ROAD SAFETY ENGINEERING

The road safety engineering (RSE) function has the overarching aim of reducing the risk of collisions on the road network by implementing a range of low-cost improvements.

Road traffic safety refers to the methods and measures used to prevent road users from being killed or seriously injured. Typical road users include: pedestrians, cyclists, motorists, vehicle passengers and passengers of on-road public transport (mainly buses and trams).

ROAD ACCIDENTS

- Fatal traffic accident is one which involves a person who dies as a result of an injury sustained in the accident (usually within 30 days); it excludes confirmed suicides

- Serious accident involves a person who is detained in hospital as an in-patient, or who suffers any of the following injuries: fractures, concussion, internal injuries, crushings, severe cuts and lacerations, or severe general shock, that require medical treatment

- Slight accident is one involving a person who is only slightly injured, e.g. a person who sustains a sprain, bruise or cut, which is not judged (by the police) to be severe, or slight shock requiring only roadside attention

- Damage-only accident does not involve people who sustain personal injuries

Causes of Road Accidents :

1. Distracted Driving

Distracted driving becomes a larger threat every year and has been the leading cause of car accidents for the past decades. Please pay attention to the road while you are driving. That means no calls, no texting, no eating, no reading, no grooming or application of makeup, and talking while behind the wheel.

2. Drunk Driving

Drunk driving is one of the most dangerous causes of accidents in the U.S. and is the most deadly. If you have had anything to drink, take a taxi or give your keys to a sober friend. It is not worth the risk.

3. Speeding

Although it can be tempting to push the speed limit when you are running late, speeding is the second most common cause of accidents, so you should resist the urge and stay within the legal limits.

4. Reckless Driving

Changing lanes too quickly, speeding well over the limit, and acting aggressive on the roads can lead to horrible accidents. It is important to take your time and remain calm while driving to avoid needless accidents caused by simple carelessness.

5. Rain

While you can't always avoid driving in the rain, the slippery, treacherous road conditions caused by heavy rains should be avoided when at all possible. If visibility is too low to drive or the roads seem particularly slick, you should pull over and wait until the storm passes.

6. Running Red Lights

It may seem obvious, but it bears repeating. Red always means stop. Even if it seems like no other cars are coming, you can cause a serious accident by running a red light and you will be breaking the law. We've heard several excuses from busy entrepreneurs trying to run through red lights while thinking about work, from those legal contracts to investor relations, and at the same time literally trying to answer to work emails. Understand that life is more important than all these issues combined and it's best to be safe than sorry.

7. Night Driving

Lack of visibility makes hazards more difficult to see at night. Make sure that you are extra alert on the road at night, and use your full lights when on an abandoned road without streetlights.

8. Design Defects

Sometimes accidents are caused by flaws in the car itself. While you cannot always avoid this, make sure to take note of any recalls in the news and take your car in for regular maintenance.

9. Tailgating

There is never an excuse to get too close to the car in front of you, no matter how frustratingly slow they seem to be going. Keep a safe distance from other cars so that you will have time to react to sudden turns or uses of brakes.

10. Wrong-Way Driving/ Improper Turns

Everyone makes mistakes, but lapses in judgement while driving a car can cause horrible accidents. Be aware of street signs warning of one-way streets or other irregularities, especially in unfamiliar areas.

When people don't get in the proper lane to make a turn, use signals properly, or follow traffic signals, accidents happen. Always look out for traffic signs and obey the proper right-of-way when you make a turn.

10. Teenage Drivers

Teens don't have the experience to know what to do in unsafe conditions and that naïveté causes accidents. If you have teenagers, make sure that they have had a defensive driving course, do not permit cell phone use while driving, and limit the passengers they can take with them in the car.

11. Drugs:

While alcohol is the culprit we usually associate with DUIs, drugs, including marijuana, prescription pills and other illegal drugs also cause terrible accidents. Never drive if you are under the influence of any drug, prescribed or not.

12. Potholes:

Potholes are very frustrating for drivers because sometimes they can't be avoided. Try to drive around potholes to avoid damaging your car, when you can, but do not swerve into another lane if cars are coming. Despite the fact that there are some laws that could work in your favor, don't take chances, especially with the heartbreaking car accident statistics from previous cases.

13. Tire Blowouts

If you get a flat while driving, it can cause you to swerve unexpectedly. Try to stay calm and keep control of the wheel while pulling over as soon as it is safe. Call for help if you cannot change the tire yourself safely.

14. Animal Crossings

Anyone who has ever heard someone tell about hitting a deer knows that this is a big danger. For this reason, take extra caution when you see an animal crossing sign and always use your high beams when travelling in rural, woody areas where wild animals are common.

15. Construction Sites

Sometimes the way a construction zone is set up can be confusing. Follow the cones as well as possible and be aware of other drivers who may be confused. It is especially important to drive slowly in these areas to avoid even the smallest accidents from occuring.

BLACK SPOT

At certain sites, the level of risk of road accidents is higher than the general level of risk in surrounding areas.

Crashes tend to be concentrated at these relatively high-risk locations. These locations with an abnormally high number of crashes are generally described as black spots.

Scientific Investigation

- scientific investigation of accidents - branch of forensic science.
- Forensic scientists / Accident Investigators will carefully examine the scene of a crime for physical evidence
- Outcome of such analyses may assist the Court to determine guilt, innocence, fault or liability.
- In road traffic accidents the primary physical evidence lies in the
- site details,
- conditions which prevailed at the time of the accident,
- state of the road,
- marks and debris on the road,
- physical characteristics of the vehicles involved,
- damage sustained by the vehicles,
- injuries sustained by persons involved in the accident,
- police plan,police measurements, police photographs, police video and
- laws of physics which determine the movement of vehicles, cyclists and pedestrians before, during and after an accident.
- Secondary physical evidence comes from the statements of witnesses when they refer to times, distances, speeds and locations. However, the validity and interpretation of such statements are matters for the Court to determine

Statistical method of analysis of Accident data

- purpose -to find the possible causes of accident related to driver, vehicle, and roadway.
- to develop information such as:
  Driver and Pedestrian -Accident occurrence by age groups and relationships of accidents to physical capacities and to psychological test results.
- Vehicle - characteristic of vehicle, severity, location and extent of damage etc.
- Roadway conditions -characteristics of the roadway and roadway condition etc.

Accident Rate per Kilometer

number of accidents of all types per km of each highway and street classification.

R = A/L

R = total accident rate per km for one year,

A = total number of accident occurring in one year,

L = length of control section in km

Death rate based on population

number of traffic fatalities per 100,000 populations.

R = (B × 100000)/ P

R -death rate per 100,000 population,

B = total number of traffic death in one year and

P = population of area

Death rate based on registration

number of traffic fatalities per 10,000 vehicles registered.

R = (B × 10000) / M

R -death rate per 10,000 vehicles registered,

B -total number of traffic death in one year

M -number of motor vehicles registered in the area

Accident involvement Rate

numbers of drivers of vehicles with certain characteristics who were involved in accidents per 100 million vehicle-kms of travel.

R = (N × 100000000)/V

R -accident involvement per 100 million vehicle-kms of travel,

N -total number of drivers of vehicles involved in accidents during the period of investigation

V -vehicle-kms of travel on road section during the period of investigation

Accident Rate based on vehicle-kms of travel

number of accidents per 100 million vehicle km of travel.

R = (C × 100000000)/V

R = accident rate per 100 million vehicle kms of travel,

C = number of total accidents in one year and

V = vehicle kms of travel in one year

Problems

1. The Motor vehicle consumption in a city is 5.082 million liters, there were 3114 motor vehicle fatalities, 355,799 motor vehicle injuries, 6,721,049 motor vehicle registrations and an estimated population of 18,190,238. Kilometer of travel per liter of fuel is 12.42 km/liter. Calculate registration death rate, population death rate and accident rate per vehicle km.

Solution: Approximate vehicle kms of travel = Total consumption of fuel × kilometer of travel per liter of fuel =5.08 × 109 × 12.42 = 63.1 × 109 km.

Registration death rate can be obtained from

$R = (B \times 10,000) / M$

R is the death rate per 10,000 vehicles registered, B (Motor vehicle fatalities) is 3114, M (Motor vehicle registered) is 6.72 × 106. Hence, $R = (3114 \times 10000) / 6.72 \times 106 = 4.63$

Population Death Rate can be obtained from the equation.

$R = (B \times 100,000)/P$

Here, R is the death rate per 100,000 population, B (Motor vehicle fatalities) is 3114, P(Estimated population) is = 18.2 × 106.

$R = (3114 \times 100000)/18.2 \times 106 = 17.1$

Accident rate per vehicle kms of travel can be obtained from the equation below as:

$R = (C \times 100,000,000) / V$

Here, R is the accident rate per 100 million vehicle kms of travel, C (total accident same as vehicle fatalities) is 3114, V (vehicle kms of travel) is 63.1 × 109.

$R = (3114 \times 100 \times 106)/63.1 \times 109 = 4.93$

Accident data collection

- accident data collection is the first step in the accident study.
- primarily done by the police.
- secondary data
- which are filed by motorists themselves -Motorist accident reports

Accident data collection includes

General - Date, time, person involved in accident, classification of accident like fatal, serious, minor

Location -Description and detail of location of accident

Details of vehicle involved -Registration number, description of vehicle, loading detail, vehicular defects

Nature of accident -Details of collision, damages, injury and casualty

Road and traffic condition - Details of road geometry, surface characteristics, type of traffic, traffic density etc.

Primary causes of accident -Details of various possible cases which are the main causes of accident.

Accident cost - Financial losses incurred due to property damage, personal injury and casualty

Data collected need proper storing and retrieving. Why?

- Identification of location of points at which unusually high number of accident occur.
- identify the causes of accidents.
- Development of procedure that allows identification of hazards before large number of accidents occurs.
- Development of different statistical measures of various accident related factors to give insight into general trends, common casual factors, driver profiles, etc.

Accident reconstruction

Representing the accidents occurred in schematic diagram to determine the pre-collision speed.

helps in regulating or enforcing rules to control or check movement of vehicles on road at high speed.

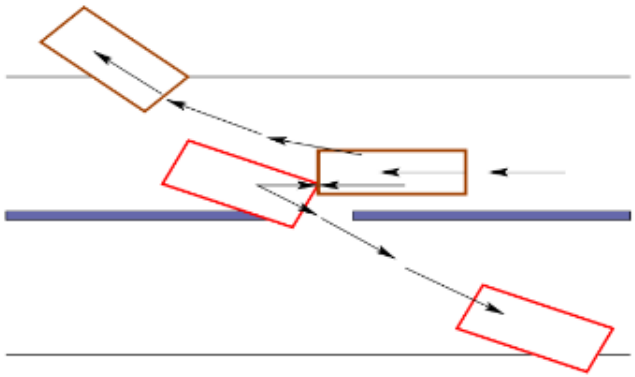

Figure 42:4: Collision diagram of two vehicles

collision of two vehicles is shown that occur during turning movements.

collision diagram.

Each collision is represented by a set of arrows to show the direction of before and after movement

provides a powerful visual record of accident occurrence over a significant period of time.

Types

collinear impact

Rear end collision

Head-on collision.

angular collision.

Data Mining

Popular

To explore data recorded Police Information System, discover patterns, predicts future behaviour, effective decision to reduce accidents.

Automated software-based solution

Road Accident Data Management System (RADMS)

RADMS is a geographical information system (GIS) solution for identification of black spots, wrong driving practices, road infrastructure, vehicular defects, road types, damage to property, overloading issues, driver issues and other factors causing or related to road accidents.

iMAAP -tool for identifying and analysing causes of crashes

Road Accident Data Recorder (RADaR) - software application

- developed for tablet
- to help the traffic police to collect the accident data in comprehensive manner which will enable scientific analysis to determine the actual cause of the accidents

Traffic Accident Analysis Using Decision Trees and Neural Networks

Accident Prediction from Traffic Data using Hadoop provide alerts before accidents happens based on highway conditions like road surface, light on highway, turns etc.TrafficAccident Analysis Using Decision Trees and Neural Networks

Safety Performance Function

- SPF is an equation used to predict the average number of crashes per year at a location as a function of exposure and, in some cases, roadway or intersection characteristics (e.g., number of lanes, traffic control, or median type) (1). For highway segments, exposure is represented by the segment length and annual average daily traffic (AADT) associated with the study section
- Application: SPFs are used to predict crash frequency for a given set of site conditions. The predicted crashes from the SPF can be used alone or in combination with the site-specific crash history (i.e., Empirical Bayes method) to compare the safety performance of a specific site under various conditions.

The Empirical Bayes method is used to estimate the expected long-term crash experience, which is a weighted average of the observed crashes at the site of interest and the predicted crashes from an SPF.

Empirical Bayes Method

The empirical Bayes method assumptions are (1) a Poisson distribution for the accidents, and (2) a Gamma distribution for the distribution of the averages in the population of systems.

With these two assumptions, the number of systems with k accidents must obey the negative binomial distribution. The expected number of accidents, a'k, in the after period on a system that had k accidents in the before period is

$$a'k = (k+1)*N'(k+1)/N'k$$

Application of computer analysis of accident data

- TEAAS-Traffic Engineering Accident Analysis System: a Software used to analyze the accident data (North Carolina)

- FARS (Fatality Analysis Reporting System) and GES (General Estimates System) UK

- Road Accident Data Management System (RADMS) India