

ROADSAFETY–ACCIDENTHOTSPOTSANDCORRECTIVEMEASURESTO REDUCESEVERITY

Introduction

Road traffic continues to be a major developmental issue, a public health concern and is a leading cause of death and injury across the world killing more than 1.35 million globally as reported in the Global Status report on Road Safety 2018 with 90% of these casualties taking place in the developing countries.

India ranks 1st in number of persons killed across the 199 countries followed by China and US. Road crash deaths in India are the highest in the world. The disproportionate impact can be gauged by the fact that with only 1% of world's vehicles, India accounts for 11% of all crash-related deaths. Repressed differently, a crash death happens every four minutes. Crashes on India's roads claim the lives of about 150,000 people and disable at least an additional 750,000 each year, large share of which are pedestrians and cyclists, mainly representing working-age adults from the poorer strata of society.

A macroeconomic study by the World Bank on road safety indicated that reducing road traffic injuries in half could translate into an additional 15 to 22 percent of GDP per capita income growth over 24 years. For a country like India, failing to meet the UN Sustainable Development Goal target to halving road deaths by 2020 accrues to about 2-3 percent points in unrealized per capita GDP growth. MoRTH have presented figures that crash costs may be equivalent to 3.14 percent of the national GDP.

Aim

The aim of this article is to create awareness about various aspects like accident hot spots so that everybody individually, collectively and institutionally may devote themselves towards reducing the accident rates and their severity, to ultimately achieve the target of **Minimum ACCIDENTS Today & Ever after.**

Scope

This article covers the following aspects:-

- Overview of road accidents in India.
- Understanding road accidents.
- Factors responsible for road accidents.
- Black Spots and Their Analysis.
- Solution for reduction of road accidents.
- Modern measures for reduction of road accidents.
- Innovative measures for reduction of road accidents.
- Measures taken by Project Arunank and recommendations.

BRO Committed to Road Safety

Ministry of Road Transport and Highways (MORTH) is the nodal agency to improve overall road safety in the country. The Ministry's annual report on 'Road Accidents in India' is a valuable and rich resource for policymakers and researchers alike that provides detailed and comprehensive data on the causes, pattern types and inter-state and global comparison of road crashes in the country. Working across the 4Es of road safety i.e. Engineering, Enforcement, Education and Emergency care; the Ministry is undertaking various initiatives that demonstrate its global commitment to reducing road crash fatalities by at least 50% by 2030.

The third Global Ministerial Conference on Road Safety was held in Stockholm, Sweden in February 2020. At this conference, all the participants including India, reaffirmed their strong commitment for achieving the goals of reducing road accident-related deaths by at least 50% by 2030.

Border roads organisation is a premier agency of road construction in the country. BRO has constructed 50,000 km of roads in North and North eastern part of the country. As BRO is mostly working in mountainous areas, hence road safety has always been KRA of the organisation. BRO roads provide a sense of safety to commuters and its hilarious slogan boards keep them alert. A substantial part of BRO's expenditure towards road construction goes for improving safety of road users like protection walls, slope stabilisation and road furniture.

Keeping up with this tradition of road safety and to add further dimension to it, HQ DGBR is now organising road safety motor bike expeditions, conducting seminars and publishing articles on road safety through newly established CoERSA and carrying out road safety audits.

Overview Of Road Accidents In India

Road accidents in India kill almost 1.5 lakh people annually. A total of 4,49,002 road accidents have been reported by States and Union Territories in the calendar year 2019, claiming 1,51,113 lives and causing injuries to 4,51,361 persons.

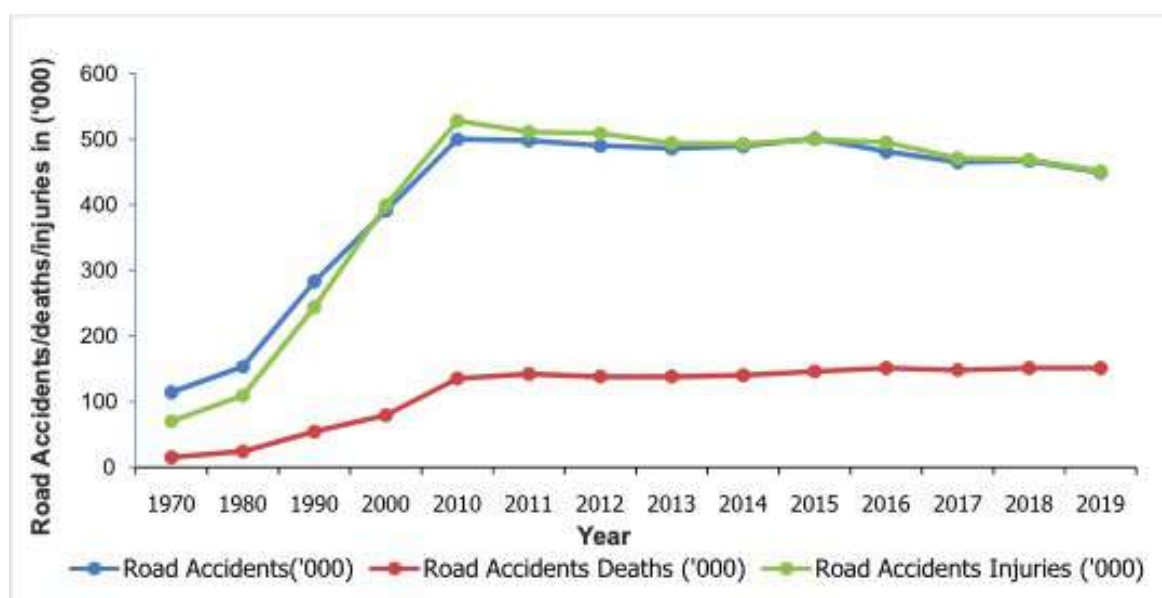


Fig.1 Trends of Roads Accidents, Deaths and Injuries

While accidents, deaths and injuries in India registered a steep rise till 2010, the same somewhat stabilized after 2010, with marginal year to year fluctuations despite every high rate of growth of automobiles.

Highways which account for about 5% of total road network witnessed a disproportionately large share of accidents of 55 % and accident related fatalities of 63% during the year 2019. Fatality rate per km of the road is the highest on Highways with 0.67 deaths per km annually. States having max length of Highways accounted for 61% of accident related states. The eight North East States accounted for nearly 2.7% of the total road accidents deaths. However, a further co-relation needs to be drawn with the population and its density in the Northeast Region of the country.

Factsheet 2019

- Two wheelers accounted for 35% of total road accident deaths followed by cars & LMVs 19%, pedestrians & cyclist 17% and trucks & HMV 16%.
- Over-speeding accounted for the maximum share of road accident and road accident deaths ranging between 62% to 73%.
- Hit and run cases, Head on collision and Hit from the back accounted for about 55% of persons killed.
- The category which registered the maximum increase in terms of persons killed was collision with fixed objects.
- Young adults in the age group of 18-45 years accounted for nearly 69% of road accident victims.
- The share of males in number of total accident deaths was 86%.
- The share of number of persons killed in rural area, away from cities was 67%.

Understanding Road Accidents

Four guiding principles are central to an understanding of causal factors associated with road accidents.

- People make mistakes that can lead to road traffic crashes. People by nature will make mistakes. When these mistakes occur on the road, they can lead to crashes. Even when people are not deliberately taking risks, they can still make mistakes that can result in a crash.
- The human body has a known, limited physical ability to tolerate crash forces before harm occurs. The human body is vulnerable and not built to withstand impact forces greater than 30 km/h. Any impact greater than 30 km/h greatly increases the risk of dying.

- Individuals have a responsibility to act with care and within traffic laws, but a shared responsibility exists with those who design, build, manage and use roads and vehicles to prevent crashes resulting in serious injury or death and to provide post-crash care.
- In order to multiply their effects, all parts of the system must be strengthened in combination and road users are still protected if one part fails.

Factors Responsible For Road Accidents

Road accidents are multi-causal and are the result of a combination of various factors. These can broadly be categorized into following factors:-

an inter

- Human error
- Road environment
- Vehicular condition

Human Error

Accidents caused by human error include cases of accidents caused by following reasons:-

- Traffic rule violations
- Driving without valid driver license
- Non-use of safety devices

Traffic rule violations

Over speeding is the main violation associated with accidents, accident-related deaths and injuries in 2019, accounting for 71% of the road accidents, 67% of total deaths and 72% of total injuries.



Photo.1 Traffic Rules Violation

Driving without valid license

Driving without valid license/learner's license accounted for the 15% accidents.



Photo.2 Non-use of Safety Device and Caution Display Boards

Non-use of Safety Devices

Non-use of helmets accounted for the 30% accidental deaths. Non-use of seatbelts accounted for the 14% accidental deaths.

Road Environment

Accidents caused by road environment include cases of accidents caused by following reasons:-

- Accidents happening in a particular geographical area.
- Accidents related to the type of road features.
- Type of junction & type of traffic control.
- Weather condition, etc.

Accidents happening in a particular Geographical area

60% of accidents took place in open areas and killed 64% of persons as contrary to popular thinking that most accidents happen in crowded or congested areas. It is followed by the residential areas which accounted for the 18% accidental deaths.

Accidents related to the type of road features

Vehicle speed tends to be high on straight roads in open areas hence straight roads accounted for the 64% accidental deaths. Curved road, steep grade road and others mix type of road accounted for the 32% accidental deaths. Ongoing road works and other construction on the road accounted for the 3% accidental deaths. Potholes and defective roads accounted for the more than 1% accidental deaths.



Photo.3 Accidents in Different Geographical Area

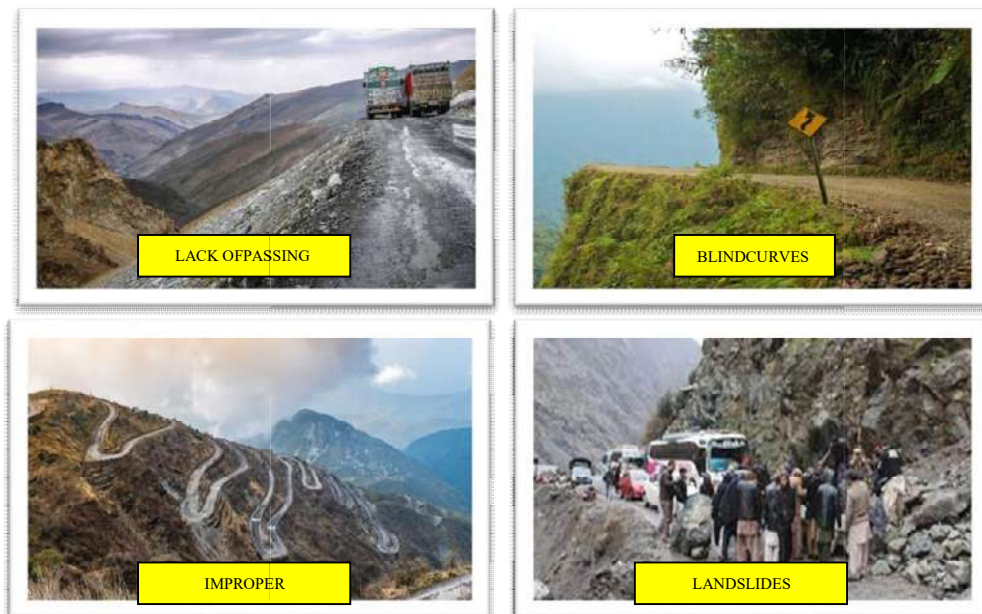


Photo.4 Causes of Accidents in Hill Areas

Type of Junction & Type of Traffic Control

Types of road junctions accounted for the 9% accidental deaths. Uncontrolled crossings accounted for the 19% accidental deaths.

Weather Condition, etc.

Rainy or foggy weather and snowfall accounted for the 20% accidental deaths.



Photo.5 Bad Weather Conditions

The other road environments responsible for accidents are

- Natural obstacles—Trees & overhangs
- Presence of poles & posts
- Dilapidated or missing footpath
- Pedestrians crossing over median



Photo.6 Other Road Environment Causing Road Accidents

Vehicular condition

Accidents caused by vehicular condition include cases of accidents caused by following reasons:-

- Overloading accounted for the 10% accidental deaths.
- Age of the vehicles more than 10 years accounted for the 41% accidental deaths.

Factors Responsible for Accidents and their Severity in Plains and Mountains.

Summary of Factors responsible for accidents in plains and in mountains areas given below.



FACTORS RESP FOR ACCIDENTS AND SEVERITY IN PLAINS



- DISTRACTED DRIVING (USING MOBILE WHILE DRIVING)
- SPEEDING / RECKLESS DRIVING
- DRUNK DRIVING
- NOT WEARING SEAT BELT
- RAIN/SNOW OR WET ROADS
- POTHOLES AND BAD ROAD CONDITION
- BREAKING TRAFFIC RULES
- TAILGATING
- ANIMAL INFRINGEMENT



FACTORS RESP FOR ACCIDENTS IN MTNS



- IMPROPER ROAD GEOMETRY
- LESS NUMBER OF PASSING PLACES
- BLIND TURNS
- INAPPROPRIATE GRADIENTS
- WET AND SLIPPERY ROADS
- POOR LIGHTING
- LACK OF ROAD FURNITURE
- NEGLIGENT PARKING
- NATURAL OBSTACLES
- LANDSLIDES/NATURAL DISASTERS



What is a Black Spot And How do you Deal with these?

Black spots are defined clearly and information on the same is going to be available on a portal given below.



BLACK SPOTS

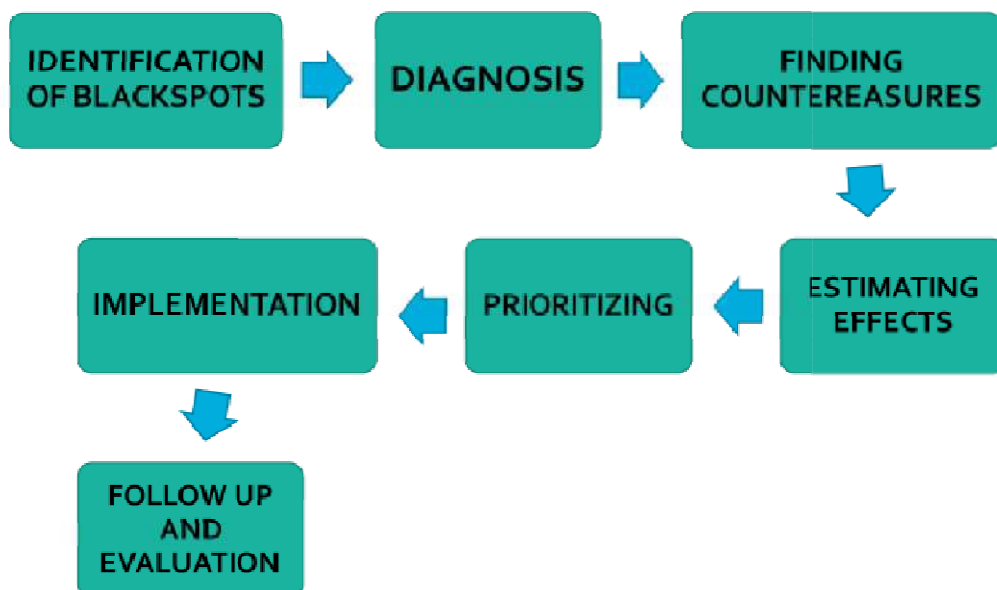


▪ Identification of Accident Black Spots

- Black spot defined as stretch of NH
 - Approx 500 m in Length
 - Five rd accidents/10 casualties in three years
- 5583 Black spots identified in India till 2018
- Classified based on rectification required
 - Short term measures like rumble strips, lighting or sign bds
 - Long term measures like road design/elevation, road widening, building of road overbridge, bypass, flyover, cattle underpass
- Portal being developed for getting status/progress of rectification on real time basis



BLACKSPOTS ANALYSIS- A SCIENCE IN ITSELF



SolutionsFor ReductionOf RoadAccidents

SAVELIVES-AComprehensiveSolutionToReduceRoadAccidentsandtheirSeverity.

SAVE LIVES is a concept given by WHO in 2017 to reduce road accidents based on Sweden's Vision Zero strategy, which has the long-term vision of achieving no fatal injuries within the transport system. This concept guides policy makers to provide a safe, affordable, accessible and sustainable transport system to public and can be modified to suit particular national or local needs.

SAVELIVES system is divided into six components as depicted below.

- **Speed management**
- **Leadership on roads safety**
- **Infrastructure design and improvement**
- **Vehicle safety standards**
- **Enforcement of traffic laws**
- **Survival after a crash** **Speed management**

A 5% cut in average speed can result in 30% reduction in the number of fatal road traffic crashes.

Following measures can help in speed management:-

- Establish and enforce speed limit laws nationwide, locally and in rural areas & hills.
- Build or modify roads which calm traffic, e.g. roundabouts, road narrowing, speed bumps and rumble strips.
- Vehicle manufacturers to install new technologies, such as intelligent speed adaptation, to help drivers keep to speed limits.

Leadership on roads safety

The leadership measures by the governing body responsible for traffic management can reduce road accidents to a large extent. Community groups and NGOs can be allies through advocacy and awareness campaigns. These measures have proven to reduce crashes by 10%. In fact, mass media campaigns have a much more significant effect on behavior when coupled with enforcement and educational activities. Following can be done to ensure roads safety:-

- Create an agency to spearhead roads safety.
- Develop and fund a roads safety strategy.
- Evaluate the impact of roads safety strategies.
- Monitor roads safety by strengthening data systems.
- Raise awareness and public support through education and campaigns.
- Build compact and connected cities.
- Provide a variety of safe mobility options and public transport systems.

Infrastructure design and improvement

The road safety must be built in the initial planning of the infrastructure, and it should be ensured that it is an inherent part of its design. Following can help in road safety:-

- Providesafeinfrastructureforallroadusersincluding sidewalks,safecrossings,refuges,overpassesandunderpasses.
- Providebicycleandmotorcyclanelanes.
- Makethesidesofroadssafefbyusingclearzones,collapsiblestructuresorbarriers.
- Designsafaintersections.
- Separateaccessroadsfromthroughroads.
- Prioritizepeoplebyputtinginplacevehiclefreezones.
- Restrict traffic canspeedinresidential,commercialandschoolzones.
- Providebetter,saferroutesforpublictransport.
- Designsarterstreets.



Photo.6InfrastructureDesignMeasures

Vehiclesafetystandards

Establishandenforce motorvehiclesafetystandardsregulationsrelatedto:

- Seatbelts
- Seatbeltanchorage
- Frontalimpact
- Sideimpact
- Electronicstabilitycontrol
- Pedestrianprotections
- Childrestraintpoints

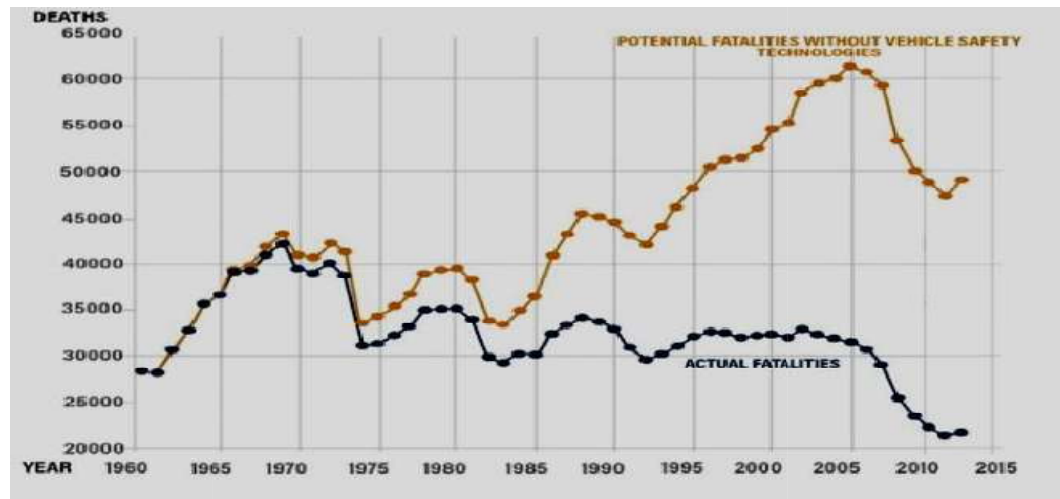


Fig.2 Potential Fatalities without Vehicle Safety Technology

Enforcement of traffic laws

Establishing and enforcing laws at national & local levels and rural & hilly areas can help in reducing road accidents to a large extent:-

- Overspeed
- Drinking and driving
- Motorcycle helmets
- Seatbelts
- Child restraints
- Red light cameras
- Driver's training

Survival after a crash

The golden hour philosophy, which was introduced by Dr. R. Adams Cowley in 1961, recognizes that casualties will have a much poorer chance of survival if they are not delivered to definitive care within one hour from the time of the accident. The golden hour includes the time taken for call-out, travel to the incident site, extrication and transport of the patient to hospital. In India, 1 out of 6 serious trauma victims dies, but in the USA the figure is 1:200. The best way to provide prompt medical treatment is through a national or regional trauma system, which includes hospital-based mobile medical teams that are trained to work efficiently with ambulance services, local police and fire services. Following measures can help in ensuring chances of survival after a crash:-

- Develop organized and integrated hospital and facility-based emergency care systems.
- Train those who respond to crashes in basic emergency care.
- Promote community first responder training.

Modern Measures For Reduction of Road Accidents

Machine Vision. It is the ability to use machines together and interpret visual data. The application of this technology to a transportation system is an outgrowth from the development of vision for robots. It is an inexpensive technology for monitoring continuously in semi-automatic mode. This technology can be used for monitoring of pavement condition and detection of vehicles and pedestrians on the roadway by using an electronic camera and a microprocessor.

Intelligent Vehicle. Machine vision can be further upgraded to create an intelligent vehicle which is automated, safety oriented and cruise controlled like automatic speed control, automatic braking, auto ignition on & off, navigational aids for lane & route selection, auto lighting, etc.

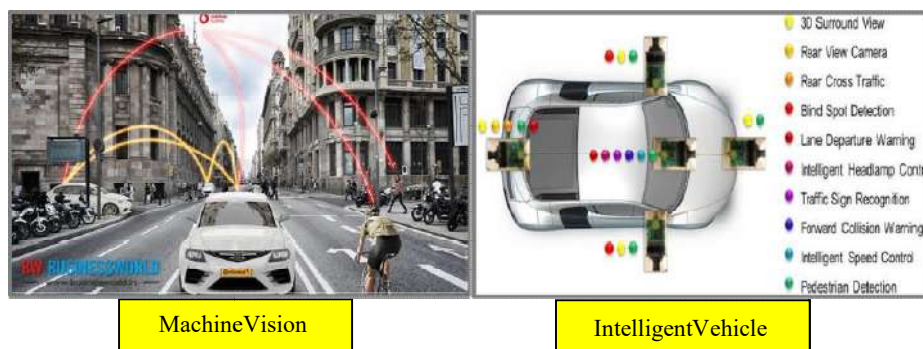


Photo.7 Modern Measures

Traffic Incident Detection. It predicts traffic incident by detecting changes in traffic characteristics e.g. speed with the help of a microwave sensor, video imaging or CCAT system. Drivers are then informed about the incident through variable message boards to avoid congestion.

Intelligent Highways. The ultimate dream of transportation futurologists seems to be the completely automated highway where vehicle control is taken away from the driver. It may have the following features:

- Driver info technology with on-board vehicle outing advice and navigation system,
- Remote vehicle control technology,
- Auto vehicle identification,
- Radio broadcasting of info,
- Freeway and corridor controls.

Harmonic Radar System.It can be used as a driver information system to warn of the onset of hazardous situations which could lead to a collision with a roadside object or another vehicle and to over-ride driver control and stop the vehicle or at least cause moderate collision impact.

Electronic Tachographs and In-

vehicle Recorders.Electronic tachographs are used to monitor the driving patterns of vehicles. Monitoring can be for purposes of fleet management or driver observance of regulations about driving periods and vehicle speed. In-vehicle recorders are used to gather information about the events leading up to crashes. It can be used as a deterrent for traffic rule violation.

Automated speed Detection.Automating the procedure could greatly improve the effectiveness of speed enforcement programmes. There are three technologies which could be considered:-

- Machine vision to recognize number plates;
- Marking of vehicles with a bar-code which can be scanned automatically; and
- Fitting electronic transponders to vehicles.

Induction loops.These are beneficial since they detect vehicles waiting at the junction and send this data to traffic signals, which change automatically based on the situation.

Intelligent Intersection.It's an end-to-end solution comprising a sensor set, powerful sensor fusion algorithms to generate a comprehensive environmental model and Dedicated Short-Range Communication to transfer valuable information between the intersection and the connected vehicles. The solution makes it possible to warn an oncoming driver about crossing a pedestrian outside the driver's line of sight. Its data can also be used to control signal changes, streamlining traffic and reducing emissions and idling time at intersections.

Co-

operative intelligent transport systems.It allows vehicles to communicate with other vehicles and infrastructure such as traffic signals that are fitted with the same system. Drivers then receive alerts about upcoming hazards and traffic signal information. The technology is sometimes referred to as "connected vehicles".

Pavement Bar-Codes.It involves the placing of fixed or portable pavement markings at locations where information needs to be transmitted to drivers about prevailing conditions. The pavement marking is in the form of a bar code which can be read by a device fitted to the underside of vehicles. Its potential applications are:-

- Enable monitoring of driver/vehicle performance against parameters such as speed limits;
- Provide the basis for introducing a time/vehicle/location to all collection system;
- Provide information to drivers regarding the conditions applying to sections of roads e.g. speed limits and potential hazards.

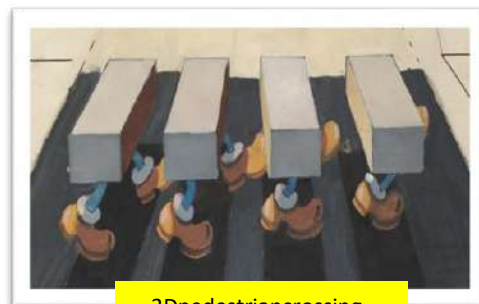
Innovative Measures for Reduction of Road Accidents

These are based on the idea that non-confrontational warnings can be equally effective to prevent people from flouting traffic regulations. Some of the innovative measures being taken in different countries for reduction of road accidents are as follows:-

- Speed Indication Display
- Smart helmets
- The alcohol ignition interlock
- The drowsiness detection system
- Automated emergency braking
- Blind Spot Warning
- Smart signs
- 3D pedestrian crossing
- Life saving stickers



Lifesaving stickers



3D pedestrian crossing

Photo.8 Innovative Measures

Some Measures Taken By Project Arunank and Recommendations

Measures for Road Safety by Arunank: An example on Kimin-Potin Road

Kimin – Potin road at Km 8.50 traversed alongside a vertical cliff of around 100 m height. In rainy season, which lasts for eight months in this area, along with water, lot of debris used to fall on the road surface. This stretch was a perennial black spot and continuously invited lot of accidents due to falling debris. Even during BRO personnel was reluctant to operate on this stretch due to fear of making it worse.

119 RCC completed this arduous task within a record time. CE and his team transformed a monstrous black spot into an aesthetical and safe stretch where anybody could drive for pleasure. This instance is one of numerous efforts being undertaken to improve road safety in the AOR of Project Arunank.



RecommendationwithRespecttoSAVELIVES

SAVELIVESsteps	MeasurestakenbyProject Arunank	Recommendation for consideration
Speedmanagement	Signboards,Sloganboards,Speed bumps at various locations.	<ul style="list-style-type: none"> • LatesttechniquesmaybeadoptedlikeSpeedindicationdisplay. • Fr Enforcement of Speed Limits Police Posts have to be Established in forward areas where new roads have come up but no police posts are there.
Leadershiponroadsafety	Crash barriers added in thejobsofICBRoadsbysanctioningRAE'S. AllrunningjobsandDPR'sarecaterforallroadsafety requirements.	<ul style="list-style-type: none"> • BROshouldtakepartintotraininglocalschoolchildrenaboutroadsafety. • OccasionallyBROshouldorganizeroadcampaignsaboutroadsafety. • BROwiththehelpoflocal admin should constructTrafficParksinthetownwhereHQRCC's arelocated. • HQDGBRandProjectshould organize massmediacampaignsaboutroadsafety.
Infrastructuredesignandimprovement	Latest road safety measuresincluding stabilization of soilandslopesincorporatedinallDPR's.	<ul style="list-style-type: none"> • RoadsafetyDPRsforexistingroadshouldbepreparedafter RoadSafetyAudit. • SmartsignsshouldbeintroducedinBRO. • Crown Reduction a must in roads in border areas where multiple attack points have been made for Formation cutting using aerial resources. • May like to review decision for 10m wide Formation cutting as against 12 m in NHDL specifications for maintaining proper sight distances around curves
Enforcementoftrafficlaws		<ul style="list-style-type: none"> • Negligibleenforcementin forward areas where BROis working. If BRO officials begiven Traffic Magistrate Powerinthoseareas,thengoodenforcementmaytake place.

Survival after a crash	MI rooms and Field Workshops at unit level are extending all help during emergency.	<ul style="list-style-type: none"> MI rooms and Field Workshops are helping locals in emergency albeit. They should be officially integrated in to emergency care and disaster management along With RCC/BRTFs.
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Conclusion

According to World Health Organization, without urgent action, road traffic fatalities will continue to rise resulting in 2.4 million fatalities each year by 2030. The scientific evidence on the magnitude, risk factors and effective interventions for the prevention of road traffic injury is readily available. As with other policy areas, such knowledge alone cannot bring about a change in the road safety situation; the real challenge is how to translate that knowledge into sustainable solutions in different contexts. It's important for everyone to understand that the status quo of increasing road deaths is not inevitable. We can do better; we can be safer. To start with, as a BRO engineer, let's take the pledge that roads in my AOR shall have **ZERO ACCIDENTS Today & Ever after.**

JAI HIND