

## **REST-STOPS AS A PLANNING ENGINEERING OPTION TO FATIGUE**

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### **Abstract**

Road accidents on the Kenyan roads claim about 3,000 lives annually. It is estimated that the economy further loses approximately Ksh. 14 billion or 5 % of its gross domestic product too on accident related expenses (MoTC, 2004). However, this intractable problem persists amidst efforts to introduce measures including enforcement to use seatbelts and insertion of speed-governors.

In an effort to understand some of the underlying causes, this study examined travellers' perception of fatigue as a contributor to crashes. Both empirical and exploratory research methodology was used to capture the opinions of the road users and to get statistical information by carrying out a survey of 715 road-users on Mombasa Road. The results showed the occurrence of fatigue to be a major cause of 87 %, 83 % and 82 % of the nodding off, exhaustion and yawning experienced respectively by passengers. Similar results were reported for drivers. The effects of fatigue were attributed to poor road conditions by 76 % and long periods of sitting by 64 % of the passengers interviewed. To counter fatigue effects, 72 % and 79 % of the private car and truck drivers respectively stopped to relax at petrol stations. The use of open countryside was cited by 53 % of the passengers interviewed as an alternative place to stop. The results underscore the need to devise effective measures that will relieve fatigue but at the same time be environmentally sound. Indeed well planned rest-stops by location, proximity to urban centres, at black spots and near scenic viewing points can provide avenues to re-energize and provide an escape from driving under hazardous conditions and also be used as a point to enjoy the special characters of region.

**Key words:** Crash, fatigue, rest-stops, Mombasa Road

## 1.0 Introduction

The *World report on road traffic injury prevention* reports that worldwide, an estimated 1.2 million people are killed in road crashes and as many as 50 million are injured each year (Peden M. *et al.*, (eds), 2004). Many causes contribute to this high figure among them are drunkenness, careless driving, poor roads, etc. However, an emerging latent safety issue facing the road transport industry today is fatigue (both for the drivers and the passengers alike) as it is not easily recognised and diagnosed. In Kenya, for instance, road transport has become a bloodbath in which Kenyans continue to lose lives. While in the past bad roads have been blamed for the high number of road accidents, this is no longer a foregone conclusion as the government has invested heavily in rehabilitating roads around the country. Lately, the few roads still in bad condition are proving to have a smaller role than commonly believed in causing traffic crashes. For instance, despite construction of 1,063 km of new roads and rehabilitation of 40,500 km of existing ones, Kenya records more than 13,000 crashes annually, 85 % of which are due to human error, the rest (15 %) are due to poor roads and vehicles (Kamau, 2009). What is indisputable is that Kenyan roads have a serious and ongoing road safety problem.

The grim statistics of Kenya's "dance with death" on the roads is presented in bits on the walls of all police station traffic departments. Statistics show that road accidents in Kenya is the third largest single cause of death after malaria and HIV/AIDS and present a challenge to overall health status, morbidity, disability and associated health care costs (MoTC, 2004). The traffic section under the police department estimates that eight lives are lost each day on the roads. This translates to at least 54 lives per week. If the figure remains constant, it means not less than 3,000 lives would be lost on our roads each year. In monetary terms, road crashes cost the Kenyan economy approximately KShs.14 billion or 5% of the GDP on average annually (*ibid*). Despite this alarming statistics, it seems that there is a culture of lack of respect for road use, which appears to be characterised by a lack of understanding of, or respect for road safety.

## 2.0 Road Safety and Fatigue

Every year, police see 'mystery crashes' in which it is not possible to determine a cause. Many of these incidents are thought to involve a fatigued driver who fell asleep at the wheel. A typical mystery crash might occur on a highway when one vehicle drifts out of its lane into the path of oncoming traffic and hits another vehicle head-on, often with tragic results.

While this could easily be dismissed as an unfortunate incidence, it has been noted that drivers are under immense pressure and stress to drive longer periods for economic reasons. Part v section 66A (1) Kenyan law recommends 8 hours within the Traffic Act (cap 403) as the maximum driving duration on the road. This

sections states that '*No person shall drive a public service vehicle or a commercial vehicle for more than a total of eight hours in any period of twenty-four hours.*' Although diverse safety measures including enforcement of the use of seatbelts, introduction of alcohol testers have been put in place aiming at ensuring the safety of drivers and their passengers, the accident ratio has scarcely decreased while the number of crashes has actually increased. This in essence recognises that there is more to these measures that need to be done. It is appreciable that today's multi-function vehicles require high alertness, judgment and handling skills to control them. This puts tremendous strain to the drivers. Bosch Group, a leading global manufacturer of automotive and industrial technology points out that the 'human factor' is the greatest risk of critical driving. They report that "mental factors" are the most important cause of fatal crashes (Bosch, 2007).

According to Roads and Traffic Authority (2001), fatigue is a general term commonly used to describe the state/experience of being "sleepy", "tired" or "exhausted". Generally, fatigue can be taken to be the physical and mental impairment brought about by inadequate rest over a period of time. This means fatigue affects both the physical and the psychological well-being of individuals. It can result from long or arduous work, little or poor sleep and the time of day when the work is performed and sleep obtained. This loss of alertness is accompanied by poor judgement, slower reactions to events, and decreased skill, such as in vehicle control. For instance, Williamson *et al.*, (1992) found that fatigue negatively affects driving performance with slower reaction times, poor steering and poor gear selection and change. Overall, it affects the efficiency, effectiveness and safety of a driver's performance in carrying out the driving task. The involvement of fatigue in a road crash can range from falling asleep at the wheel to inattention (HORSCOCTA, 2000).

However, it should be pointed out that driver fatigue is difficult to identify or recognise as contributing factor to a crash. This point is well amplified by National Transportation and Safety Board (1990) in the statement that many accident investigations do not obtain the information necessary to determine the contribution of fatigue, namely, the condition of the drivers, the extent to which they have been deprived of sleep, and their state of alertness. However, whether fatigue is recorded or not, crashes on roads are clearly pointing a finger to this danger. Of importance though is the fact that nobody is immune to tiredness and it can become deadly when combined with driving. Many symptoms of fatigue exhibit themselves in a number of ways including: yawning, poor concentration, tired or sore eyes, restlessness, drowsiness, slow reactions, boredom, feeling irritable, making fewer and larger steering corrections, missing road signs, having difficulty in staying in the lane and micro-sleeps (RTA, 2001). While it is a recognised fact that resting on a long journey is important, the road infrastructure needs to provide such points to pull-over. Much of the efforts at

lowering the crashes on Kenyan roads concentrate on fixing the existing transport system, the new regulations on installing speed-governors and fixing seatbelts. Unfortunately, the contribution of 'human error' on the high road carnage is forgotten. This study, therefore, went out to investigate road users' perception of fatigue in relation to public health and environmental issues, with a view to suggest appropriate planning engineering options that could be incorporated into the road infrastructure system to ease the effects resulting from fatigue.

### 3.0 Methodology

This study employed both empirical and exploratory research methodology to capture the opinions of the road users and to get statistical information from the police department. The firsthand accounts of the users' experience and their perceptions on road crashes have been captured through a series of questionnaires. As the principal and potential receptors of fatigue, road users (drivers and passengers alike) were questioned on their experiences and exposure to the phenomenon. The questionnaires also captured fatigue characterisation by identifying the causal agents to help identify the right management strategy.

The actual data collection occurred between October 2008 and January 2009 at three major points on Mombasa road: Voi, Mtito Andei and Mombasa. These three towns were purposively sampled as they offered a stop-over for most travellers on the highway. The accessible population consisted of all travellers at the time of data collection on the road. All travellers who stopped at the sampled points provided they consented to participate in the study were eligible to be included in the study. Some identified respondents declined to be interviewed despite adequate explanation given to them about the purpose of the study. 715 questionnaires were administered to 400 passengers, 100 private cars drivers, 115 passenger service vehicle (PSV) drivers and 100 truck drivers. Out of this, 634 responded to the questionnaires and returned them, an 89 % response rate. There was no follow up of the travellers. We triangulate the field findings by discussing the research themes with key informants within the transport sector and official reports. Completed questionnaire were checked for completeness and consistency prior to data entry into the computer using EXCEL and SPSS soft wares. A summary of the profile of the respondents is displayed in Table 1 below.

Table 1: Summary of respondent profile

	Age		Gender (%)		Driving experience (yrs)		Usual Travelling mode (%)	
	Md	Av	M	F	Md	Av	PSV	Private
<i>PSV drivers</i>	40	38.8	97	3	7	8.4	-	-
<i>TRUCK drivers</i>	39	40.3	100	0	8	9.1	-	-
<i>PRIVATE car drivers</i>	33	34.1	91	9	6	8.5		-
<i>Passengers</i>	24	27.1	62	38	-	-	93	7

Where: Md  $\equiv$  median; Av  $\equiv$  average; M  $\equiv$  male; F  $\equiv$  female; PSV  $\equiv$  passenger service vehicle.

Overwhelmingly, the commercial (PSV and truck) is still male-dominated with 97 % and 100 % of the PSV and truck drivers respectively being male. Drivers in these categories are also older with more years of experience than the private car drivers interviewed. 93 % of the passengers interviewed use road transport as their main means of travelling thus they have a lot of experience on issues relating to road fatigue.

#### 4.0 Road-Users Perception of Road Fatigue

Passengers experience regarding travelling fatigue is captured by asking them how often they experience selected symptoms normally associated with fatigue. The responses are graphically displayed in Figure 1.

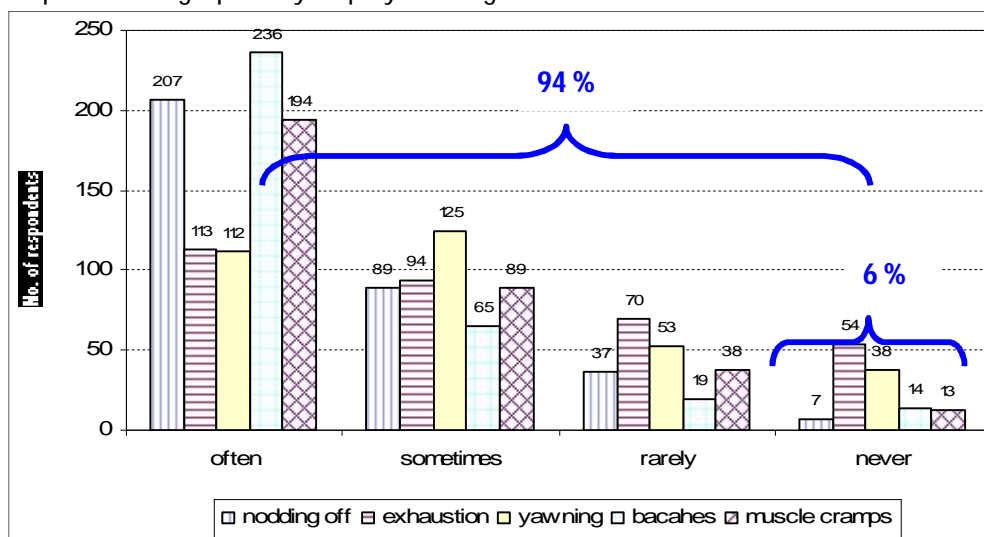


Figure 1: Response on fatigue indicators by passengers

The results reveal that occurrence of fatigue (i.e. *often and sometimes* – when combined) is a major cause of 87 %, 83 % and 82 % of nodding off, exhaustion and yawning respectively. Nodding off, exhaustions and yawning are noted to be psychological fatigue systems and their high occurrence clearly indicates a problem on the road. Physical fatigue represented by backaches and muscle cramps seem to be tackled by passengers in some way during the journeys hence their relatively low scores. Overall, only 6 % do not think fatigue is a factor “at all” while travelling while 94 % think that fatigue occurs to them at some point during their journey.

Similarly, drivers (PSV, private car and truck drivers alike) are also affected in a multiple of ways by fatigue. An assessment is made of the occurrence of some of these symptoms to drivers too. More assessment symptoms are used in the case of drivers because:

- (i) For some driving is their daily occupation

- (ii) They are likely to experience some symptoms that are not experienced by passengers and
- (iii) Are active road users unlike passengers who are passive road-users.

In every category, less than 10 % experience fatigue on "every trip". Interestingly, the response to fatigue causing "delays in braking" received a high response of "never" from 34 %, 25 % and 49 % of PSV, truck and private car drivers respectively. In comparison with passengers, drivers' response on experience of fatigue on "every trip" is low. It is not clear to what extent the fear of retribution may contribute to this response though. But this low frequency of the symptoms of fatigue on "every trip" could suggest a development of inbuilt body inertia to the effects of fatigue given that they are on the road most of the time unlike passengers. However, the same cannot be said of private car drivers. They seem to enjoy flexibility during their journey hence a relatively low response in the category "every trip". Physical fatigue factors i.e. sore eyes, stiffness or cramps, and headaches and backaches elicited high response rate – 52 %, 52 % and 34 % respectively – by private car drivers who indicated this does not occur to them at all. For commercial vehicle drivers, i.e. truck and PSV drivers, they indicate the same factors occur to them most on "few trips". As for the rest of the factors, which are psychological in nature, boredom on "few trips" and loss of concentration on "some trips" have heavy toll on drivers across board. The data in Table 1 shows the extent to which drivers experience fatigue as they carryout their duties on the road.

Table 1: Frequency of occurrence of fatigue to drivers

Symptoms	Drivers	Never	Few trips	Some trips	Most trips	Every trip
Boredom while driving	PSV	10%	34%	21%	14%	4%
	TRUCK	16%	34%	7%	12%	6%
	PRIVATE	11%	23%	30%	17%	4%
Sore eyes	PSV	25%	30%	16%	8%	2%
	TRUCK	15%	28%	15%	9%	7%
	PRIVATE	52%	17%	10%	4%	0%
Loss of concentration	PSV	14%	29%	26%	11%	2%
	TRUCK	12%	29%	15%	12%	5%
	PRIVATE	12%	26%	35%	10%	0%
Stiffness or muscle cramps	PSV	30%	26%	22%	12%	2%
	TRUCK	18%	22%	14%	14%	3%
	PRIVATE	52%	14%	12%	3%	0%
Yawning	PSV	9%	16%	22%	19%	11%
	TRUCK	8%	18%	12%	24%	7%
	PRIVATE	12%	35%	18%	14%	1%
Delayed or poor	PSV	25%	30%	14%	7%	1%
	TRUCK	25%	22%	9%	12%	1%

gear changing	PRIVATE	40%	29%	8%	4%	0%
Delays in braking	PSV	34%	26%	12%	6%	2%
	TRUCK	25%	16%	11%	12%	4%
	PRIVATE	49%	25%	5%	2%	0%
Poor overtaking decisions	PSV	20%	26%	21%	12%	2%
	TRUCK	24%	20%	18%	6%	4%
	PRIVATE	28%	20%	16%	16%	1%
Headaches and backaches	PSV	15%	32%	22%	7%	4%
	TRUCK	8%	16%	18%	14%	11%
	PRIVATE	34%	34%	12%	2%	1%
Mood changes or increased irritability	PSV	23%	25%	16%	8%	3%
	TRUCK	11%	15%	11%	13%	7%
	PRIVATE	46%	18%	11%	4%	0%

On the other hand, fatigue is attributed to a number of causes by extent as shown in Figures 2 and 3 by passengers and drivers respectively. The causes of the fatigue symptoms "often" to passengers is mainly attributed to poor road conditions (76 %) and long periods of sitting (64 %). 40 % of the drivers attribute fatigue occurring to them "often" while driving for long periods. However, 11 % of the drivers indicated taking a conscious decision to stop in contrast to 89 %, who despite the awareness of fatigue signs creeping in; they push on with their journey. The reasons behind their decision being:

- (i) Nearness to the end of the trip
- (ii) Pressing appointments
- (iii) The wish to arrive at a reasonable hour
- (iv) Need to go for another trip.
- (v) Security of certain sections of the journey

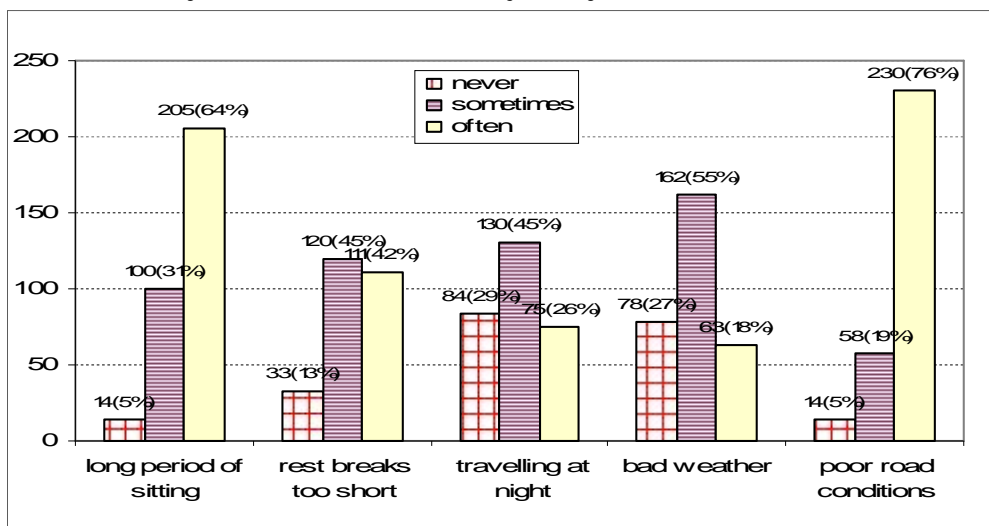


Figure 2: Response to common causes of fatigue

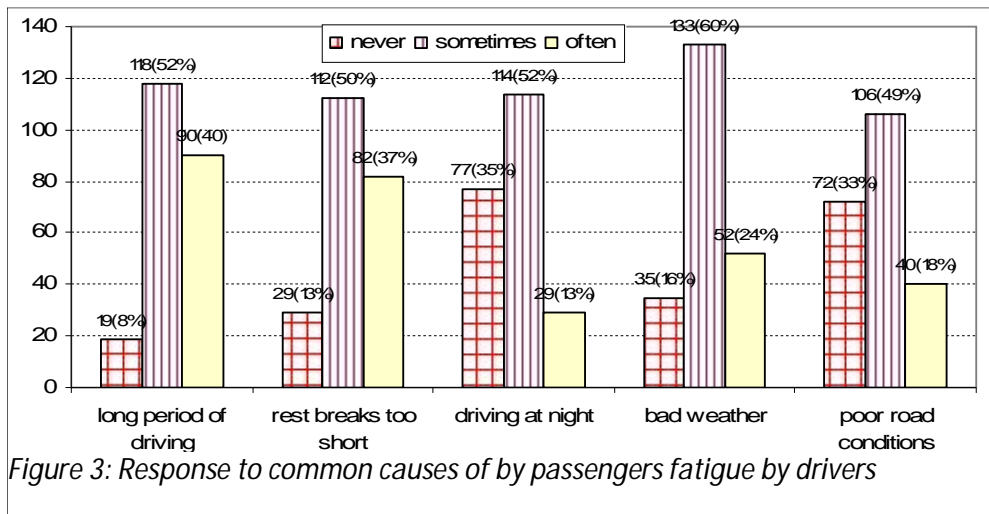


Figure 3: Response to common causes of by passengers fatigue by drivers

When fatigue creeps in, road-users resort to a number of alternatives to ease its effects. Apart from the effects of fatigue, 68 % of the road-users reported being desirous to stop to relieve themselves, 26 % to view fascinating scenery on the way and 6 % to purchase grocery and tourism artefacts. This calls for the incorporation of elements in the rest-stops that will take care of these needs of the road-users. Therefore, rest-stops should be located within close access to the route, have clear visibility from the road, flat areas for truck parking, close proximity to utilities such as water and areas that provide shade and scenic value (as good views and an attractive setting will encourage road-users to stop). Figure 4 shows the percentage number of respondents per category who opt for various alternative locations on their journey to stop and relieve themselves.

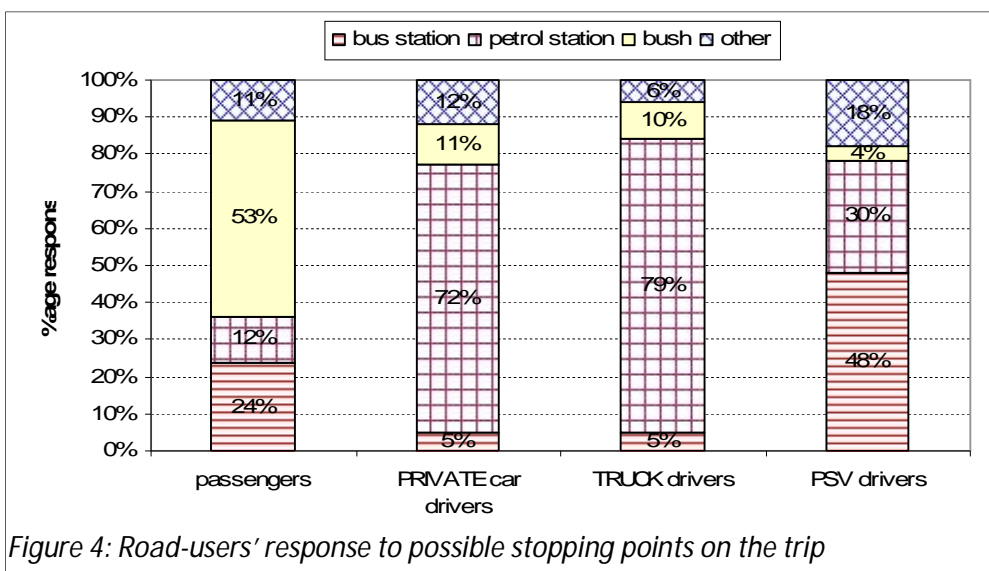


Figure 4: Road-users' response to possible stopping points on the trip



This study, for instance, revealed the 53 % of the passengers stopped in the countryside (bush) mainly to relieve themselves (plate 1). This raises a number of environmental issues that include: possible transmission of diseases and pollution of water source, loss of environmental aesthetics and destruction of vegetation. 72 % private car drivers and 79 % truck drivers respectively use petrol stations as their favourite stopping points. Petrol stations have become a favourite stopping point to the extent that many owners of these places have started adjacent eating joints. Toilet facilities at some of these petrol stations are also charging Kshs. 5.00 (US\$ 0.07) per visit for cleaning and maintenance. Additionally, since many of these areas were not meant for parking, it was observed that some of them do not provide enough parking spaces for the truck drivers and thus forcing many drivers to stop haphazardly and in the process endangering other road-users and impeding the flow of traffic (Plate 2). Many of these areas spring up spontaneously and are unplanned thus offering low level of services. Summarily, traveller desire rest, safety and security and convenience. The following section attempts to translate these 3 aspects into spatial planning ideals.



Plate 1: A stop in the countryside



Plate 2: Dangerous roadside parking

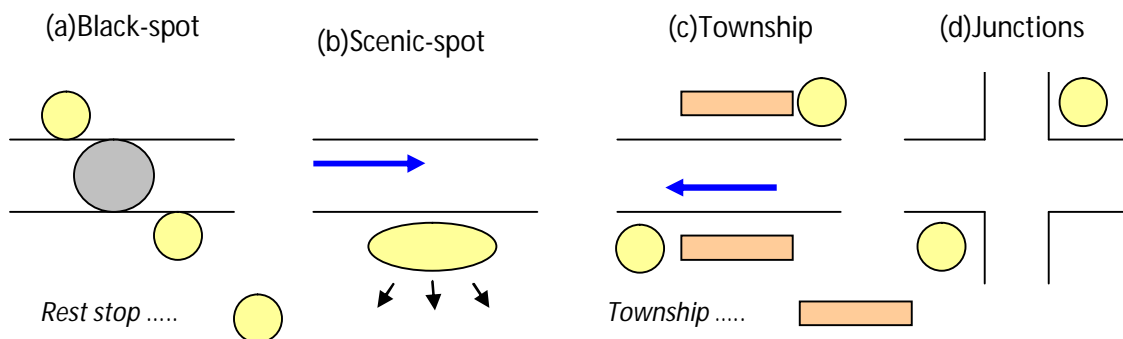
### 5.0 Rest-Stops as a Countermeasure to Fatigue

The fast pace in today's "24 hour society" seems to pressurise many people to sacrifice their health. The study has revealed clearly that fatigue is becoming a common problem. It is affecting both the drivers and the passengers equally and its effects are being felt indiscriminately. Therefore, the intervention approach to fatigue adapted in this study is focussed on the need to address the fatiguing aspects of travelling demands and the availability of breaks during long journeys, which offer the opportunity for temporary recuperation from the effects of fatigue. The concept of introducing rest-stops is based upon the premise that traveller fatigue, the boredom and monotony associated with travelling can be reduced if road users break their journey regularly. Rest-stops could further offer additional opportunity to safely pull-over and give the travellers time to relieve, re-energize and enjoy the special character of the regions through which they travel through. Apart from this very useful health-restoring ability, rest-stops can also provide drivers an escape from driving under other hazardous conditions including bad weather conditions. Rest-stops would serve multiple purposes including:

- (i) Providing safety breaks for travelling motorists on long distances,
- (ii) Providing a location for travellers to relax and take a break from highway travel,
- (iii) Providing comfort stations, and in some cases, food and beverage services
- (iv) Providing safety and convenience locations on the road where travellers can stop and relieve themselves before proceeding on the journey.

To achieve the above stated purposes, rest-stops require some minimum design elements to function appropriately. This would include: toilets (with related conveniences), landscape furniture (including benches, play equipment, picnic tables), shade (artificial or natural), space for stretching, parking space, garbage bins, safety and crime prevention through design, among others. The inclusion of all these facilities would depend on local conditions, the quality of maintenance able to be secured and the amount of use.

Identification of possible stopping opportunities along the route is important. Locations would include near black-spot, near towns, at junction and at scenic locations. Figure 5 illustrated some of possible locations rest-stops could be sited.



**Figure 5:** Possible locations for rest-stops.

- (i) Locations of black spots: In determining the priority for providing roadside rest stops, the locations of fatigue "black spots" and other road safety issues could receive primary consideration. Rest-stops could be located just before black spots for the drivers to be most alert as they approach these dangerous areas on the road.
- (ii) Locations with scenic views: The need to rest could also give the traveller a chance to enjoy the scenic views of the landscape along the road. Good views and an attractive setting will encourage road-users to stop. Therefore, locations could be able to maximize site uses by considering other amenities such as scenic views, points-of-interest, or historic sites.
- (iii) Proximity to towns: Proximity to urban and commercial services centres gives another opportunity for citing rest-stops. Close proximity to public utilities such as water, sewerage connections, and electricity is desirable, as this reduces the cost of building and operating the rest area, as well as improving the quality. These centres could also offer opportunity for the travellers to refuel, enjoy meals and even buy items needed for the journey. Closeness to settlements also enhances security of the rest-stops.
- (iv) At intersections and junctions: Road intersections and junctions (existing and future) could offer another excellent opportunity for rest-stops.

The spacing of rest areas needs to be conservative. If a driver decides to miss an opportunity, this should not mean they have too far to drive before another opportunity. For example, if a rest area is located every 1.5 hours, a driver who chooses not to stop at this rest area will need to drive for three hours before stopping – an undesirable distance. Forcing motorists to "push on" when fatigued promotes dangerous driving.

In addition, public acceptance is critical for the locations of the rest stops as this will determine their usability. Safety of the users of rest stops should be borne in mind while determining their location. Safety of the rest stops could be assessed by the frequency of their use and acceptability by the road users. The safety

measures could be achieved through: Location near townships, leasing of the rest-stops to community management through public-private partnership arrangements and frequent patrols by highway police units at these rest-stops. Like any place to be visited by people, rest areas/stops should have some basic amenities. The rest area should be an attractive, park-like area separated from, but within general sight of the road. Based on survey responses from truck drivers, passengers and PSV drivers, toilets, shade and rubbish bins are considered the most desirable features at rest areas.

## 6.0 Management of Rest-stops

Rest-stops can reduce fatigue-related accidents by allowing motorists to stop and rest at regular intervals. If they are to be effective against fatigue, they must be located at strategic points, taking into consideration motorist speeds, fatigue onset times, desired driving interval times and the location and suitability of other stopping opportunities as discussed above. Further, to ensure they meet the needs of motorists, and to encourage ongoing future use, rest-stop areas need to be conveniently located, readily accessible, attractive, and include appropriate rest facilities.

The provision of good, sufficient and safe rest-stops should form an integral part of road infrastructure safety management. Relaxation is essential for safety on long distance trips by users of all types of vehicles. Good rest-stops should provide parking, outdoor facilities, sanitary facilities and personal safety. Essentially, good rest-stops should provide the mental relaxation and opportunities to stretch and walk; in essence they should resemble a small park. They should, if possible, provide a glimpse of the areas' scenery and its original local flavour.

Security is a very important aspect of a rest-stop area. Not having security invites vandals and criminals to prey on the traveling public at a time when they are the most (physically) vulnerable. With increase in crime, a decrease in use will occur, which means the area may end up remaining a "vacated" area.

To ensure the above, rest-stops could be managed using the following options:

- (i) Public sector management: this is better placed to promote empowerment of local residents from a neutral standpoint, where a service is the main objective and profits are secondary.
- (ii) Private sector management: if public sector lacks sufficient capability to administer the rest-stops, private sector could bring in its resources and expertise to manage them.
- (iii) Public-private partnerships management: combines business acumen of the private sector with the solid creditworthiness of the public sector. A joint development would be a viable mechanism to offset the cost of build and maintain rest-stops while offering much sought after services to travelers.

- (iv) When well maintained and managed, rest-stops could provide many benefits to the local community and the traveling public. These include:
- (v) Road safety: rest-stops will improve road safety by reducing the occurrence of fatigue-related road crashes.
- (vi) Empowerment: local community could be economically and socially empowered through opportunities to services such as selling goods to roads–users.
- (vii) Regional revitalization: local residents can start independent businesses and sell local wares and agricultural produce to travelers, thus awakening an otherwise “sleepy” locality.

## **7.0 Conclusion**

In investigating the potential of fatigue as a significant contributor to crashes, this study has revealed that road users appreciate the effects of fatigue. This study confirms what has in many instances been referred to as “human error” as being one contributor to crashes on the road. Travellers revealed experiencing fatigue during their journeys. Physical fatigue is prevalent to passengers psychological fatigue heavily affects drivers. The causes of fatigue included poor road condition and long sitting periods. To relieve themselves, travellers used unplanned locations that were not intended for this purpose and offer low services including petrol stations and bushes. By eliciting travellers opinions, the study has brought to the fore the extent of fatigue problem and the need to address it. The results show high occurrence of fatigue among both passengers and drivers. Further, no appropriate places were observed nor indicated by the travellers as having been specifically designated as rest-stops.

## **8.0 Recommendations**

Therefore, the study recommends the incorporation of well planned rest-stops, at appropriate locations with the requisite amenities to be a feature of road infrastructure to offer an opportunity for drivers and their passengers a chance to re-energize.

The intention of rest-stops is to provide a place for a short break. Accordingly, rest-stops must provide a level of ‘relief’ and amenity that encourages travelers to stop.

- (i) Rest areas are envisaged as fatigue and road safety management tool. To be effective in this role, rest areas need to be attractive and accessible to potential users.
- (ii) The prevention of fatigue will require regular breaks from driving as appropriately designed locations. The location of rest-stops should be determined by among others the corresponding onset or location of risk factors.

- (iii) Rest-stops need to be environmentally sustainable, and where practical, within localities that encourage sustainability of local flora and fauna.
- (iv) Solutions to rest-stop management should be economically viable.

It is obvious that site-specific characteristics such as visibility, capacity and accessibility can influence the use of a rest-stop area. At least part of a rest area should be visible from the highway for people to feel safe. Also it ought to be kept to a reasonable size, if it becomes too big or too crowded it will end up being uncomfortable and not suitable for relaxation. Irrespective of anything else done to make rest areas popular, the two overriding issues among the traveling public are safety and cleanliness.

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