest areas may not attract travellers and highway users to stop. Therefore, long-term planning must keep pace with the development of rest centers, commercial services, large service stations, stopping areas for large vehicles, road technology, and the needs of users. Some of the

most important properties that rest areas on highways must have are: a quiet environment, shade, and flat surface. [9].

Factors to focus on when selecting highway rest locations:

- There must be a buffer zone between the rest areas and any nearby urban community for fear of sabotage; the distance between them is not less than 100 meters.
- The site must have a picturesque nature and a distinct attraction that increases the chance of travellers choosing it for their convenience and enjoyment.
- The site must be spacious and overlooking the highway so that the site area is not less than 10 acres. It is preferable that the site be square in shape, with open spaces provided, as well as diversity in the parking area for cars and large trucks.
- The site must have a slight slope of 2-3%, as flat sites cause water drainage problems and sites with a steep slope cause a problem for accommodating those with special needs.
- The site must be rich in shade trees.
- The site should be at least a distance of 30-50 meters away from the highway so that the noise and glare of car lights do not affect the passengers.
- The site should provide emergency services such as firefighting and back up supplies of electrical power sources, a dependable water supply, and proximity to wastewater treatment facilities [7].

As for the design of rest areas, the site must be divided into several functional areas for the purpose of ensuring the safety of users as it clear in Figure No (3). The site should separate the movement of different motorized vehicles as well as to provide seating for the disabled in a place close to the service facilities.

- The first area should consist of a parking area for all kinds of motorized vehicles with an entry and exit road. When planning parking lots, it is necessary to determine the number and type of vehicles that are scheduled to be present at any given time.
- The second area should include a comfort area for passengers with umbrellas, tables, and seats. And in the case of a larger service center, there must be a small hotel, restaurant, café, and a small mall.
- The third area should include a sanitary area with restrooms that include latrines and hand-washing basins, with waste baskets [3].

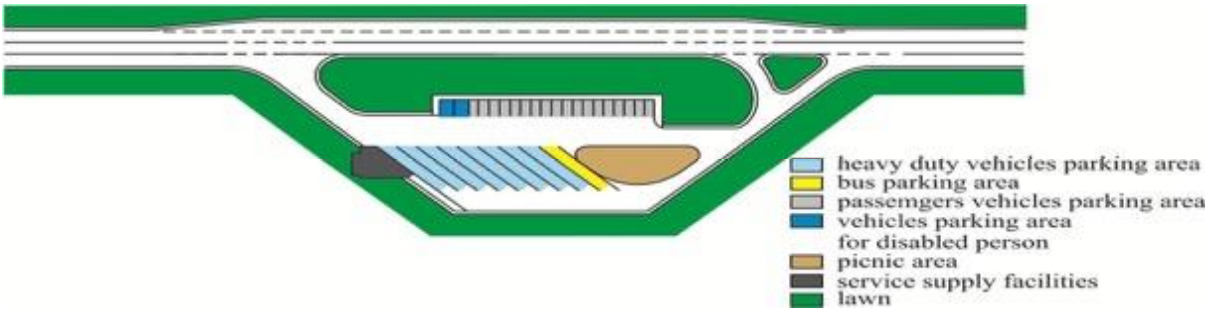


Fig. 3 An example of the division of a rest areas into different functional areas (Bertuliene, L & Zilinskiene, L 2014, p.6)

10- Types of highway rest areas users

When planning and designing rest areas, the types of users and their various needs must be taken into account. There are three main categories of road users:

- Truck drivers
- Car drivers and passengers
- Tourists

Each of these categories has different motives for stopping, and they bear full responsibility in using the provided rest area services to deal with the problems of fatigue, exhaustion, and stress.

- Drivers of trucks and heavy vehicles must stop for a specified period, in accordance with the International Traffic Law. The downtime is 15-45 minutes for short drives and 9-11 hours for long drives.
- Tourists have the freedom to choose when to stop. This category of traveller benefits from the services provided by the rest facilities such as shops, restaurants, cafes, petrol stations and information centers for archaeological sites. The presence of rest areas in remote and sparsely populated rural areas is critical due to the lack of commercial and service facilities on both sides of the highway.
- Car drivers and passengers, including residents of towns and villages who travel for business, shopping, or personal purposes, also benefit from service areas. Although the duration of their trip may be short, they still need to stop to take a break and fulfill their needs.

All types of highway rest areas must be available 24 hours a day, 7 days a week for all categories of highway users, including those who are disabled [6].

11- Types of rest areas on both sides of the highways

The diversity of rest areas stem from several factors, including: the capacity of the rest areas, funding, the number of different services offered, and the types of public facilities equipped within these rest areas. Here are some of these types:

- Rest areas for motorists
- Heavy truck drivers' rest areas

When determining the services and facilities that must be located in the rest areas on both sides of the road, it is necessary to differentiate between the needs and requirements of motorists and drivers of heavy vehicles, as well as determining the capacity of these facilities. There are specific rules for designing the roadside rest areas in terms of location, type of vehicle, type of user, and traffic size. Therefore, the rest areas were classified into three categories as follows:

1) Major rest areas
2) Minor rest areas
3) Truck driver's rest areas

All of these types of rest areas include basic services, including: seating, tables, chairs, and shades, and wastebaskets. Most types of rest areas are available to all highway users except for some small rest areas. Heavy vehicles cannot enter this type of rest areas because of the natural restrictions of the site [8].

1. Major rest areas

This type of rest area tends to serve and meet the needs of long-distance travellers of all categories, including truck drivers, as it provides them with a dedicated and separate place to park their trucks. These rest areas are used most of the time as a place for an extended stay. Some of the most important features of the major rest areas are:

- The high capacity to absorb highway users, up to 20 double beds at any time, 20 parking spaces for different types of motorized vehicles with the identification of path movement for each one.
- The presence of a fence surrounding the rest area to delineate its borders and natural features.
- At least two areas protected by shade that provide tables and chairs separated from the movement of motorized vehicles. It also should include easy access to them by users, especially the disabled.
- Waste collection bins in places of easy access and also toilets for both genders, which are equally accessible.
- Lighting during the night, public telephones, protected pedestrian paths, a petrol filling station and a car repair station, a café, a restaurant and a motel.
- A unique name that distinguishes the rest-areas from others; this name should reflect the geographic location of these rest areas [8].

2. Minor rest areas

Small rest areas are a destination for a high percentage of passengers, so they must provide all the needs of highway passengers for a short period of time. Therefore, it includes basic services such as toilets, lighting, an adequate number of seats, tables and umbrellas. The capacity for this type of rest areas is 8 double beds, and parking for 8 cars. These minor rest areas are on smaller sites, which limits the possibility of safe entry and parking for some heavy vehicles or machinery. For this reason, this type of rest areas is not suitable for truck drivers [8].

3. Truck drivers rest areas

These rest areas provide the same services as the minor rest areas but the capacity for the number of beds here is less: up to 4 double beds. There is dedicated parking for 4-6 trucks, (with an area of 100 m * 9 m), so it is safely designed as a rest area for truck drivers and heavy machinery, although it can also be used as a rest area for different high ways users [8].

12- Specifications of design elements for rest areas on highways

1) **Signage**

Signs are an important guiding element on both sides of the road that help the traveller determine their destination according to their needs Figure No (4).

- Signs that indicate the presence of the rest areas should be clearly posted on both sides of the road between 1 km and 10 km before reaching the rest areas.

- There must be signage at the entrance of the rest areas at a distance of not less than 300 meters from the entrance to avoid accidents and allow safe entry.
- Signs should be placed at current rest areas that indicate the services offered and distance to the next rest area.
- Signs introducing the various services offered should be posted in visible places within the rest area [9], [12].

Fig,4 Signage in Highways

(Department of Transport and Main Road, p. 8, 2014)

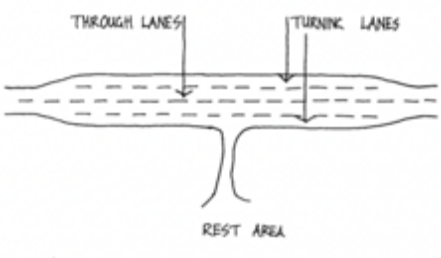
(Department for Transport, Energy and Infrastructure, P.1, 2008)

2) **Buffer zone and safe entry**

For the protection and safety of rest area users, the distance of the rest areas from the highway should not be less than 30 meters Figure No (5b). It is preferable that it be an area rich in trees that do not obscure the view of the rest area from the road but that also reduce the noise of motorized vehicles on the highway [4].

Here we should focus on several important points, including:

- There must be a space on the side of the road to turn and give the possibility of acceleration and deceleration of motorized vehicles to reduce the risk of collision when entering and exiting it as shown in Figure No (5a).
- There should be a clear long-distance line of vision for travellers as they enter the rest area and as they exit the rest areas and merge onto the highway.
- The entrance must be wide enough for two adjacent vehicles to enter simultaneously, and it must be long enough but no more than 22 meters with speed reducers (bumps) [16], [11], [12].



A turn on the road to leave a safe distance Buffer zone between the road and the restroom

(Moore, 1985, P. 37, 39)

Figs. 5a and 5b

3) Entrances, exits, and movement area

When designing or developing rest areas on highways, the movement of motorized vehicles should be limited to one direction and only in a specific area within the site. It should be well defined by different surface materials such as vegetation, fences, or barriers [16]. The parking area should be flat and equipped with clear and appropriate traffic signs for all motorized vehicles. The parking area should be in the front of the rest areas to reduce the noise caused by the traffic on the highway [8].

4) Entrances for the disabled

All types of rest areas and their facilities should be designed to allow persons with special needs to use them comfortably, smoothly, and with safe access to all facilities. Particular attention should be given to the suitability of surfaces around these facilities for the disabled, such as tables and seating areas.

5) The fence

The presence of a fence around the rest areas on the highways is very important to protect all their facilities and their users from the surroundings, whether the potential danger comes from vandals or the impact of motorized vehicles on the road. In addition, the rest areas can be located by landscaping and barriers as it helps to reduce wind speed and control the flow of garbage and plant waste from the surrounding areas [12], [10].

13- Outside services that must be provided in highway rest areas

The type of services provided in rest areas on highways varies according to the type of rest area and the type of users. So the utility standard determines the user's comfort level and this will influence the driver's decision of whether the driver wants to stop for a break or not. Facilities must correspond with the user's needs and satisfy all their basic requirements.

Here are the most important elements that should be available in all types of rest areas:

1. Shaded tables

All rest areas on both sides of the highway are equipped with a place designated for sitting, with a minimum of 6 chairs, and be suitable and comfortable for road users. To achieve this, the site can either use natural large shade trees or various types of cloth or variegated iron to protect in times of rain or fierce sun as it demonstrates in Figure No (6). [11], [13].

Fig. 6 Roadside rest area, Waverly Creek, Source: Mr. Graeme, Ronsley, RAAG (DTME, 2014, P. 28)
Shaded Seating area, Sixty's Rest House Libya, Source, Researcher (2010)

2. Toilet rooms

Most kinds of rest areas must contain toilets and showers Figure No (7), especially rest areas that host long-time travellers. The site designated for the establishment of such projects must be provided with a water supply system and a sewage system. In addition, cleaning materials should be provided with a permanent presence of labour to clean the toilets, [8]. Toilet rooms must be provided for both genders and they should be separated by a wall and have entrances that open to the outside. The area of toilet rooms that contain eight toilets should not be less than 65 square meters and the entrance to the toilet room must be designed in such a way that it blocks the direct view from it and to it. These rooms must contain washbasins in their own separate section so that they can be used even when the toilets are unavailable because they are full or being cleaned or repaired. The toilet rooms must also include rooms for disabled people and for changing babies' nappies with an area of 6 meters [4].

Fig.7 Toilet rooms, in the Sixty's Rest House, source, the researcher (2010)

3. Rubbish bins

Waste and its collection are major concerns of highway rest area management. Designers of rest areas should plan the method of gathering the garbage and limiting its spread. Rubbish bins should be easily accessible to users, with clear signs that indicating their location. The litter box should be elegantly designed as well as easy to use. The best material for easy cleaning and durability is thick plastic. Adding wheels will help the cleaners move them and gather them in the main waste disposal area as shown in Figure No (8). Separate containers should also be provided for recyclable materials to be collected and used again [10].

Fig.8 Waste Bins in the Sixty's Rest House, source, the researcher (2010)

4. Motorized Vehicles Parking and their Shading

The rest areas must be designed according to standards that meet road safety requirements and avoid conflict between the movement of motorized vehicles and pedestrians. Some of the most important characteristics that must be considered by the designers of rest houses are:

- Providing parking for small cars near the service facilities.
- Allocating parking spaces for heavy vehicles away from public facilities and pedestrian paths
- Clearly marking entrances and exits that control the flow of traffic without the need to backtrack.
- Placing signs instructing where and how to stop so that there is no congestion in the parking lot of motorized vehicles and so that stopping does not exceed 30 minutes.
- Assessing the demand and supply of parking spaces for each site are based on the number of vehicles that enter rest areas [10].

According to a 2016 study conducted by the Office of Design and Environmental Guide in the state of Illinois in America, approximately 10% of highway traffic stops at highway rest areas, and the study indicated that 9% of passenger cars and 15% of trucks enter rest areas. And this is determined according to the type of the rest area and the area of its site as previously mentioned [13]. It is necessary to provide shade by using as many natural shade trees as possible in the rest areas to shade cars. Shading is a very important matter for motorists, especially in areas with high temperatures. It is also one of the factors that affects the quality and success of rest areas by raising the level of security, drivers' comfort, and protection for motorized vehicles. It shows that designers value the health and safety of motorists by protecting their vehicles from the scorching sun [9], [8].

5. Lighting and Security

Many developed countries are interested in the lighting element in rest areas on both sides of highway and consider it a highly important security element. It provides security and psychological comfort for travellers on highways and reduces the level of crime, especially if the rest area's site is in a remote or isolated place. Some of the most important criteria that must be taken into consideration are smooth and clear designs for pedestrian paths through natural lighting. Designers should also take advantage of investing in natural light opportunities available in the day through installing solar panels so they can illuminate the paths at night [9]. Night lighting in rest areas ensures safe access to various facilities after the fall of darkness. The type of lighting is determined by the type of space and the service it provides [7]. Many projects in rest areas on highways in many developed countries, which have used solar panels Figure No (9), have proven the success of solar-powered lights, with the possibility of setting a switch to prevent vandalism and theft. It is worth mentioning here that, lighting must be available in all rest areas, specifically near toilet facilities, as well as shades. It should also provide light in the seating areas. In addition to these, it increases the safety by using CCTV cameras [9].

Fig.9 Solar lighting, sources (Department of Tourism and Major Events, 2014, P. 31)

6. Water and electricity supply

Infrastructure such as water and electricity must be available in all types of rest areas. Sites must provide water tanks, filled either through rainwater or pumped from wells, for personal use, such as washing hands, flushing toilets or using showers (if rooms are provided for a short stay). Water must also be available for use in cleaning operations and various services for major rest areas. Signs should be used when the water is not suitable for drinking. A consistent electricity supply is also important to provide lighting, especially at night, in order to identify the rest area and reduce theft and robbery that may occur especially if the rest areas are in remote areas and far from urban gatherings [10], [8].

7. Children's Play Areas

Children's play areas are among the most important elements that may be provided in rest areas on both sides of highway because of their positive impact on rejuvenating children's energy after a long period of sitting in one place inside the car. These games should be designed according to age-appropriate standards that encourage development and learning and are enjoyable. The play areas should offer a variety of games and should be built with careful consideration of safety for children during their games as it shown in Figure No (10). It is preferable that the children's play area be near the parking area, but at a sufficient distance to ensure the safety and security of children. The space for children's play is (9*12), which is sufficient to establish several options for children's play [4], [10].

Fig.10 Children's play areas

Department of Tourism and Major Events, (p. 26, 2014), Sixty's Rest House, source, the Researcher (2010)

8. Landscaping

It is necessary, as much as possible, to preserve the nature of the site and its topography when creating a rest area, especially preserving the existing shade trees and other natural elements to raise the aesthetic value of the site and to achieve a natural environment suitable for rest and relaxation.

9. Rest Building

One of the most important requirements of a rest building is to have a clear entrance, a protected passage free of obstacles, (such as trees or small bushes) which provide a clear view of the lobby area and is compatible with the external services of the rest area. According to American standards, the rest building area is approximately 280 square meters to accommodate some of the functions and amenities needed to meet the needs of travelers of all kinds.

The most important spaces that must be provided in the rest building are as follows:

- **Entrance:** The entrance of the building should be wide and its doors should be made of glass to provide a clear view of the hallway. Its door must be equipped with high-quality latches and closing devices to withstand high use.
- **Lobby:** The area of the lobby should be between 75 to 93 square meters and with several large-sized glass windows to increase the proportion of natural light inside. One of the most important services that must be present in the lobby is the information panel. The area of this panel, (1.2 x 1.8 meters), provides all the information and notifications that the traveller needs. In addition, a lobby should provide public telephones -- at least one telephone in the lobby and another in the external area near the parking lot.
- **Shopping area:** The location of the sales area should be next to the lobby to sell some of the traveller's various requirements. It is preferable to provide places to sit.
- **Storage rooms:** Storages should be varied in their products, and their area should not be less than 21 square meters. In addition, storages must be near the service areas, whether they are in the shopping area, the kitchen, or near the bedrooms, with internal and external access doors, and a fire extinguisher.
- **Mechanical room:** This room is the main operation room and the backbone for the rest area. It contains all the mechanical equipment needed to serve the rest area. Its area is approximately 32 square meters and it can be accessed from the inner lobby and from the outside. It includes a desk, a telephone, a security system area, and screens, with a storage space for electronic equipment for the security system.
- **Motel:** In the major rest areas, rooms must be provided for long-distance travellers, with minimum requirements for a short stay not exceeding one night. Within each rooms, there should be either single and double sleeping beds, wall cupboards, and a sofa for seating that can be used as a bed. Bathrooms can either be connected to each bedroom or shared by the guests at the motel. This depends on the size of the motel and the number of customers. By standards, motels in larger rest areas may have up to 20 rooms [8].

- **Pavements:** pavements must be adjacent to all parking areas and heavy vehicle parking lots and be designed to comply with the requirements of accessibility to all services within the rest areas, with direct access without any obstruction. Some accessories (drinking water, seating, newspaper holders, recycling bins) should be provided next to the curb and installed on concrete platforms. The sidewalks leading to the main entrance of the building must be 1.5 meters wide and be built of concrete, and the surface must be slip-resistant. Other walkways that lead to some outdoor recreational services within the rest areas are made of loose gravel, shredded bark, or loose cork [4].
- **Fuel station:** This area of the station is designated for refueling and must be sufficient to accommodate several fuel pumps that meet the vehicles' needs of different types of fuel at peak times, taking into account the distance between the fuel pumps. In addition to this, the area and shape of the fuel station should be sufficient for offices, warehouses, compressor rooms, air pumps, and kiosks without causing any obstruction to the movement of different vehicles within the gas stations and the rest area. Therefore, the area or size of the plot depends on the location of the rest area such as:

  on ordinary land 35 m (facade) x 45 m
  on mountainous terrain 20m x 20m
  on urban area 20m x 20m

  When the fuel station is a part of the rest area complex, the space required for other facilities such as parking, restaurant, restrooms, toilets, shops, seating areas, and motel (if available) will be additional spaces combined by one entrance [20]

14- Case Study of Sixty's Rest-house

Nalut Road is the highway that connects Tripoli, (the capital city), and Nalut and other mountain cities. The Sixty's Rest House is located on Nalut Road, 100 km west of the capital, Tripoli. It provides shelter for many travellers and tourists. While driving down Nalut road, there are no services starting from Al-Azizia until we arrived at Sixty's Rest House. The road is dark at night with no lights and no traffic signs which is increasing the number of accidents, especially at night. Sixty's Rest House directly overlooks the highway without leaving the legal distance stipulated by most international standards for road safety and buildings. The rest house is built on a plot of land with an area of approximately two hectares. It includes some services for highway users, such as a small café, seating areas, and children's play areas, with toilets for both genders with attention to the general appearance of the restroom as it clear in Figure No (11). As for the vehicles parked, they were mixed for all types of cars and were adjacent to a road directly without a fence that protected the rest house users. In some cases, motorized vehicles were standing on the side of the road. But, unfortunately, after the events of the February Revolution, the rest house were completely destroyed and became a ruin, and there was nothing left of it that the traveller could use on the highway as it obvious in Figure No (12).

Fig. 11 Sixty's Rest House Libya Source, Researcher (2010)

Fig.12 Sixty's Rest House Libya Source, Researcher (2021)

15- Discussion

As part of the field study of this paper, 81 questionnaires were distributed to the visitors of Sixty's Rest House in 2010, located on Nalut Road.

The questions posed to the users of the rest house were:

- What are the most important services that the user sees as necessary to be provided within a rest area on the highways in Libya?
- What are the most important reasons that make passengers stop at a rest area on the highways?
- What is the preferred distance between the rest areas on the highways linking Libyan cities?

- What are the preferred facilities to be inside the rest area?
- What are the reasons behind the small number of rest areas on Libya's highways and the low level of services in them, (if any)?

Not only were these questions asked to the visitors of this rest house, but also data and information were collected concerning:

- Percentage of traffic on the highway that stopped at Sixty's Rest House.
- Percentage of motor vehicles entering Sixty's Rest House.
- The average period of stay inside Sixty's Rest House according to the category of the visitor and the type of motorized vehicle.

The answers were different and disparate. About 38% of the travelers attributed their stopping to eating some fast food; 29% wanted to use the toilet; 8% stopped for the purpose of taking a rest, and they attributed their not stopping earlier to the low level of safety on the road.

As for the overnight stay, the percentage was not high. Car drivers preferred to continue on their way, while truck drivers preferred to have rooms for overnight stays and continue on their way the next day with their load.

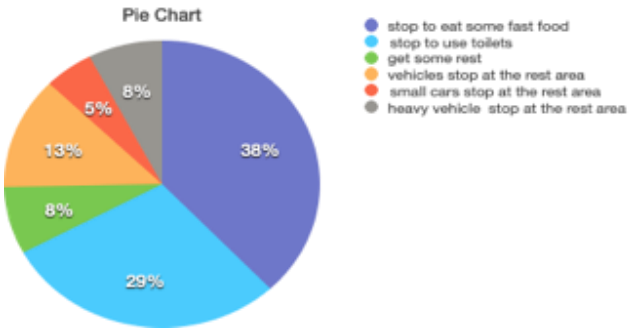
Most of the answers about the distance that they prefer between rest area on the highway were between 90-120 km. They commented that at this distance the driver begins to feel tired and the children and passengers feel bored from sitting for so long.

Among the important services that they prefer to have on the highway are: toilets for both sexes, (taking into account the disabled), a place to sit, children's playground, shops, a cafe and restaurant, parking for motorized vehicles with a petrol station and workshops for repairing motor vehicles.

The percentage of traffic that stopped at the rest house was approximately 13%. The percentage of motorized vehicles entering the rest house was approximately 5% small cars and 8% trucks as it explained in Figure No (13).

The time period that users of the rest house stay is between 30 minutes to two hours. This depends on the type of user, their purpose for stopping, and their needs.

the reason for stopping	participants number
stop to eat some fast food	30
stop to use toilets	23
get some rest	6
vehicles stop at the rest area	10
small cars stop at the rest area	4
stop at the rest heavy vehicle area	6



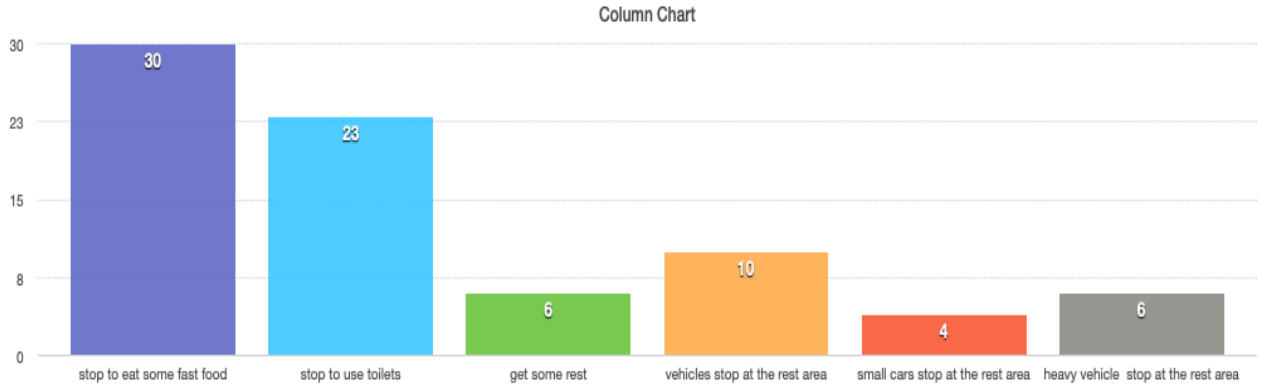


Fig. 13 Responses of The Users of Sixty's Rest House

The field study concluded that the responses of the users of Sixty's Rest House were harmonious with what was previously emphasized in the literary studies in this paper in terms of the type of services that must be provided in highway rest areas and the desired distance between rest areas on the highways.
This question was also asked: what are the reasons behind the lack of rest areas on the highways linking the Libyan cities, and the lack of interest in existing rest areas?
It was posed to a number of officials in the transportation and tourism sector in Tripoli, and a number of points were drawn from the interviews conducted with them. They attributed this lack to the following reasons:

- The transportation sector policy in Libya suffers from a lot of weakness and confusion, especially on the issue of rest areas projects on both sides of the highways linking the Libyan cities.
- There is an absence of a clear work mechanism through which to clarify the authorities responsible for the establishment, follow-up, and maintenance of this type of service buildings on both sides of the highways, and the weak financial support for this type of project.
- There is no guideline for designing and planning rest areas on both sides of the highways in Libya.
- Few are interested in this type of traffic project. Even though there are such rest areas, they are few and belong to individuals, and the simplest international standards for rest areas and highway safety do not apply to them and they do not meet the needs of travellers and vehicles of different types.
- There is a weak general culture among travelers regarding the importance of these types of traffic services, and it is reflected in the failure to stop at some of the rest areas on some highways linking Libyan cities. This may be attributed to the poor level of services provided by these rest areas.

This paper analyzed strategies and standards for highway rest areas in a number of countries in the world such as the United States of America and Australia. These rest areas are rest places close to the highway. They are designed and constructed to provide various services to highway users for the purpose

of ensuring a safe, comfortable, smooth, and hassle-free journey. Fatigue is one of the main causes of highway accidents, so highway rest areas are one of the important components of the highway system. Through this study, a number of international standards were highlighted for planning and distributing rest areas on highways. The ideal distance traveled between these rest areas according to their types is at most 80 km for large rest areas and 25 km for small rest areas. This paper also identified the important data and characteristics of the location, the building, the space, for rest areas on the highways. All the rest areas include basic services such as car parking lots, toilets for both sexes and the disabled, seating areas, children's play areas, a cafe, a restaurant, and gas stations. The spaces vary according to the type of rest areas and the services provided through them.

This paper summarized the results of the questionnaire and the interview with a number of the users of Sixty's Rest House. They stressed the need for such projects to be available on the highways because of their great importance in reducing driver fatigue, tiredness, and providing a safe place to meet their personal needs. In the absence of a guide that controls the planning and design process for rest areas on both sides of the highway linking Libyan cities. a guideline is reached which presents a number of architectural controls and standards for Libyan highway rest areas. As well, a number of recommendations were made for officials related to the tourism and service sector to plan and design highway rest areas in Libya.

16- Guideline for planning and design standards for highway rest areas linking Libyan cities

Through what was reviewed in the previous studies that were touched upon in this paper, the extremely important points that were extracted from officials in the transportation and tourism sector, and the opinions of the visitors of the Sixty's Rest House, a guideline can be extracted that will contribute to the development of a mechanism to raise the level of highway rest areas linking Libyan cities.

16.1- Criteria of planning and distribution's highway rest areas in Libya

The planning and distribution of the rest area are determined according to a number of considerations:

- The general plan of the rest areas should be in line with the nature of the surrounding area, respecting its historical and architectural background, if any, and its reflection on the general shape of the rest areas.
- Regular rest areas should be established on both sides of the highway with a distance of no more than 90 km or one hour driving for large rest areas, while small rest areas that contain fewer services are every 25 km.
- A buffer zone should be created between the rest area and any urban gathering with a distance of not less than 100 meters for fear of sabotage problems.
- The rest areas should be obvious and not hidden by trees or buildings, and not completely separating the rest area from the road. This is one of the reasons why travelers do not use the rest areas on highways; they have not seen them.
- Rest areas should be artificially or naturally fenced to protect pedestrians, especially children.
- The highway rest areas must be prepared to be used in all the different seasons of the year.

The rest area must contain three functional places to separate the movement of the various motorized vehicles on the site, as well as to ensure the safety of users as follows:

- **The first zone** - dedicated to parking all kinds of cars and trucks, linking them with the road by an entry and exit gate. When planning car parks, it is necessary to specify the number and type of passengers and vehicles that will be present. According to previous studies and the case study (Sixty's Rest House) of this paper, they were set at 8% for small cars and 11% for trucks.
- **The second zone**- A comfort area for travellers with umbrellas, tables, and seats. In the case of a large rest area, there must be a small hotel, a restaurant, a cafe, a small mall, an area for the repair of motorized vehicles and a petrol filling station. In a small rest areas, there should be the aforementioned facilities and also provision for inspection and maintenance parts for cars and trucks.
- **The third zone** - A sanitary area with toilets that include WC and hand-washing basins, with waste baskets.

16.2- Selecting rest areas' location on both sides of the Libyan highways

The following criteria must be taken into account:

- The site should be characterized by a beautiful natural environment, and the environment surrounding the rest area must be calm and comfortable to allow the user or driver to take a rest or sleep.
- The site should be at least of 30-50 meters from the highway so that the noise and glare of car lights do not affect passengers.
- The site should be spacious and overlooking the highway, and the site area of rest area should not be less than 10 acres. It is preferable that the site area be square in shape.
- The site should have a slight slope of 2-3%, as the flat sites cause a problem of water drainage, and sites with a steep slope cause a problem for those special needs.
- The site must be rich in shade trees.
- Availability of infrastructure and emergency services such as (firefighting, rescue, electrical power sources, water supply, and proximity to sewage treatment facilities).

The demand and supply of car parks for each site are evaluated based on the volume of traffic for vehicles in rest areas so that it is not less than 14 parking spaces for small cars and 6 parking spaces for trucks.

16.3- Classification highway rest-areas users in Libya

- Truck drivers
- Automobile drivers and passengers

According to the International Traffic Law, it is required to stop for a period of time, depending on the type of motorized vehicle and the hours of driving. Therefore, it is stipulated that:

- ❖ Drivers of trucks and heavy vehicles must stop for 15-45 minutes for after driving for short distances and 9-11 hours after long-distance driving.
- ❖ Motorists and passengers have the freedom to choose when stop to renew their energy, do activities and fulfill their needs.

16.4- Criteria of design's highways rest areas in Libya

16.4.A Design elements of rest areas and their services on highways

Signs

Signs are an important guiding element on both sides of the highway that help a traveller determine their destination.

- Guiding signs should be placed between 1 km to 10 km before reaching the rest area.
- Place signs on both sides of the road to describe the different use of rest areas.
- There must be signs at the entrance to the rest area at a distance of not less than 300 meters from the entrance.
- Place signs at the location of the current rest area to indicate the provided service facilities at the next rest area and the distance required to reach it.

The buffer zone, Entrances, exits, and security

- The distance between the rest area and the highway should be 30-50 meters.
- The buffer zone must be rich in trees that do not obscure the view of the rest area from the highway.
- There must be a space on the side of the highway for turning and sufficiently wide lanes to provide for acceleration and deceleration for motorized vehicles to reduce the risk of collision when entering or exiting.
- The entrance and exit gates of the rest area must have a clear line of vision for travellers as they exit or merge back onto the highway. It is necessary to provide gates extending at least 10-30 m at the rest area.
- The width of the entrance must be sufficient for two adjacent vehicles to enter, and it must be a sufficient length of no more than 22 meters with the presence of speed bumps.
- The movement of motorized vehicles must be in one direction only, within the rest area.
- The movement area within any type of rest area must be defined or limited by different materials such as vegetation cover, fences, or other physical barriers.
- The parking area must be flat and equipped with clear and appropriate traffic signals for all motorized vehicles.
- The parking area should be in the front area of the rest area to reduce the noise caused by the traffic on the road.

The fence

- A fence surrounding the rest area is necessary to protect all of its facilities and users from the surroundings, whether the danger is from vandals or the impact of motorized vehicles on the road.
- The fence should be made of natural materials such as trees or artificial materials.

16.5- Types of the rest area on both sides of the Libyan highways

Rest areas are classified according to the different requirements of drivers and vehicles in terms of location, type of vehicle, type of user, and traffic volume. They are classified as follows:

16.5.1 Main rest areas

This type of rest area tends to serve and meet the needs of long-distance travellers of all categories, including truck drivers, with separate places to park their trucks. The capacity of the major rest areas is up to 20 double beds and 20 parking spaces for different types of motorized vehicles. It must have at least two areas shaded naturally by large trees or industrially by shades made of cloth. It should provide a minimum of 6 chairs separated from the movement of motorized vehicles.

The most important facilities that must be included in the major rest areas:

- **Waste collection bins**, which are distributed throughout the rest area and easily accessible to the rest area users, with clear signs indicating their location. They must be elegantly designed and made of plastic material with wheels.
- **Toilets for both genders**, with the following requirements:
  - ❖ The toilet room area should contain eight toilets and should not be less than 65 square meters. Rooms with an area of 6 meters should be provided for people with special needs and for changing diapers. The sink area should be separated by a wall with doors that open to the outside.
  - ❖ The entrance to the toilet room must be designed in such a way that it blocks the direct view from it and to it.
  - ❖ Toilet rooms must contain washbasins located separately from the latrines so that they allow for use when toilets being used or being cleaned or repaired.
- **Lighting and security**, the most important criteria that must be taken into account:
  - ❖ Optimum planning, smooth and clear design of pedestrian paths through natural lighting, and exploitation of natural light opportunities available during the day to be used to illuminate the paths at night (solar panels).
  - ❖ Solar panels must be used, with the possibility of placing a switch to prevent vandalism and theft.
- **Public telephones**. At least one telephone must be provided in the rest area for general use and another in the outdoor area near the parking area for motorized vehicles. In addition, to providing fast workshops phones for cars**.**
- **Vehicles Parking:**
  - ❖ Providing parking for small-sized cars near the service facilities with an occupancy rate of 5%.

- ❖ Allocating parking spaces for heavy vehicles away from public facilities and pedestrian paths to be able to enter and exit easily without the need to go back; the occupancy rate is 8%.
- ❖ Providing guiding signals about where and how to stop, and the stop does not exceed 30 minutes.
- ❖ parking spaces for heavy vehicles.

- **Footpaths**
  - ❖ It is protected naturally or artificially, and it is 1.5 meters wide, and it is built of concrete, and the surface must be slip-resistant.
  - ❖ Other corridors that lead to some recreational outdoor services located within the rest areas site are made of gravel, shredded bark, or cork.
- **Gasoline filling station** and car repair, so that its area is:
  - ❖ On the flat ground (35 m x 45 m)
  - ❖ On mountainous land (20 m x 20 m)
  - ❖ In urban areas (20m x 20m).
- **Water and electricity supply**. Water and electricity must be provided in all types of rest areas for personal use, and this is through the provision of water tanks, whether filled by rainwater or by underground wells.
- **Children's play areas**
  - ❖ Children's games should be designed according to standards that are age-appropriate, and promote learning, development and are enjoyable.
  - ❖ A variety of games should be offered with a careful consideration for the safety and security of the children.
  - ❖ The space designated for children's play should be at least 9 * 12, which is sufficient to set up several playground equipment options for children's play.
- **Entrances for use by disabled travellers and those with special needs**

❖ All types of rest areas and all their facilities should be designed to allow persons with special needs to use them comfortably, smoothly, and with safe access.

❖ Special attention should be given to the suitability of surfaces around facilities for the disabled, such as tables and seating areas.

- **Rest House building**. It should have a clear entrance while providing a protected corridor free of obstacles and a clear view. The area of the rest house building is approximately 280 m square. The most important spaces that must be provided in the rest house building are as follows:
  - ❖ Entrance: The entrance must be wide and its doors should be made of glass. The door must be provided with high-quality closing devices to withstand its high use.
  - ❖ Lobby: The area of the lobby area should be between (75 square meters to 93 square meters) with a large number of large-sized glass windows to increase the proportion of natural light inside.
  - ❖ Shops: the location of the shops is next to the lobby to sell products that meet the travelers' needs; it is preferable to provide places to sit.

- ❖ Storges: theirs's area is not less than 21 square meters and it must be near the service areas.
- ❖ Mechanical room: Its area is approximately 32 square meters. It includes a desk, a telephone, a security system area, and screens, with a store for electronic equipment for the security system.
- ❖ Motel: In the major rest areas, rooms must be provided for the long and short-distance travelers, provided that they do not exceed one night. The rooms should provide single or double bedrooms, wall cupboards, with a sofa for seating that can also be used as a bed. Bathrooms may either be connected to the bedrooms or they may be shared with the other motel guests. The number of rooms in the motel in the major rest areas reaches 20 rooms.
- ❖ Café and restaurant.
- ❖ Fuel station

Secondary rest areas

Small rest areas are a destination for a high percentage of users, so they must provide all the needs of highway users for a short period of time. The capacity for this type of rest area is 8 double beds and parking spaces for 8 vehicles.

Therefore, the basic services include:

- Toilets
- Lighting
- Benches, Tables, and waste bins
- Parking for motorized vehicles.

16.5.2 Truck drivers rest areas

These rest areas provide the same services as the smaller rest areas, but the capacity for the number of beds here is less, up to 4 double beds, with dedicated truck parking for 4-6 trucks, with an area of 100 m * 9 m; it is known as a rest area for truck drivers and heavy machinery.

17- Recommendations

The paper came out with a number of recommendations for the responsible authorities (the Ministry of Transportation, the Ministry of Planning, and the Ministry of Tourism). In addition, they should work together to improve the level of highway services, reduce accident rates, and provide a level of high-end services that keep pace with the progress of the times in traffic services and the needs of travelers. The recommendations consisted of a number of the following points:

- Rest areas are set up on local and regional roads according to their needs.
- Rest areas for highways must be included in the services of the road network, and there must be joint cooperation between the Urban Planning Department, the Tourism and Transportation Department.
- Rest areas are arranged after a careful evaluation of the proposed sites for rest areas and after determining the distances between the different types of rest areas.

- Pay attention to the selection of rest areas, where the architectural character and style of the rest area constitutes a historical and cultural background that is embodied in the user's mind, especially in his or her frequent visits.
- It should be taken into account when planning the selection of rest areas on both sides of the highways that the site should have beautiful landscapes, diverse terrain, and different plants such as shade plants and ornamental plants.
- When planning to establish rest areas on highways, diversity in the rest areas must be taken into account according to what road users require (drivers, passengers, and automated vehicles).
- When designing and building rest areas, it is recommended to divide them into several functional areas such as vehicle parking (small car parks, heavy car parking), passenger rest areas, service facilities areas, and green areas.
- When designing rest areas, it is necessary to take into account the regulation of traffic movement of all kinds in the site of the rest area, so that it is safe and smooth.
- It is necessary, to use signs and banners in visible and readable places inside and outside the rest area because of its great importance in determining the direction of the movement of vehicles, as well as indicating what's available in the service facilities of the upcoming rest area.
- The ability to maintain rest areas' performance and cleanliness through the design of attractive architectural elements provides high service for travelers and ensures the permanence of their use.
- The use of solar energy in rest areas stations may help solve the lighting dilemma.
- Paying attention to rest areas on both sides of highways in terms of their establishment and maintenance is an effective way to reduce the fatigue of passengers and the rate of serious highway accidents. They are also a lucrative tool to increase the public income of the Libyan state.

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